ICoME 2024

The 22nd International Conference
for Media in Education

CONFERENCE PROCEEDINGS

Performative Approach to Media Studies in Education

August | Wed 21st - Fri 23rd | 2024

Meiji University, Nakano Campus, Tokyo

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4 **Developing The Self-Efficacy of Novice Programmers Through a Multiplayer Game**
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Misaki Sugimoto (Nihon Fukushi University)

3 **Exploring Self-Reliance through the Internet: The Case of Myanmar Refugees in Japan**
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4 **International Exchange Program and Borderless Collaborative Learning in Expanding with ICT**
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2 **Development and Evaluation of Modeling-Related Problem Posing Classes Aimed at Acquiring Mathematical Modeling Competencies**
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3 **Formative Design and Development XR based Simulation for CPR Training**
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University), Seonyul Lee (Chonnam National University), Jeeheon Ryu (Chonnam National University)

4 **Designing Inquiry Learning with Mathematical History to Foster Students' Epistemic Curiosity**
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Xinyu Dong (Wenzhou University)

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4 **How concepts related to agency are different between MEXT and OECD**
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2 **Educational Program for Media Literacy through Metacognition and Mutual Understanding**
Masataka Hashimoto (Institute of Advanced Media Arts and Sciences)

3 **Development of an Automated Responses AI Model in VR-based Simulations for Pre-Service Teachers**
Seonyul Lee (Chonnam National University), Yuseon Jeong (Chonnam National University), Jeeheon Ryu (Chonnam National University)

4 **Development of an ethical competency framework for AI use in education for pre-service teachers**
Bokyung Go (Seoul National University), Cheolil Lim (Seoul National University)

Room 511 (15:15-16:45, August 21st)

1 **An empirical study of the effect of Artificial Intelligence Technology on EFL students' oral expression ability**
Yali Wang (Wenzhou University), Gang Yang (Wenzhou University), Yudie Rong (Wenzhou University)

2 **The Use of ChatGPT in EFL University Students' Oral English Learning and Its Effects on Learning Performance and Cognitive Load: An Empirical Study**
Yudie Rong (Wenzhou University), Gang Yang (Wenzhou University), Zhuocen Zou (Wenzhou University), Yali Wang (Wenzhou University)

3 **Exploring the Educational Effect of Generative AI-Driven "Wall-Hitting" Activities in Elementary Japanese Language Classes**
Shigemichi Tanaka (Naruto University of Education), Tetsuya Bando (Naruto University of Education)

4 **Advanced Learner Model for Error Collection: Using Japanese honorifics as an example**
Shubin Qin (Japan Advanced Institute of Science and Technology), Wen Gu (Japan Advanced Institute of Science and Technology), Koichi Ota Japan Advanced Institute of Science and Technology), Shinobu Hasegawa (Japan Advanced Institute of Science and Technology)

Room 512 (15:15-16:45, August 21st)

1 **Development and Evaluation of Story-based Instructional Materials to Improve Engagement in Mathematics**
Haruka Sakurada (Tokyo University of Science), Kento Nakamura (Tokyo University of Science), Yuki Watanabe (Tokyo University of Science)

2 **From traditional library to Metaverse learning commons**
Sumin Hong (Seoul National University), Taeyeon Eom (Seoul National University), Sungkyung Park (Seoul National University), Minhee Lim (Seoul National University), Cheolil Lim (Seoul National University)

3 **Enhancing Awareness of Unconscious Bias and Behavioral Change Potential through Playbuidling in Higher Education**
Natsumi Ikezoe (Meiji University), Makiko Kishi (Meiji University)

Concurrent Session1

Evaluating the Usability of an LMS-based Educational Metaverse: A Case Study of Wonderverse

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This study aimed to evaluate the usability of Wonderverse, an LMS-based metaverse platform consisting of Wonder Class and Wonder Play. Usability criteria and methods were identified through a literature review, and separate evaluation instruments for teachers and students were developed. These instruments focused on four key domains (interface, instruction-learning support, technical support, ethical support) and included questionnaires. Additionally, task scenarios were created for participants to complete, aligning with the educational content in Wonderverse and the national curriculum of South Korea. The usability testing was conducted during four class sessions by implementing the instruments along with observations, surveys, and interviews. A total of 61 students and 3 teachers participated in the study. Data from classroom observations, post-surveys, and interviews were analyzed, providing insights into the strengths, weaknesses, and areas for improvement of Wonderverse. The findings suggest that Wonderverse has significant potential, but modifications considering the identified usability issues are necessary.

Keywords: Educational Metaverse, Metaverse, Usability, Usability Test, Wonderverse

Introduction

Within the education context, the metaverse offers new opportunities to enhance both teaching and learning experiences. Incorporating the metaverse in educational settings is growing, driven by establishing relevant laws and regulations for distance education. The enactment of the Ministry of Education's "Framework Act on The Promotion of Digital-based Distance Education" and the inclusion of related provisions in the "Elementary and Secondary Education Act" have facilitated this growth. The 2022 revised curriculum emphasizes the development of six core competencies: self-management, knowledge information processing, creative thinking, aesthetic sensitivity, communication, and community skills. These competencies highlight the importance of life-related learning, reflection on the learning process, interdisciplinary integration, and deep learning to foster 'student agency' and digital literacy.

The increased emphasis on digital literacy education due to COVID-19 has validated the potential of the metaverse as an educational medium, as demonstrated by various studies and practical implementations. Metaverse platforms have been widely adopted across different academic levels and subjects, including English (Sudarmaji & Yusuf, 2021), science (Sahin & Yilmaz, 2020), coding (Park, 2021), art (Lee, 2021), mathematics (Park, 2022), and music appreciation classes (Kwak & Jeong, 2022). These examples demonstrate the diverse applications of the metaverse in actual classroom settings.

The metaverse offers various educational potentials by supporting personalized learning, blended learning, immersive learning, authentic learning, and resource-linked learning – essential teaching and learning models for future education. The metaverse's educational advantages include expanding self-identity and experiences, promoting learning immersion, creating learner-centered ecosystems, ensuring inclusiveness and safety, and providing rich learning support (Kye et al., 2023).

While existing metaverse platforms have primarily been developed for gaming, cultural, and social activities, it is crucial to ensure the effectiveness of metaverse education by identifying usability evaluation factors that consider the

educational usability of the metaverse. Systematic development of educational metaverse platforms tailored to the elementary and secondary school curriculum is necessary.

This study focuses on Wonderverse, an educational metaverse platform comprising Wonder Play and Wonder Class. Wonder Play is a metaverse space designed to simulate reality, allowing learners to engage in story-based learning content and solve quests, thereby facilitating active learning and providing high immersion. The learning content in Wonder Play is created based on the achievement standards of the 2022 revised curriculum, helping students systematically acquire essential concepts and competencies. Wonder Class, a learning management system for teachers, assists in real-time monitoring of attendance, activity status, students requiring support, and the distribution of students by stage during class. It also offers functions for awarding and deducting rewards to enhance learning attitudes and student motivation. The usability of Wonderverse is a critical factor influencing the quality of teaching and learning. Therefore, this study conducted a usability evaluation to ensure the effective classroom use of Wonderverse. Evaluation metrics and tools were developed, and methods such as observation, surveys, and interviews were employed to identify issues and suggest improvements. This research proposes strategic measures to enhance Wonderverse's overall usability, increasing its applicability in educational settings. By improving its usability, Wonderverse can be effectively utilized by both teachers and students, enhancing the educational experience.

Research Design & Methods

A mixed-method approach combining both qualitative and quantitative research methods was employed to evaluate the usability of Wonderverse. First, an extensive literature review was conducted, examining key terms like "metaverse," "educational metaverse," "usability evaluation," and "usability evaluation of metaverse." The literature was analyzed based on various factors, including educational levels, research objectives, and evaluation methods. Next, case studies of existing metaverse platforms commonly used in education, such as Gather Town, ZEP, Minecraft, Roblox, ZEPETO, ifland, and V Story, were analyzed. These platforms were examined for their educational functionalities, such as knowledge construction, context provision, emotional support, and learning environment features. From the literature review and case studies, key usability evaluation factors for Wonderverse were identified, including interface, instruction-learning support, technical support, and ethical support, with specific sub-factors like learnability, ease of use, interactivity, immersion, presence, motivation, goal orientation, content relevance, content differentiation, technical stability, security, and ethical safety. Evaluation items were developed for both learners and teachers. Then, pre-training sessions were conducted to familiarize instructors with Wonderverse and ensure compatibility with school devices. The educational content used for evaluation focused on "endangered species", aligned with the revised curriculum. Finally, the usability evaluation was conducted through surveys with three classes, involving three teachers and 61 students. Descriptive statistics were used to analyze the responses. Field observations, including task scenarios, observation records, and video recordings, were also conducted to collect data and provide insights for usability improvements. Also, post-interviews with teachers and students were carried out to gather qualitative feedback. The interviews addressed overall satisfaction, reasons for satisfaction, suggestions for improvement, and the helpfulness of the learned content.

Results

This study conducted a usability evaluation of the Wonderverse beta version in May 2024, targeting teachers and students from three elementary schools in Seoul and Gyeonggi Province. The evaluation comprised surveys, observations, and interviews. The specific findings are as follows.

Survey results revealed significant insights into the usability of Wonderverse as perceived by both learners and teachers. First, learners evaluated the usability of Wonder Play, while teachers assessed both Wonder Play and Wonder Class, providing comprehensive feedback on their experiences. First, the usability of Wonder Play was assessed using a 5-point Likert scale. Overall, learners (N=61) rated the usability of Wonder Play as relatively high (M=3.76). Specifically, learners reported increased motivation to participate actively in lessons using Wonder Play (M=4.34). They also found the goals and content of the lessons clear (M=3.89) and experienced smooth interactions with classmates and NPCs (M=3.82). However, ease of operation and presence received the lowest ratings (M=3.39). Second, teachers (N=3) rated the usability of Wonder Class as relatively high (M=3.61). The content provided by Wonder Class was deemed appropriately aligned with the curriculum and suitable for the learners' levels (M=4.33). The platform's differentiation from other metaverse teaching materials was also noted (M=4.33). Security aspects, such as controlling external access and protecting personal information, were positively evaluated (M=4.00). However, technical stability was rated lower (M=2.67). Third, teachers rated the usability of Wonder Play as relatively high (M=3.88). They noted high student engagement during lessons (M=4.67) and found the virtual space to be highly realistic (M=4.67). The ease of learning

the interface and functions was also positively evaluated (M=4.00). However, ethical safety concerns, such as addressing cybercrime, received the lowest ratings (M=3.00).

Next, observations were conducted to gather qualitative data on the usability of Wonderverse, focusing on both learner and teacher behaviors during its use. The analysis of learners' average time spent on activities and their completion rates revealed a general decrease in time spent as the sessions progressed, indicating increased familiarity with the operations. Completion rates were consistently high across the schools, with only minor variations. Overall, most learners followed the teacher's instructions well and participated actively. However, some issues were observed, such as teachers' unfamiliarity with Wonder Class operations leading to data loss and difficulties in real-time monitoring. Additionally, variations in quest completion speeds among learners occasionally resulted in off-task behavior and difficulties in navigating the map.

Finally, interviews were conducted to gain deeper insights into the experiences of both teachers and learners with Wonderverse. Teachers highlighted the increased student interest and participation facilitated by Wonder Class and Wonder Play. They appreciated the ease of lesson preparation and the utility of Wonder Class's interface and management features. However, they identified areas for improvement, such as simplifying the interface connections, integrating student screen monitoring, and enhancing data recovery and individual student control capabilities. Learners found Wonder Play engaging and more realistic than traditional textbooks, particularly enjoying the quests. They provided positive feedback on the interactivity and goal orientation. However, they suggested improvements in navigation, chat functions, map features, and character customization. Technical issues, such as delayed screen transitions and handling SOS requests, also required attention.

Discussion and Conclusion

This study fundamentally aims to explore the usability and potential for improvement of Wonderverse, an educational metaverse, by having instructors and students utilize it during class sessions and evaluate its usability. To assess and suggest enhancements for Wonderverse's usability, surveys, field observations, and interviews were conducted with teachers and students from three elementary schools in Seoul and Gyeonggi regions. The results indicated that while Wonderverse shows significant potential as a valuable teaching and learning medium, certain usability improvements are necessary. The conclusions and implications derived from this study are as follows:

Firstly, both instructors and students demonstrated relatively high levels of satisfaction with the usability of Wonder Play. Survey results indicated that learners perceived Wonder Play as highly motivating for class participation, and instructors found it very effective in terms of immersion, presence, interactivity, and functional learnability. These findings align with Zhang et al. (2022) on immersive social interaction in the metaverse and Cai et al. (2022) on providing environments similar to the real world.

However, both instructors and learners reported lower usability in terms of ease of operation. Observation results showed a trend of decreasing time required to complete Wonder Play quests as sessions progressed, which can be interpreted as learners become more familiar with the controls after the initial session. Interviews revealed that learners found sprinting slow and the map limited in information and functionality. Thus, the primary issue seems to be the inconvenience experienced during navigation rather than the difficulty of the controls themselves. To enhance ease of operation, features facilitating quicker and easier navigation to destinations should be prioritized.

Additionally, there was a discrepancy in perceived presence between instructors and learners. While instructors rated the presence of Wonder Play highly, learners perceived it as relatively low. This can be attributed to the fixed third-person perspective and limited viewpoint adjustments noted by learners in interviews. Therefore, considering an option to perform quests from both third-person and first-person perspectives could be beneficial.

Secondly, regarding the usability of Wonder Class, survey results indicated that instructors found the content well-aligned with the curriculum and appropriately tailored to learners' levels. However, interview feedback highlighted issues with the vocabulary level of the content and the difficulty of quests for certain students. Thus, it is essential to provide supplementary explanations for difficult terms and specific guidance on why quests failed and how to overcome these challenges. Additionally, there was a demand for collaborative team quests to foster students' cooperation skills and diversify the learning experience.

Further, several areas and elements in Wonder Class were identified as needing improvement, including technical stability, student activity monitoring, and the class management interface. Teachers reported difficulties in real-time

data monitoring and utilization, and complexity in navigating between pages. The low technical stability rating can be linked to issues such as the inability to recover accidentally deleted class data. Teachers also faced challenges in managing students and providing adequate support during activities. Therefore, enabling instructors to monitor Wonder Class while moving around and providing a comprehensive view of all students' activities is necessary. Adding features for controlling and supporting individual learners, as well as providing help or support functions to address simple errors independently, would also be beneficial.

This study identified usability issues in Wonder Play and Wonder Class through usability evaluation and proposed corresponding improvement measures. The usability of digital platforms like Wonderverse can significantly impact the effectiveness of teaching and learning activities (Lim et al., 2009). Enhancing the usability of Wonderverse is crucial for supporting educational activities, necessitating continuous evaluation and improvement. The usability evaluation results presented in this study can serve as foundational data for enhancing Wonderverse's usability.

The limitations of this study and suggestions for future research are as follows. Although this study proposed improvement measures to enhance the usability of Wonderverse, it was limited by conducting the usability evaluation only once. To further improve usability, it is important to understand the needs of relevant stakeholders and repeatedly conduct usability evaluations incorporating feedback from instructors, learners, and experts to develop and optimize the platform. Future research should focus on optimizing Wonderverse to support teaching and learning activities effectively by implementing the suggested improvements from this study. These follow-up studies, reflecting the importance of instructional support functions emphasized by Kim et al. (2023) and Shin, Jeon, and Jeong (2023), will contribute to making Wonderverse a more effective educational metaverse platform. Moreover, future research could conduct multifaceted evaluations to maximize the educational utilization of Wonderverse, such as comparing usability differences based on prior experience with educational metaverses or between PC and tablet usage and identifying specific usability improvement measures for each context.

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Exploring the skills used in teachers' use of data in school improvement

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The effective techniques for the utilization of educational data by schools and teachers are reported. Similarly, how schools and teachers deal with the use of educational data and the challenges they face have been discussed. This study aims to analyze and interpret how teachers deal with educational data on a regular basis, how they use educational data, and what professional skills they demonstrate in doing so through cases in Japanese schools. We participated in teacher training sessions and collected and analyzed information on how teachers and teacher leaders feel about and use educational data through questionnaires and participant observation. We observed differences between teacher leaders and teachers in their perceptions of educational data use. Teacher leaders used data literacy along with practical wisdom as their professional skills.

Keywords: Teachers' use of data, Dashboard, Platform, Professional Skill, School Improvement

Introduction

International research on the use of educational data has focused on the content of innovative technologies and their effectiveness in data visualization and science. However, schools and education professionals are rarely involved from the beginning in the co-design of dashboards used for data visualization, and researchers specializing in education have pointed out that their opinions are used only for the operational evaluation required by system development (Bowers 2021).

Schools store and exchange a variety of information (utilizing data infrastructure) through applications in the management and administration of school affairs and learning activities. However, schools have not paid much attention to the digital platforms that serve as their foundation. In response to this situation, it has been pointed out that it is important and meaningful for educators to pay analytical attention to how data are collected and used by those who operate the systems and promote educational research (Pangrazio et al. 2022).

On the other hand, it has been pointed out that schools have a wealth of data for evidence-based decision-making but are not using it to solve problems because of existing school traditions and busy schedules. The disconnect between educational administration and the results sought by schools in relation to efforts to utilize educational data and the stress of schools are also noted as reasons for this. To solve these problems, the importance of carefully considering what issues teachers face and what they should value when they use data, based on specific cases where educational data are used by the school as a whole and by individual teachers, etc., has been pointed out (Rääk et al. 2021).

In Japan, many schools and teachers have had access to one terminal per student since 2020, thanks to the proactive efforts of the Minister of Education, Culture, Sports, Science, and Technology. By 2023, a cloud-based one-to-one environment for students will be realized in almost all municipalities.

However, in many schools and local boards of education in Japan, the link between school affairs information and learning information is still not well developed. 1-to-1 terminals have been used as tools for teaching and learning, but the information collected and recorded has rarely been used as educational data to improve schools and classes. Therefore, this study assumes that the use of dashboards and platforms will lead to the use of data in all Japanese schools in the future and focuses on how teachers feel, what they actually pay attention to, and what actions they take when using data. We are also interested in accumulating knowledge through case studies on what should be valued in relation to the use of data in education to examine whether the difference between the use of data by individual teachers and the use of data by school organizations is similar in Japan. We would also like to conduct basic practical research on how to deal with the issues discussed in the aforementioned studies that will arise in Japan in the future.

Research Design & Methods

This study aimed to analyze and interpret how teachers deal with educational data on a regular basis, how they use educational data, and what professional skills they demonstrate in doing so. We performed the following two steps in this study:

First, Survey 1, a questionnaire survey, was conducted with the cooperation of City A to determine "how teachers deal with educational data on a regular basis and how they utilize educational data."

Next, Survey 2 was conducted with the cooperation of City B to participate in training situations where teachers utilize educational data and explore "how teachers act, how they communicate with each other, analyze and interpret data, produce certain results, and decide what to do next," by conducting a participant observation.

All study participants provided informed consent, and the study design was approved by the appropriate ethics review board.

Results

City A is a large city that includes mountainous and urban areas. We requested their cooperation because we believed that, as a city in Japan, the location of its schools was unbiased and representative. The survey participants were elementary schoolteachers in City A. In Japan, elementary school teachers have made more progress in using Information and Communication Technology (ICT) in their classes than secondary school teachers. We selected teachers with three years of experience working at the school because we wanted them to respond to the question about their experience since 2020, around when the school environment changed. All study participants provided informed consent, and the study design was approved by the appropriate ethics review board. A total of 177 third-year service teachers who agreed to participate in the survey were requested to complete the questionnaire in early June 2023. Eighty respondents met the deadline. At the end of June, we requested the same 177 teachers in their third year of employment to participate in a survey to self-evaluate their ICT use. Consequently, 132 teachers met the deadline. Eight questions rated their efforts in terms of positive (5 points) to negative (1 point) responses.

Table 1 shows a difference between the school's efforts and one's own efforts in Q2, "Student's use of ICT," and Q5, "using survey information to improve lessons," as well as variations in the responses. Looking at the results of Q7 and Q8, it can be understood that the respondents were more negative on average when conducting their own surveys to improve their lessons and classroom management than the results of the other questions. The standard deviation was also larger than that of the other questions; therefore, it can be interpreted that there was a tendency for variation in the responses among teachers.

Table 1
Comparison of school initiatives and own initiatives regarding ICT use

	About initiatives at the school where you work; Teachers in their third year of employment (n=80)		About your own efforts; Teachers in their third year of employment (n=132)	
	Average	Stdandard Deviation	Average	Standard Deviation
Q1.Teachers' use of ICT in the lessons	4.19	0.80	4.18	0.80
Q2.Students' use of ICT in the lessons	4.14	0.79	3.71	1.04
Q3.Teachers' use of ICT in school affairs	3.95	0.74	4.02	0.97
Q4.Utilizing various survey information on students to understand students	3.78	0.86		
Q5.Utilizing various survey information on students to improve lessons	3.76	0.82	3.17	1.21
Q6.Need for teacher training on the use of educational data	3.86	0.91		
Q7.Conducting self-designed surveys to understand how students are doing in order to improve lessons			2.86	1.25
Q8.Conducting self-designed surveys to understand how students are doing for classroom management			3.2	1.14

According to the "free answers" of teachers in their third year of employment, it was evident that they tend to consider the "use of ICT in teaching as well as learning activities" and the "use of educational data using ICT" to be two different things. The tendency has become evident that "ICT use in teaching and learning activities" was understood as an initiative contributing to the improvement of teaching and learning and "ICT use of educational data" as an initiative to evaluate students.

In summary, ICT has been used as a tool to guarantee learning, support learning activities, and support school affairs since 2020, based on the results of a survey conducted in City A, Japan. However, teachers have not focused on the use of educational data acquired through learning and communication activities using one terminal per student in a cloud environment with a high-speed network. It has become evident that in addition to teachers' lack of interest in the use of educational data in the first place, they lack awareness or recognition that the use of ICT and educational data are closely related. The free descriptions in the questionnaire survey included "I have an image of using ICT for test marking and grading," "I may look at student records stored on ICT to help me understand my own classes and students when I have trouble teaching students," and "Even if I have my students record their learning using ICT, it will not be useful for me because my classes change every year. Therefore, I do not think I will spend much time on it." From the above, it can be imagined that the use of data in educational activities and school improvement is understood in schools in various ways, including teachers' images of their practices and the meaning and significance of their efforts.

City B has 15 junior high school districts, including 15 junior high schools and 28 primary schools. Since 2018, the local Board of Education in City B has deployed integrated education for elementary and junior high schools throughout the city. We requested their cooperation because we believed that as a local city in Japan, the location of its schools was unbiased and representative. This is because this is a city where primary and junior high schools belonging to the junior high school district have been working on integrated primary and junior high education initiatives, looking at educational data.

Participatory observations during the training on the use of educational data were made between January 2023 and January 2024. The training was attended by 43 leaders of primary and junior high schools who promoted integrated primary and junior high education.

The training was conducted in the following manner. First, the participants were divided into junior school districts to discuss the initiatives, referring to the educational data.

The educational data used to reflect on the integrated primary and junior high school education efforts in each junior high school district were the result of students' responses to the following questions:

Do you agree with the following statements?

① Increased sense of self-efficacy and feelings of self-esteem

Q1. I have good grade points

Q2. I want to be helpful to other people

② Improving awareness of norms and communication skills.

Q3. I comply with school and class rules

Q4. When talking with my friends, I listen to them till the end before responding

③ Fostering benevolent feelings and behaviors toward others

Q5. When I see someone in need of help, I willingly go ahead to help the person

Q6. I respect individual differences, such as ideas and personalities

④ Reducing anxiety in junior high-school students

Q7. I enjoy going to school

⑤ Establishing core foundational learning abilities (basic academic skills).

Q8. I have favorite subjects and learning activities at school

Q9. I understand the topics taught in Japanese classes

Q10. I understand the topics taught in arithmetic/mathematics classes

Q11. I understand the topics taught in English classes

Q12. I note the key points (aims and goals) and summaries (reflections) in class.

Q13. I willingly engage with my studies

⑥ Cultivating the ability to think, judge, and express

Q14. When I have the opportunity to express my ideas, I can refer to data, texts, narrative structures, and so on, which enables me to communicate my thoughts well

⑦ Fostering the ability to use knowledge and skills to solve problems

Q15. I apply the topics learned in class to other areas of study and/or daily life

Q16. I am willing to work on tasks presented by the teacher or activities planned by my classmates or groups.

Q17. I have dreams or goals for the future

Q18. I have opportunities to investigate and become involved with local issues and people in my classes, assignments, activities, etc.

⑧ Activities with elementary and junior high schools

Q19. I enjoy participating in activities together with my schoolmates

Q20. I want to be like a junior high-school student I have interacted with

Have you reduced your anxiety about the following statements?

⑨ Bewilderment around entering junior high school

Q21. I have concerns regarding being taught by a subject-specific teacher

Q22. I have concerns about participating in extracurricular (club) activities

Q23. I have anxiety about talking to my new friends

Q24. I have anxiety about talking to older students

Q25. I am concerned that the content to be learned will be more difficult

Q26. I am anxious about taking midterms and final exams

Analyze survey results and discuss the accomplishments and challenges of the junior high school district's efforts in 2023. The results of the students' responses will be used to determine the status and trends of achievement toward the objectives of the initiative.

To examine the overall trend of responses to the questions using educational data and identify items to which students' responses tended to be positive and those to which they did not.

Select items closely related to the goals and content of the junior high school district's 2023 initiatives and analyze the achievement status and trends toward the objectives of the initiatives based on the relationship between the items or related items.

The results of the analysis in relation to the objectives and initiatives of the 2023 efforts will be summarized on the whiteboard as follows to confirm the results and identify the outlook for the 2024 efforts.

Reference example: Based on the results of student responses to questions 1, 5, and 9 in relation to the goal of "●●" and its initiatives1 set forth by this junior high school district in 2023, we learned that ○○. Considering the results of questions 10 and 18, it was considered necessary to improve and devise measures for △△△.

Before 2022, schools were responsible for utilizing educational data, such as student and teacher response results and records of efforts, to reflect on their practices and identify the next steps to be taken. Therefore, teachers did not have the opportunity to look at or learn how schools outside their own workplaces used educational data to reflect on their practices. Training in January 2024 was conducted in the same manner as that in 2023, with face-to-face participation. Half of the participants in the 2023 training session and the other half in the 2024 training session were the same participants, while the other half were newcomers.

Participatory observation of discussions using educational data from 15 groups (junior high school districts) identified the following teachers in common over two years.

1) Leader teachers initially discussed the students and their efforts at each school as they looked at these data in response to the student challenges they had identified as middle school districts and the efforts they were making to address them. They then discussed how students responded to the joint and collaborative efforts of elementary and middle schools. As educational data were presented on a spreadsheet, they discussed it while reading the numbers and graphs on the spreadsheet. If the response trends differed from what the teachers expected, they looked at historical data and discussed whether the trends were unique to the grade level in question or whether they were a consistent trend that continued in the district. They seemed to enjoy reading and discussing the educational data on the spreadsheets from various perspectives.
2) When discussing how to solve problems for the next school year, the teacher leaders discussed various examples of what might happen if certain initiatives were implemented based on what they had observed in their own students. Interestingly, they talked a lot about how the students felt and the reasons for their behavior, taking into account their family environment and other factors. They discussed priorities of what to work on, at least to solve problems, and develop students' abilities. In their discussions, they were not only talking about methods that would produce immediate results but also about what they should take time to work on and the methods and measures they would use. They also checked the situation at each school, reached a consensus on the following year's initiatives, and wrote about what they had decided on the whiteboard.

In summary, when analyzing and interpreting the data, the teacher leaders analyzed the students' feelings and attitudes toward the initiatives (response results) and communicated them based on memorable events, students' images, and their own problems with the initiatives when recalling the reasons for their actions. Teacher leaders acquired basic data literacy as a professional skill in the use of data by teachers, and they did not resist data analysis. It was also clear that they demonstrated skills in sharing information and practical wisdom on various student understandings and building a consensus on the next steps to be taken.

Discussion

In this study, we investigated the attitudes of individual teachers and the attitudes and actions of teacher leaders toward the use of data and confirmed whether we could say, as Rääk et al. (2021) pointed out, "there is a difference between when educational data are used in accordance with school purposes and when they are used by individual teachers," through the Japanese case. While we were able to confirm that similar trends existed, the actions of teacher leaders in utilizing data also revealed clues that individual teachers could relate their own classes to the school's efforts through the use of data and move beyond the anxiety they currently feel. We also found clues to consider in designing dashboards required in schools.

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The Status and Challenges of OCW in Japanese Universities

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Abstract…*The Open Courseware (OCW) movement was introduced to Japan in 2005. After nearly 20 years of development and growth, the current status of OCW in Japan is worth examining. The purpose of this paper is to reveal the current status of OCW development in Japan as well as the challenges it encounters. Through a literature review and data collection from major university websites in the OCW community, this study catalogs the various OCW made by Japanese universities, describes the range and types of courses offered on these platforms, and analyzes publicly available content including course topics, disclosure styles, production organization, and accessibility. The results of the study show that the implementation of OCW varies across universities, with some institutions utilizing OCW as a means of improving educational accessibility and facilitating knowledge dissemination, while others are stagnant with static OCW platforms that have not been updated. The study found that copyright is a bottleneck to further openness..*

Keywords: accessibility, copyright, Japanese universities, OCW

Introduction

The OpenCourseWare (OCW) movement began in 2001, initiated by the Massachusetts Institute of Technology (MIT) with the goal of providing free and open access to its undergraduate and graduate course materials via the internet (Cheung et al., 2013). OCW offers numerous opportunities for those interested in higher education, promoting accessibility and knowledge dissemination. The United Nations extended this concept to Open Educational Resources (OER), characterized by the "5Rs of Openness" which was widely accepted (Furukawa, 2020; Shigeta, 2021). Cheung et al. (2013) categorized OER into four types: open textbooks, OCW, open online courses, and open-source software and tools. These concepts are often used interchangeably in research and reports without strict differentiation. While every piece of OCW is an OER, not all OERs are open courseware (Terrell & Caudill, 2011).

In 2005, Japanese universities rapidly launched their OCW initiatives, starting with several major institutions and establishing the Japan OpenCourseWare Consortium (JOCW) in 2006. This initiative also expanded into the OER domain. In 2020, JOCW was renamed OE-Japan, leading the development of open education in Japan, centered around key universities (Furukawa, 2020). During the COVID-19 pandemic, the widespread implementation of online education and related copyright issues saw some relief with revisions to copyright laws facilitating openness.OER have significantly impacted teaching practices in higher education. It is now time for educators to reconsider how to leverage these resources to transform teaching processes.

Universities, as producers of advanced knowledge, can benefit society by making their educational materials publicly available, promoting knowledge advancement, and enhancing educational equity by providing more people with access to higher education. To provide more meaningful references for practitioners in universities, it is essential to focus specifically on OCW. Some researchers have questioned the significance of open online learning, suggesting that initiatives like MIT OCW served marketing agendas, possibly for acquiring funding, rather than purely promoting open access (Nkuyubwatsi, 2018).OCW in Japan originally followed the MIT model. Is it merely following trends or is it continuing to develop in an organized fashion? What is the current situation and what challenges does it face?

Research Questions:

1. How are the OCW (OpenCourseWare) programs defined and structured at major Japanese universities, and what specific types of content do they disclose?
2. What are the primary themes and styles of the disclosed OCW content?
3. What are the outcomes and progress of OCW initiatives in these universities?

Research Design & Methods

To address these research questions, we focused on the host universities of Japan's OCW, including both the initial host universities and those that joined subsequently. We then visited the websites of all these universities to determine their characteristics. These characteristics encompass the range and types of courses offered on the platforms, and we analyzed the disclosed content, which includes course topics, disclosure styles, copyrights, accessibility etcs. All

information collected from the websites was documented in a spreadsheet. However, not all websites provided comprehensive information, resulting in some aspects of certain programs being marked as unavailable (N/A)

Results

Table 1 summarizes the operational conditions of the OCW programs at various host universities in Japan. Among them, Keio University, as one of the first universities to respond to the OCW initiative, is no longer a host university and its website is inaccessible. Osaka University and Waseda University are also inaccessible. The operational statuses of the active universities can be divided into three different categories: "Active," which means they are still updating with new content; "Maintained," which means there are no new updates but existing materials continue to be provided; and "Inactive," which means updates have stopped and content may be stagnant. The OCW sites of Tokyo Institute of Technology, The University of Tokyo, Nagoya University, and Hokkaido University mainly exhibit an active operational status. Kyushu University and Kyoto University have ceased updates.

Table 1 Operational Conditions of OCW Programs in Various Japanese Universities

	University Type	Site	Accessbillity	Operational Condition
Osaka University	National University	http://ocw.osaka-u.ac.jp/	✘	Inactive
Kyusyu University	National University	http://ocw.kyushu-u.ac.jp/	✓	Maintained
Kyoto University	National University	http://ocw.kyoto-u.ac.jp/	✓	Maintained
Tokyo Institute of Technology	National University	http://www.ocw.titech.ac.jp/	✓	Active
The University of Tokyo	National University	http://ocw.u-tokyo.ac.jp/	✓	Active
Nagoya University	National University	https://ocw.nagoya-u.jp/	✓	Active
Hokkaido University	National University	https://ocw.hokudai.ac.jp/	✓	Active
Waseda University	Priviate University	http://www.waseda.jp/ocw/	✘	Inactive
Keio University	Priviate University	http://keio-ocw.sfc.keio.ac.jp/	✘	Inactive

Table 2 presents a detailed analysis of OCW at various Japanese host universities, highlighting definitions, copyright statuses, number of public releases, disclosure styles, and thematic focuses. Kyushu University and The University of Tokyo offer regular academic courses under independent copyrights, primarily disseminating content through lecture materials and videos. Kyoto University, with over 6300 releases under a CC BY-NC-SA license, and Nagoya University, effective until July 2024, provide comprehensive OCW programs that include farewell lectures and open campus events. Tokyo Institute of Technology focuses primarily on academic courses, offering a substantial collection of lecture notes and recordings. Hokkaido University's OCW spans both regular and public courses, although the number of releases is not specified, covering a wide array of topics under a CC BY-NC license. This overview illustrates the diverse approaches to OCW implementation, showcasing variations in content scope and copyright frameworks across institutions.

Table2 Overview of OCW Program Offerings and Content Styles at Japanese Universities

University	Definition	Copyright	Number of Public Releases	Disclosure Styles	Thematic Focuses
Kyusyu University	Regular academic courses	Independent	NA	Lecture materials and videos	Regular academic courses, farewell lecture before retirement, open campus event, public lectures
Kyoto University	Videos, lecture materials, course syllabus of regular academic courses and public lectures	CC BY-NC-SA	More than 6300	Videos, lecture materials, course syllabus	Regular academic courses, farewell lecture before retirement, open campus event, public lectures
Tokyo Institute of Technology	Lecture materials of regular academic courses	CC BY-NC-SA	5086 lecture notes; 40 videos/audio	Mainly syllabus	Regular academic courses
The University of Tokyo	Lecture materials and videos of regular academic courses	Independent	More than 1400 (up to July 2020)	Lecture materials and videos	Regular academic courses
Nagoya University	Lecture materials of selected regular academic courses	CC BY-NC-SA	376 lectures and 277 farewell lectures (up to July 2024)	Syllabus, lecture materials, videos	Regular academic courses, farewell lecture before retirement
Hokkaido University	Video and lecture materials of regular academic courses and public courses	CC BY-NC	NA	Syllabus, lecture materials, videos	Regular academic courses, farewell lecture before retirement, open campus

Discussion

In this study, we conducted an overarching exploration focused on the main host universities of OCW in Japan, which was more focused than previous research. A limitation is that our data was primarily collected from papers and websites, lacking interviews with project managers. Nonetheless, it revealed some aspects to consider when implementing OCW in Japan.

Definition of OCW

These universities have different understandings and emphases on OCW and are not consistent with its origin at MIT. MIT's OCW is characterized by the following features: (1) OCW is intended to provide, free of charge to the world, materials created by MIT professors for MIT students. It is not distance education. Credits are not awarded. Registration is not required. There is no contact with professors. (2) OpenCourseWare is a publishing activity on MIT's web, meant to permanently open and share knowledge, accessible to anyone. (3) MIT conducts research and development with the aim of benefiting society (Miyagawa, 2003). Educational activities that are useful globally are part of MIT's mission, a role that OCW fulfills. The focus at Japanese universities varies. Some are based on the original meaning of OCW, presenting actual classroom teaching in forms such as videos, lecture materials, and syllabus. Others may only upload syllabus or materials for a specific class. Just from the definition of OCW, this provides users with various ways to utilize the content, such as syllabus suitable for novice teachers to construct their teaching, while the provision of videos and text materials benefits learners who want to study. Whether these public focuses or characteristics are natural or deliberate strategies by each university is unclear, and it is unknown whether they are part of a market strategy, as some have criticized MIT OCW.

Copyright Handling

Copyright handling also shows diversity. As shown in the Table2, different universities have different methods of marking copyright. In the deployment of OER, Creative Commons (CC) licenses are commonly used and can take various forms(Nkuyubwatsi,2018). However, among these key universities, it can be observed that copyright handling is not always based on CC. In early reports on OCW practices, copyright handling processes were often highlighted as significant issues (İslim et al., 2016). Copyright not only affects the actual processing speed and the willingness of faculty to participate in OCW, but also has a significant impact on how learners use the resources. If OCW aims to benefit self-learners, educators, and students by removing barriers in education and learning through the free sharing of knowledge, it appears that current copyright practices have not yet fully aligned with this goal. This is an area that warrants further exploration.

Operational Organization

Regarding operational organization, some host universities, such as Osaka University and Waseda University, are inaccessible. Updates at Kyushu University stopped in 2019. As previous research indicated, Japan has limited national expenditure on OER, and the efforts of higher education institutions are also restricted, making continuous maintenance challenging (Furukawa, 2020). Kyoto University maintains its OCW due to internal organizational restructuring but no longer updates it. Currently, Hokkaido University, The University of Tokyo, Nagoya University, and Tokyo Institute of Technology are still producing and updating content. To explore the operational mechanisms and reasons behind this, further research involving interviews with the project managers of these programs is needed.

Conclusion

This study provides a comprehensive analysis of the current status and challenges of OCW programs at major Japanese universities. The findings reveal a diverse landscape of OCW implementation, with significant variations in content scope, disclosure styles, and institutional engagement. While some universities actively leverage OCW to enhance educational accessibility and foster knowledge dissemination, others have not maintained their platforms, resulting in stagnation. Copyright issues emerged as a significant barrier to broader openness, necessitating more flexible and supportive policies to facilitate content sharing.

The insights from this study underscore the importance of clear definitions and consistent implementation strategies for OCW programs. By understanding the distinct approaches and challenges faced by Japanese universities, this research contributes to the global discourse on open online learning and its role in promoting educational innovation and accessibility. Future research should include interviews with project managers to gain deeper insights into the operational mechanisms and explore effective strategies to sustain and expand OCW initiatives.

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A Design Research of First-Year Information Literacy Course: State Analysis Focusing on Learning Engagement

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Increasing significance in data and AI use impacted the needs of information and data science literacy education for everyone. In Japan, an educational program is underway with the national policy of fostering data literacy among all university students, regardless of their major. The first-year programs are expected to play a role in the acquisition of solid base for data literacy, to develop deep critical view associated with the real-world problems. We are currently conducting educational design research aimed at developing information literacy courses as a foundation for data science learning at a Japanese university. The students' needs and current condition analysis was conducted. Alongside the common approaches, we are implementing learning engagement measure over the 13 weeks of the course to analyze their change with the learning content over time since enrollment.

Keywords: Educational Design Research, Data Science Education, Engagement, Instructional Design

Introduction

First-Year Information Literacy Courses and Data Science Education

Data science (DS) and AI literacy is one of the educational priorities in Japan. Under the national "AI Strategy 2019", which aims to developing basic skills in data science and AI literacy in all university students, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) has operated Approved Program for Mathematics, DS and AI Smart Higher Education (MDASH). Additionally, a model curriculum was proposed by the Consortium, and learning objectives were presented (Consortium of Centers for Enhanced Education in Mathematics, Data Science, and AI , 2020). MOOCs, open courseware, and other educational materials corresponding to the model curriculum are also available. Fundamentally, DS literacy is associated with knowledge and skills from multiple disciplines, including mathematics, information science, and statistics (Prado & Marzal, 2013). DS learning is built on an essentially solid foundation based on these complex domains.

However, in first-year information literacy classes, we have observed the difficulties rooted in learners' knowledge and skills gap between the model learning objectives and the current situation. Each learner's difference in levels is also too significant. Furthermore, it is necessary to improve learners' motivation to take DS classes and to continue learning. This presentation is an initial investigation of an Educational Design Research (EDR) that aims to design classes to enhance students' motivation for DS learning and to lay a solid foundation in the field of first-year university information education for proceeding to DS learning. Generic Model (McKenney & Reeves, 2019) of EDR, which proceed through three core phases, including analysis, design and evaluation, interactivity to develop intervention and understandings in design strategies.

This report is on the analysis phase in the Generic Model (McKenney & Reeves, 2019). At the outset of the research project, we have piloted a student's needs analysis and analyzed the learning objectives of the given model curriculum. In addition to the information about the students' learning histories and current state related to data literacy and computer literacy, we investigated the students' engagement level during the first-year information courses.

Student Engagement in Learning

Learning engagement or student engagement is recognized as the student's active participation and commitment in learning activities, and the level of motivation and interest (Nkomo et al., 2021). Researchers associated student engagement with the framework of three dimensions that were behavioral, emotional, and cognitive dimensions. Behavioral engagement is related to participation and efforts contributing to learning tasks and lessons. Emotional

engagement includes interests, enjoyment, motivation and attitude. Cognitive engagement involves deep strategic and self-regulated learning strategies, and it requires critical deep learning (Toyama, 2018).
Toyama (2018) developed an Engagement Scale in Japanese, comprised with 17 items for assessing engagement and its relationships with task performance. Adding to the three dimensions of the engagement, this scale covers situational engagement that scale work-related state of mind. Toyama (2018) reported that interests and the enjoyment on tasks had positive relationships between high performance.
Acquiring the students' change and state of engagement is crucial that cannot be known by the objective tests and questionnaires. Measuring learner engagement and monitoring the change over the course would give us implications for course design improving better suit students' motivation and enhance learning experience.

Analysis Phase of EDR

Pilot Needs Analysis

Firstly, we overviewed to investigate the model learning objectives presented from MDASH, using the revised Bloom's Taxonomy, that is a two-dimensional analysis of the knowledge domain and cognitive process dimensions (Ichimura, 2024).
Concurrently, we have piloted a needs analysis conducted in January 2024 with a questionnaire administered to freshman students who had completed the first-year courses in a Japanese private university (Ichimura & Suzuki, 2024). The survey was conducted online using Microsoft Forms, and respondents completed the survey at any time from home or any other location. The survey items included three major categories: 1)Learning history asked about the students' enrolled l subjects related to mathematics and information courses before entering university. Also, their impressions (like/dislike) and perceptions (strong/weak) of mathematics and information courses, 2) Current skills and knowledge, associated with ICT and information, statistics, DS skills were asked. The students were asked to respond the level of confidence with a self-assessment, 3) Attitude toward DS and motivation for learning asked about factors motivating learning and subjective attitudes.
The results of the pilot survey informed the students' learning backgrounds in mathematics and information literacy classes in high school, that was widely varied due to changes in the national curriculum guidelines.
Given the feedback from instructors in charge of the DS classes that the students' aversion to mathematics is a challenge, we asked students to indicate their preference (like or dislike) and perception of strength (good or bad at) in mathematics, information science, and computer and data manipulation before and after admission. While more than half of the students responded that they were not good at high school mathematics or somewhat disliked it, they exhibited a more positive attitude towards information literacy classes. Correlation analysis indicated that perceptions in pre-admission information literacy subjects and post-admission mathematics, computer, and data manipulation were related to confidence in information literacy, statistical literacy, and DS skills. Enhancing positive attitudes in information subjects is likely to lead to improved DS skills. Additionally, improving information skills may also lead to increased interest and motivation to enroll in DS courses (Ichimura & Suzuki, 2024). On the other hand, the factor analysis on students' motivation for DS learning identified direct consequences of rewards, such as job opportunities, as a significant influence.
Additionally, results of DS-related skills revealed that the students were weak in utilizing basic statistical knowledge learned in lessons for the mastery of Excel functions. Applying knowledge in experimental trials and evaluating and representing data and graphs were highlighted as areas for enhancement. To facilitate the transfer of learning, we made some adjustments in the Spring 2024 semester, including the preparatory learning activities (Bransford & Schwartz, 1999).
Piloted research has shown the promising role of information literacy courses and the impact of positive attitudes in the information subjects on the DS skills improvement. The current study aims to extend these findings for course design by examining students' engagement.

Student Engagement Track

Having had the results from the pilot analysis, we explored ways to understand the students' inner states and changes in motivation during the course and began monitoring students' engagement levels throughout a 13-session course. At this stage of the study, we aimed to understand the following questions: What are the students' current knowledge and skills in each area included in the DS literacy foundation? How do students perceive information science and DS learning? How engaged are students in the current information course?
Our engagement record instrument analyzes student engagement, focusing on behavioral, affective, cognitive, and situational aspects. Data collection began at the beginning of the spring semester in April 2024. 168 freshman students, who had just entered the university, agreed to participate in this study and submitted the survey after the first orientation lesson. On the instrument, the students reflected on their level of commitment and interest in the learning topics and tasks in each lesson, including the preparation activities outside of the classroom. This self-reflection was included as a reaction paper to capture the students' changes in their multi-dimensional engagement levels over the

course. The engagement questions were cited from Toyama (2018), asking students to assess 17 scales using a 7-point Likert scale ranging from 1 'Strongly Disagree' to 7 'Strongly Agree'.
Additionally, students were presented with learning objectives for each class at the beginning of the lessons and asked to self-evaluate the percentage of those objectives they achieved. They were also asked to provide written reflections on their learning. The students were to submit their reflections and self-reports of engagement scales over the 13 weekly lessons. Tracking engagement levels across different topics and learning activities will be analyzed.
Other data collection methods included pre- and post-surveys as described by Ichimura & Suzuki (2024), and objective quizzes with data literacy questions.

Results and Discussion

The data collection and analysis for the Spring 2024 semester are in progress. The results of the engagement and survey analysis will be added to the presentation.
Table 1 comprises the 17 scales included in the engagement tracking instrument and the results from the first lesson. The 7-point scale was calculated as 1: 'Strongly Disagree' to 7: 'Strongly Agree'.

Table 1

Engagement Scales and Results of the First Orientation Lesson

Subscale	Scales	*M*	*SD*
Behavioral	I concentrated on this task.	4.26	2.05
	I worked enthusiastically on this task.	4.22	1.94
	I worked hard on this task.	4.28	1.95
	I tackled on this task energetically.	4.04	1.81
	I worked this task without giving up until the end.	4.27	1.91
Affective	This task was interesting	3.98	1.81
	I liked this task.	3.75	1.54
	I enjoyed this task.	3.87	1.69
	This task was fun.	3.78	1.67
	I felt excited while working on this task.	3.70	1.50
Cognitive	I was thinking a way to solve this task successfully.	3.96	1.78
	I was thinking about how to solve the task effectively.	3.67	1.58
	I tried devising a way to solve the task.	3.64	1.52
Situational	While working on this task, I thought only about the task.	4.12	1.81
	Time flew quickly while working on this task.	3.59	1.66
	I was absorbed in this task.	4.01	1.81
	I was I am immersed in this task.	3.86	1.73

Note: The first author translated the scale from Toyama (2018) into English. *n*=168

The findings indicate that students generally show a higher level of engagement across behavioral and situational dimensions, with mean scores around 4. The affective dimension shows slightly lower engagement, particularly in aspects related to enjoyment and interest. The cognitive dimension, represented by questions on effective problem-solving and thinking processes, also reveals moderate engagement levels. The mean score for feeling that 'time flew quickly' indicated lower engagement levels in students' reactions after the orientation lesson, which mainly covered the setting of the digital environment, including campus accounts and network access.

Conclusion

In the initial phase of EDR, we explored the students' state analysis focusing on their change in learning engagement. The reflective instrument related to different dimensions of engagement: behavioral, affective, cognitive, and situational is comprised. The findings will indicate points to consider in student responses across these dimensions, providing insights into areas for potential improvement in course design and strategies.
Based on the results gained so far, a positive perception of information literacy subjects might promote DS learning. The results of monitoring students' engagement will present critical suggestions to enhance DS learning for all.

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Technostress in Chinese College Students: Factors and Coping Strategies

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Abstract This study examines variations in technostress perception among Chinese college students, focusing on demographic characteristics such as gender, major, grade, and place of origin. It investigates the influence of computer self-efficacy, school support for technology-enhanced learning (TEL), and digital competence on technostress, and explores student coping strategies for technostress. A survey of 1,268 students across five Chinese colleges was conducted, supplemented by interviews with 235 students. Findings reveal that female students, students in the sciences and engineering major, and students from rural areas have higher technostress than male students, students in the liberal arts major, and students from urban areas. Higher computer self-efficacy, school support for TEL, and digital competence correlate with lower technostress. Demographic factors impact perceptions of these variables. Students employ a variety of coping strategies to deal with technostress.

Keywords: Computer Self-Efficacy, Digital Competence, School Support for Technology-Enhanced Learning, Technostress, Coping Strategies,

Introduction

Over the past decade, higher education institutions have embraced information and communication technologies (ICTs) to create ubiquitous access to educational resources and services. Studies have shown that the effective use of ICTs can enhance student learning (Vandeyar, 2015), but it often demands additional time, information processing, and skills, potentially leading to psychological strain (Jung, Kudo, & Choi, 2012; Paul & Glassman, 2017). This increased burden can manifest as technostress for college students.

Studies by Califf and Brooks (2020), Jena (2015), Joo, Lim, and Kim (2016) highlight the detrimental impact of technostress on teachers' job satisfaction, performance, and willingness to use technology. In the student population, technostress can lead to burnout, decreased engagement, and even intentions to abandon TEL. Despite the prevalence of technostress in educational environments, research specifically focusing on university students remains scarce. This study seeks to contribute to a more nuanced understanding of technostress in the Chinese higher education context by investigating its influencing factors, demographic variations, and coping strategies.

Three research questions were addressed in this study. First, what are the differences in the perception of technostress by demographic factors of university students in China? Second, what are the effects of computer self-efficacy, school support for TEL, and digital competence on technostress? Third, what strategies do university students use to cope with technostress in China?

Research Design & Methods

Participants

The participants in this study were 1,268 students from five universities across China. 235 students elected to respond to the open-ended questions voluntarily. Out of the 235 students who engaged with the open-ended question segment of the research, 52 students independently and voluntarily opted to participate in additional in-depth interviews.

Instruments

The technostress questionnaire developed by Wang, Tan, and Li (2020), the computer self-efficacy questionnaire developed by Wang (2010), the school support for TEL questionnaire developed by Maipita et al. (2023), and the digital competence scale devised by Wang, Wang, Wang, Chen, and Pi (2021) were employed in this study. Each instrument has good reliability and validity. To gain a deeper understanding of strategies that college students use to cope with technostress, a series of interviews were conducted. These interviews were structured around the research framework established by Tarafdar et al. (2020). Central to the interview process was an open-ended question: how do you often cope with technostress?

Data Collection

This research utilized the Questionnaire Star online survey tool (https://www.wjx.cn/) for questionnaire creation. A total of 1,268 valid questionnaires were finalized. A survey link containing the open-ended question was disseminated to the 1,268 students who had previously participated in the questionnaire study. Of these, 235 students elected to respond to the open-ended questions voluntarily. Concluding the open-ended question segment, students were afforded the opportunity to provide their contact information if they were interested in engaging in more comprehensive interviews via Internet telephony. 52 students chose to share their contact details and received in-depth interviews.

Data Analysis

Data from the questionnaire survey was analyzed using SPSS 27.0. Independent-sample t-tests and one-way ANOVAs examined differences in technostress across genders, majors, grades, and places of origin. Multiple regression analysis assessed the impact of computer self-efficacy, school support for TEL, and digital competence on technostress levels. Content analysis was employed to categorize coping strategies from interviews.

Results

The average scores of technostress exceeded 3 (out of a maximum of 5), indicating that university students in China generally experience a high level of technostress. Table 1 shows that significant differences were found in the student's perception of technostress by gender, major, and place of origin. Female students reported higher levels of technostress (M = 3.26, SD = .94) compared to male students (M = 2.99, SD = .88). Students majored in science and engineering perceived higher levels of technostress (M = 3.25, SD = .92) than students majored in liberal arts (M = 3.02, SD = .91). Students from urban areas (M = 3.09, SD = .90) perceived higher technostress than students from rural areas (M = 3.25, SD = .95).

Table 1

Differences in Perception of Technostress

(N=1268)

			Technostress		
		n	*M(SD)*	*t/F*	*df*
Gender	Male	571	2.99(.88)	5.25**	1245.28
	Female	697	3.26(.94)		
Grade	Freshman	308	3.21(.89)	1.23	3
	Sophomore	358	3.10(.91)		
	Junior	338	3.15(.92)		
	Senior	264	3.08(.97)		
Major	Science and Engineering	644	3.25(.92)	4.42**	1266
	Liberal Arts	624	3.02(.91)		
Place of Origin	Urban	919	3.09(.90)	2.79**	1266
	Rural	349	3.25(.95)		

Note. ** p < .01.

In Table 2, the model's R^2 value is .293, suggesting that approximately 29.3% of the variability in technostress can be explained by the independent variables included in the model. The F-statistic is 172.162, which is significant, indicating that the overall model is a good fit for the data. Computer self-efficacy had a significant negative relationship with technostress, evidenced by a standardized β coefficient of -.333 (p < .01). Additionally, school support for TEL was also significantly negatively associated with technostress, with a β value of -.211 (p < .01). Furthermore, digital competence was found to negatively influence technostress, with a β value of .229 (p < .01). These results suggest that higher levels of computer self-efficacy, school support for TEL, and digital competence are associated with lower levels of technostress among the students.

Table2

Impacts of Computer Self-Efficacy, School Support for TEL, and Digital Competence on Technostress

(N = 1,268)

Index		*R*	R^2	*df*	*F*	*B*	β	*t*
Technostress	CS	.539	.293	3	172.162***	-.451	-.333	-12.358**
	SS					-.334	-.211	-7.805**
	DC					-.307	-.229	-9.609**

Note. CS = computer self-efficacy, SS = school support for TEL, DC = digital competence.
** p < .01. *** p < .001.

The evaluation of data from open-ended questions was executed through conventional content analysis, as outlined by Hsieh and Shannon (2005). This process led to the identification of two main categories of coping strategies for technostress: individual coping mechanisms and the pursuit of external assistance. Following this, directed content analysis was employed on the data obtained from in-depth interviews. Six specific subcategories of coping strategies were identified: self-restraint, engaging in outdoor activities, adhering to rules, knowledge acquisition, seeking school support, and communicating with friends or family.

Discussion

This study reveals that female university students experience significantly higher levels of technostress than male students, as shown in studies by Booker, Rebman, and Kitchens, F. L. (2014) and Ragu-Nathan, Tarafdar, Ragu-Nathan, and Tu (2008). One potential explanation for this gender disparity is the different approaches and attitudes toward technology and its usage. Previous research by González-Gómez, Guardiola, Rodríguez, and Alonso (2012) has highlighted that female students tend to prioritize social interactions and relationships in the context of TEL more than male students, who are often more focused on the technology itself. Students in science and engineering face more technostress than those in liberal arts due to the higher technical demands of their fields in China (Zhang, 2021). Rural students report higher technostress than urban peers due to less technical education and resources (Shaik, 2020; Kasemy et al., 2022). These findings suggest that educational institutions must address these diverse challenges to support all students effectively.

Additionally, higher computer self-efficacy, school support for TEL, and digital competence correlates with reduced technostress among university students. It is consistent with the research result of Zhao, Wang, Wu, and Dong (2022), Maipita et al. (2023), and Kim (2018). Universities should invest in training programs to boost students' computer self-efficacy and digital competence, improve technology infrastructure, and strengthen support systems for TEL to manage technostress effectively.

The interviews frequently mentioned self-restraint as a coping strategy for technostress. This resonates with Natividad-Franco and De Jesus (2022) and emphasizes the importance of personal discipline in a TEL. Effectively managing online distractions and structuring study time is crucial for preventing internet addiction, ineffective learning practices, and resultant technostress. Participating in outdoor activities, which provide a break from technological interfaces, could be beneficial in reducing technostress. Students emphasized the importance of adhering to rules. Students mentioning established guidelines from institutions, peers, or families as coping mechanisms. Developing ICT-related skills and knowledge is also an important to reduce technostress. This suggests that ICT-related learning empowers students to navigate technology with greater confidence and control, diminishing feelings of being overwhelmed. Students underscored the importance of leveraging support from their universities as an important strategy in mitigating technostress. They identified various forms of assistance that were particularly helpful, including academic guidance from course instructors, specialized technical support from dedicated college departments, and psychological counseling services provided by mental health centers on campus. They emphasized the value of interactions not just with teachers in educational context, but also with friends and family.

Conclusion

University students in China experience a notable level of technostress. The differences of technostress perceived by students explored in this study suggest universities in China should make policies based on the diversity of the students. Special focus should be given to addressing the unique challenges faced by female students, those in science and engineering fields, and students from rural backgrounds. In addition, universities should therefore intensify efforts to refine curricula, enhance training, and improve institutional frameworks. Such efforts are crucial in bolstering school support for TEL, augmenting students' self-efficacy, and advancing their digital competence. This, in turn, can significantly aid in reducing technostress among students. This study delineates six specific strategies that college students in China employ to counteract technostress. However, further study should be done to refine and advance theories related to coping strategies for technostress.

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Design and Development of XR based Geography Simulation based on LXD

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Abstract This research aimed to design and develop an extended reality (XR) learning environment, grounded in Learning Experience Design (LXD), to enhance learner experiences across diverse educational sectors. Leveraging advancements in XR technologies—encompassing Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR)—this study explored their application in fields such as geography, medicine, and arts, confirming their effectiveness in fostering immersive learning experiences. Recognizing the necessity to align XR environments with educational theories for optimized application, the study adopted a comprehensive LXD approach, considering cognitive, affective, and behavioral dimensions of learning. Focused on geographic content, specifically Köppen's climate classification, the environment aimed at enhancing understanding through interactive learning. Data collected from 103 university students, regarding academic self-efficacy and achievement before and after interaction with the XR environment, indicated significant improvements, underscoring the potential of well-designed XR applications in education. These results highlight the importance of integrating educational theory into XR design to maximize learning outcomes, suggesting directions for future research in expanding and diversifying learning experience data.

Keywords: design and development, geography simulation, LXD, XR

Introduction

The purpose of this study is to design and develop an extended reality (XR) learning environment based on learning experience design (LXD) and to analyze learners' experience. As XR technology has advanced, XR-based learning environments are being applied across various educational fields. Extended reality encompasses technologies that utilize virtual spaces for learning, such as Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) (Meccawy, 2022). In areas such as geography, medicine, science, nursing, arts, and vocational education, XR simulations have been developed, and their effectiveness has been verified (Railean et al., 2020; Okanovic et al., 2022). XR learning environments connect virtual reality with the real world, enabling learners to interact with virtual objects in the real world, thereby enhancing learners' immersion and sense of presence (Tang et al., 2021). However, despite these positive effects, there is a need to apply learning contexts based on educational theoretical foundations to ensure that XR learning environments are effectively utilized according to educational context and objectives (Choi et al., 2022). LXD is an instructional design theory that regards the overall experience that learners have during the learning process as learning outcomes (Jahanke et al., 2020; Wong et al., 2023). Therefore, from the perspective of LXD, the configuration of learning experiences is a critical factor to consider in learning design (Schnepp & Rogers, 2022). Thus, this study aims to design and develop an XR learning environment based on LXD and analyze its effectiveness. For this, this study designed and developed XR-based learning simulation and analyzed the effectiveness based on the pre-post analyzation of academic self-efficacy and achievement score. The research question is 'Is the perception and achievement score were increased after using XR based simulation?'.

Research Design & Methods

Participants

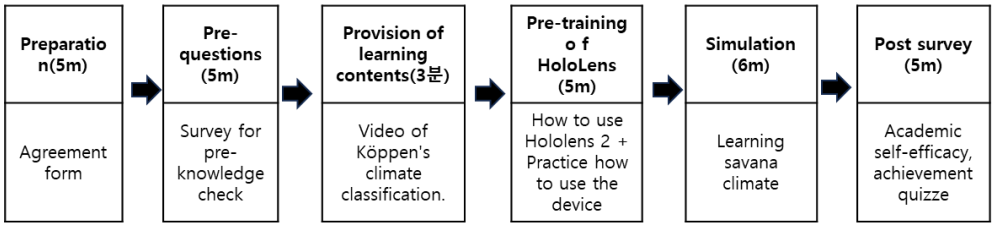
One hundred nineteen undergraduate students enrolled in a public university in South Korea voluntarily participated in the study. There were 43 male students and 76 female students. The average age of the participants was 22.55 years (SD=2.5).

Experience Design

The purpose of the study was to design and develop and analyze the effectiveness of the XR-based simulation. For this, we designed and developed XR-based Geographic learning content and collected pre-and post- achievement score and academic self-efficacy changes. Figure 1 shows the experiment procedure.

Figure 1

experiment procedure



Material

The content of the XR learning environment is focused on geographic learning content. We designed XR-based simulation with cognitive, affective, and behavioral perspectives. Table 1 shows the summary of learning contents. Figure 2 shows a screen shot of XR-based learning simulation. There were six interfaces for interaction between the learners and the system. In cognitive aspect, 'learning contents' and 'additional learning contents' interfaces were designed. They would provide cognitive knowledge to learners. In affective aspect, 'feedback' and 'prompt' interface were designed. They will give praise and positive feedback to the learners Thus students will enhance their affective aspect. In behavior aspect, '3D asset' and 'task performance phase' interfaces were designed. They activate the learners' behaviors to finish the task.

Table 1

The XR-based simulation learning contents

Theme	The learning classification	Aim	Task
Savana climate Features	• Cognitive: Conceptual knowledge • Affective: Understanding • Behavioral: Classification	• I can classify the characteristics of the savanna climate.	• Listen to descriptions of the vegetation and living environment characteristics of the savanna climate and classify related objects.

Variable and Measures

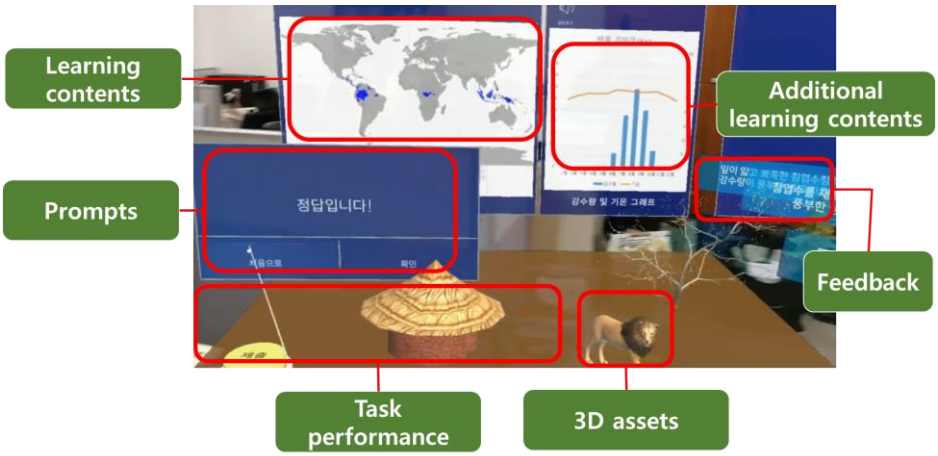
Academic self-efficacy survey includes seven items with 7 Likert Scale (Jang, 2019). For example, 'I can perform the required task in the lesson'. For the achievement test, five items were used with selection type and short answer type questions quizzes. The test items were vilified by a geography teacher who teaches geography in high school over 20 years. The achievement test items ask about Köppen's climate classification knowledge.

Analysis

To ensure the validity of the developed extended reality (XR) learning environment, users' achievement scores and academic self-efficacy scores were compared before and after using the learning environment. The collected data was analyzed using a paired samples t-test. SPSS 22.0 was utilized for the analysis, with the significance level set at .05.

Figure 1

the screen shot of XR-based learning simulation



Results & Conclusion

The results showed that students exhibited higher academic self-efficacy and achievement after the XR learning experience than before like table 2.
These results indicate that extended reality simulations provide a learning context that increases learner intervention, enhancing activity, participation, and positive experiences. This aligns with previous research (Kang & Choi, 2022; Kim & Kim, 2021; Son et al., 2018; Verkuyl et al., 2017). Active participation and positive experiences boost learners' academic self-efficacy and motivation, which in turn improve learning achievement (Pham et al., 2024). XR-based learning environment offers an educational context that enhances learning engagement through realistic learning materials(Goi, 2024). For future research, there is a need to collect and analyze more diverse learning experience data.

Table 2

The mean and t score(N=119)

	Academic self-efficacy		Achievement	
	Pre	Post	Pre	Post
Mean (SD)	3.70(1.41)	5.00(1.24)	.67(.87)	2.54(1.20)
t	-8.18		-14.44	
p-value	*p*<.000		*p*<.000	

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Virtual Reality Role-Playing in a Japanese Moral Education Class

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This study investigates the use of Virtual Reality (VR) in Japanese moral education role-playing, addressing challenges of traditional face-to-face (F2F) methods such as participant resistance, lack of realistic environments, and static roles. VR's immersive environments enhance adaptability, reduce resistance, and prevent role fixation. The study examines VR's impact on learners' empathy development and the influence of trait shyness in VR versus F2F contexts. Fifty-six students participated, using "The Silver Candlestick" for Role-Play. Empathy was measured with Davis's Interpersonal Reactivity Index and trait shyness with Aikawa's Trait Shyness Scale. Results showed no significant emotional changes but revealed a reduction in cognitive empathy (fantasy subscale) in F2F, not in VR. VR also encouraged more varied forgiveness strategies, highlighting its potential to enhance engagement and effectiveness in moral education. The study suggests developing VR-adapted lesson plans and further exploring VR's broader educational implications.

Keywords: Virtual Reality, Moral Education, Empathy, Perspective-taking

Introduction

Current Japanese moral education is undergoing transformation. The Ministry of Education revised the guidelines in 2015, positioning moral education as a special subject from 2018 in elementary schools and 2019 in junior high schools. Traditional methods were criticized for being overly formal and focused on understanding the feelings of characters in reading materials (Ministry of Education, Culture, Sports, Science and Technology, 2017c). According to Mori and Uematsu (2018), experiential learning, including role-playing, was recommended as a more effective approach.

Research Design & Methods

Overview

The study used "The Silver Candlestick" from Victor Hugo's "Les Misérables" as the role-playing material. The material is often used in moral education classes in Japan (Mukugi, Goto, & Kijima, 2019; Saga Prefectural Education Center, 2016; Wainai, 2014). Participants were divided into face-to-face (F2F) and virtual reality (VR) groups, alternating roles as the bishop and Jean Valjean. Empathy was measured using the Interpersonal Reactivity Index (IRI; Davis, 1980) and trait shyness with the Trait of Shyness Scale (TSS; Aikawa, 1991). The study involved pre- and post-tests, role-playing sessions, and recording participants' utterances during role-plays.

Experimental Environment

VR Environment.

- The hardware: Meta Quest 2 in standalone mode (no PC connection required).
- The software: VRChat.
- The avatars: Created using "Ready Player Me" for the bishop and "Tafi Avatars VRChat Beta" for Jean Valjean. The avatars were uploaded to VRChat through Unity.
- The Role-Play environment: A virtual church "Church of Heresy (+Avatars)" in VRChat, configured as a private instance to allow only the participants and the experimenter to enter.

Figure 1

The avatars used in VR Role-Play (Bishop Myriel, Jean Valjean) and the church used in the VR role-playing

Non-VR Environment. Participants wore simple costumes and used props resembling a silver candlestick made of aluminum foil. The Role-Play was conducted in different rooms at a university.

Participants

Participants were aged between 18 and 30 years. A total of 56 participants were enrolled, comprising 24 males, 31 females, and 1 non-binary individual.

Participants were randomly assigned to either the experimental group or the control group. Informed consent was obtained from all participants, with assurances that withdrawal from the study would incur no penalties. Participants received monetary compensation and reimbursement for travel expenses upon completion of the experiment. 55 participants completed the pre-questionnaire.

Procedure and Experimental Environment. The experiment was conducted over approximately one hour, with participants working in pairs. Initially, participants gathered in an experiment room, where they received an explanation of the consent forms and other relevant documents before signing them. Subsequently, they completed a pre-questionnaire, which included a demographic survey, the TSS, and the pre IRI, using their smartphones to scan a provided QR code. Upon completion of the pre-questionnaire, participants watched a 10-minute video that explained the story of the Role-Play, "The Silver Candlestick," in a picture-story show format. This was followed by an 8-minute session where participants filled out "Opinion Sheet 1" to deepen their understanding of the roles of the bishop and Jean Valjean. A 10-minute pair discussion was then conducted based on the content of "Opinion Sheet 1," focusing on how each participant would perform the roles. This discussion was conducted in F2F.

For the role-playing.

- F2F Environment: After the discussion, participants performed first Role-Play and second Role-Play in the room. They wore simple costumes resembling the bishop and Jean Valjean and used a prop resembling a silver candlestick made of aluminum foil.
- VR Environment: After the discussion, each participant moved to separate individual experiment rooms where they could not see or hear each other. They put on head mounted displays and logged into VRChat. After a brief lecture on how to move avatars and handle objects in VR, they performed first Role-Play and second Role-Play.

After second Role-Play, participants completed "Opinion Sheet 2" on paper and then filled out the post-questionnaire (post IRI). Finally, they participated in a semi-structured interview and received their compensation and travel expenses.

Variables Adapted from Traditional Moral Education Classes

1. Role-Play Material: "The Silver Candlestick," a frequently used theme in traditional moral education.
2. Role-Play Duration: The entire experiment lasted about one hour, with the Role-Play itself lasting approximately 3 minutes, in line with traditional class durations.
3. Role Alternation: Participants alternated between the roles of the bishop and Jean Valjean, promoting diverse perspectives.
4. Introduction and Development: Participants watched a video and filled out opinion sheets, similar to traditional methods of reading materials and teacher-led dramatizations.
5. Opinion Sheets: Used to deepen understanding and reflection, analogous to the traditional use of sticky notes for expressing thoughts.

This design ensures that the experimental conditions closely mimic traditional moral education settings while integrating the novel VR component to evaluate its potential benefits and drawbacks in educational contexts.

Results

Overview

The study aimed to explore the effects of VR on role-playing within moral education, particularly focusing on empathy development and the influence of trait shyness. The experiment involved fifty-six students who participated in Role-Plays under both F2F and VR conditions, alternating between the roles of the bishop and Jean Valjean in the scenario "The Silver Candlestick." The primary tools for measurement were Davis's IRI for empathy and Aikawa's TSS.

Emotional Empathy

One of the key findings of the study was that there were no significant emotional changes in participants across the sessions in either the F2F or VR environments. This indicates that both traditional and VR-enhanced role-playing did not significantly alter the emotional empathy of the participants. Emotional empathy, measured through subscales such as empathic concern and personal distress within the IRI, remained relatively stable from pre- to post-session in both conditions.

Cognitive Empathy

In contrast to the stable emotional empathy, cognitive empathy exhibited noteworthy differences between the F2F and VR conditions. Cognitive empathy encompasses the ability to understand and share the feelings of others from a more detached, intellectual perspective, and it includes subscales such as perspective-taking and fantasy within the IRI.

The study revealed a significant reduction in the fantasy subscale of cognitive empathy from pre- to post-session in the F2F condition. Fantasy refers to the tendency to imaginatively transpose oneself into the feelings and actions of fictitious characters. In traditional F2F role-playing, participants showed a decrease in their ability to engage with and empathize with characters imaginatively by the end of the session. This reduction was not observed in the VR condition, suggesting that VR maintained or even enhanced the participants' ability to empathize with characters on a cognitive level.

Table 1

Mean values and standard deviations of each subscale pre- and post- role-playing for each group

Sub-scale	All (n=56)		F2F (n=28)		VR (n=28)	
	pre	post	pre	post	pre	Post
PT	3.34(0.79)	3.58(0.78)	3.18(0.86)	3.46(0.88)	3.50(0.70)	3.69(0.65)
FS	3.40(0.77)	3.37(0.81)	3.36(0.70)	3.21(0.80)	3.44(0.84)	3.53(0.81)
EC	3.47(0.63)	3.39(0.73)	3.51(0.55)	3.39(0.67)	3.43(0.72)	3.40(0.80)
PD	2.90(0.73)	2.95(0.83)	2.86(0.78)	2.96(0.87)	2.94(0.70)	2.93(0.81)

( ) indicates standard deviation. Rounded to three decimal places.

Trait Shyness and TSS

The study also aimed to understand how the individual characteristic of trait shyness influenced empathy outcomes in VR-enhanced role-playing scenarios compared to traditional F2F contexts. The TSS was used to measure the level of trait shyness among participants. The analysis showed that trait shyness did not significantly affect the variability of the IRI subscales, including both emotional and cognitive aspects of empathy, in either the F2F or VR conditions. This suggests that VR's immersive environment could potentially mitigate the effects of trait shyness, allowing participants to engage more fully in the role-playing activities regardless of their inherent shyness.

Forgiveness Strategies

Beyond the quantitative measures of empathy, the study also included a qualitative analysis of the participants' utterances during the Role-Plays, particularly focusing on the strategies used by the participants in the role of the bishop when offering forgiveness. The VR environment appeared to encourage a greater variety of forgiveness strategies compared to the F2F setting.

In the VR condition, participants demonstrated more creativity and adaptability in their approach to forgiving the character of Jean Valjean. This suggests that the immersive and flexible nature of VR may facilitate a deeper engagement with the Role-Play scenario, allowing participants to explore different aspects of moral reasoning and empathy more freely. The varied strategies for forgiveness observed in the VR setting highlight its potential to foster a more dynamic and effective moral education experience.

Discussion

The findings suggest that VR role-playing may be more effective in preventing decreases in imaginative empathy compared to traditional F2F role-playing. VR environments can help learners immerse themselves in their roles, enhancing empathy development. Future research should focus on developing lesson plans tailored to VR environments.

Conclusion

This study aimed to clarify the impact of introducing VR technology into role-playing in Japanese moral education on learners' empathy, especially focusing on the cognitive aspect of empathy, such as perspective-taking (PT). It also sought to examine the influence of learners' trait shyness on the variations in empathy during role-playing.

The experiment divided participants into two groups: F2F and VR. Empathy was measured using the IRI, and trait shyness was measured using the TSS. The Role-Play material used was "The Silver Candlestick," a story from Victor Hugo's "Les Misérables."

Key findings include:

1) Both F2F and VR role-playing had little impact on the emotional aspects of empathy but significantly influenced the cognitive aspects.
2) Perspective-taking (PT) increased significantly in both F2F and VR groups.
3) Fantasy scale (FS) decreased significantly only in the F2F group, while it remained stable in the VR group.
4) Trait shyness did not significantly affect the changes in empathy.
5) The results suggest that VR role-playing can effectively immerse learners as characters in a story, potentially enhancing empathy development by preventing the decrease in imaginative empathy seen in F2F role-playing.

Future Research Directions

Future research should prioritize the creation of lesson plans specifically tailored to VR environments, addressing the unique dynamics and interactions inherent to VR technology.

This study underscores the potential of VR technology to overcome the limitations of traditional face-to-face role-playing in moral education. VR offers a more immersive and flexible learning environment that can effectively foster empathy among learners.

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A Pilot Experiment of Role-Playing in a Virtual Learning Space

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Abstract: Role-playing has been utilized as a teaching method in moral education classes at schools to encourage students to shift their viewpoints. Role-playing in virtual spaces was hypothesized that it could assist students in acquiring role-taking abilities by allowing them to witness different viewpoints through avatars. The overall objective of this study was to develop an instructional method and materials of role-playing, and to evaluate its effectiveness through implementation in the classroom. In this study, we had the opportunity of a pilot experiment with elementary, junior high, and high school students as participants. The purpose of the experiment was to gather feedback from the participants. The participants were assigned to groups of three and rotated between three avatars: (1) a male avatar, (2) a female avatar, and (3) an observer, to simulate experiencing gender roles, a contentious social topic. The experiment resulted in rather positive responses from the participants. However, there were disruptions in the lesson flow because the operation of the equipment required proficiency.

Keywords: Metaverse; Moral education; Role-playing; Role-taking ability; Virtual learning space

Introduction

It was not easy for infants and children to reason about feelings and thoughts from the standpoint of others when asked the question, "What would you think if you were the protagonist?" To think from another person's point of view required imagining the scene as a witness from the other person's perspective (shift of viewpoint at the physical level) and inferring the feelings and thoughts of the other person (shift of viewpoint at the social level). Shifting perspectives at the social level requires the development of role-taking ability, which is the foundation of morality. According to Selman & Byrne (1974), there are five developmental stages of role-taking abilities from childhood to adolescence. Role-playing is an excellent teaching method that enables students to shift their viewpoints at the physical level and perceive scenes from the viewpoint of their character a certain story. We have focused on virtual space, where technology has made remarkable progress in recent years. By using a platform like Metaverse that allows the construction of virtual spaces at will, it is possible to set up a morally problematic situation in a virtual space, and learners can appear as avatars and role-play as if they were in that situation.

Research Question

The research question of the study is: How does role-playing as an avatar in a virtual space affect the development of role-taking abilities? To examine this question, it is necessary to develop a virtual learning space in which learners become avatars and face morally problematic situations, and an instructional method for role-playing in a virtual learning space. Furthermore, it is necessary to evaluate them through trial classroom practice in school education. Therefore, the overall objective of the study is to develop a virtual learning space and instructional methods for role-playing and to evaluate them through trial classroom practice.

Literature Review

Sasaki (2020) initially planned learning activities consisting of three sequential phases to develop infants' and children's ability to shift their viewpoints at the physical and social levels using robots. Furthermore, the results of a study with young children and elementary school students revealed that the ability to change viewpoints at the physical level and at the social level develops independently (Sasaki, 2023a, 2023b). In other words, it became clear that activities may be organized to cultivate perspective-taking at the physical and social levels without being constrained sequentially. Role-playing is a well-established teaching method at the classroom practice level, and Tokita (2020) examined the historical background of role-playing and its role in moral education. Honma and Uchiyama (2013) reviewed research on role-taking abilities. On the other hand, there is no research on fostering morality through role-playing in a virtual space.

Research Design & Methods

Role taking ability. According to the developmental levels, as individuals grow, they progress from level 0, the egocentric level, to level 1, the subjective (first-person) level. Furthermore, they progress from level 2, the self-reflective (second-person commensurate) level, to level 3, the third-person perspective level. To promote the acquisition of role-taking abilities, we believe that it is necessary to experience each of three kinds of perspectives in a simulated environment.

Virtual learning space. The virtual learning space (upper right of Figure 1), in which learners role-play as avatars, is created in Metaverse as a platform. In this virtual learning space, learners can experience shifting physical and social perspectives by rotating between the avatars of "A. Protagonist (a first-person)", "B. Counterpart (a second- person)", and "C. Observer (a third-person)" in turn.

Purpose of this Essay. Of the three types of virtual learning spaces, Type I and Type II are under construction. For Type III, "Horizon Workroom", a service provided by Meta, allows learners to hold discussions in a conference room. We had the opportunity to experiment with role-playing in that space for 5th and 6th-grade elementary school students, junior high school students, and high school students. The purpose of the experiment is to gather feedback from the participants on whether discussions as avatars in a virtual learning space were an effective tool.

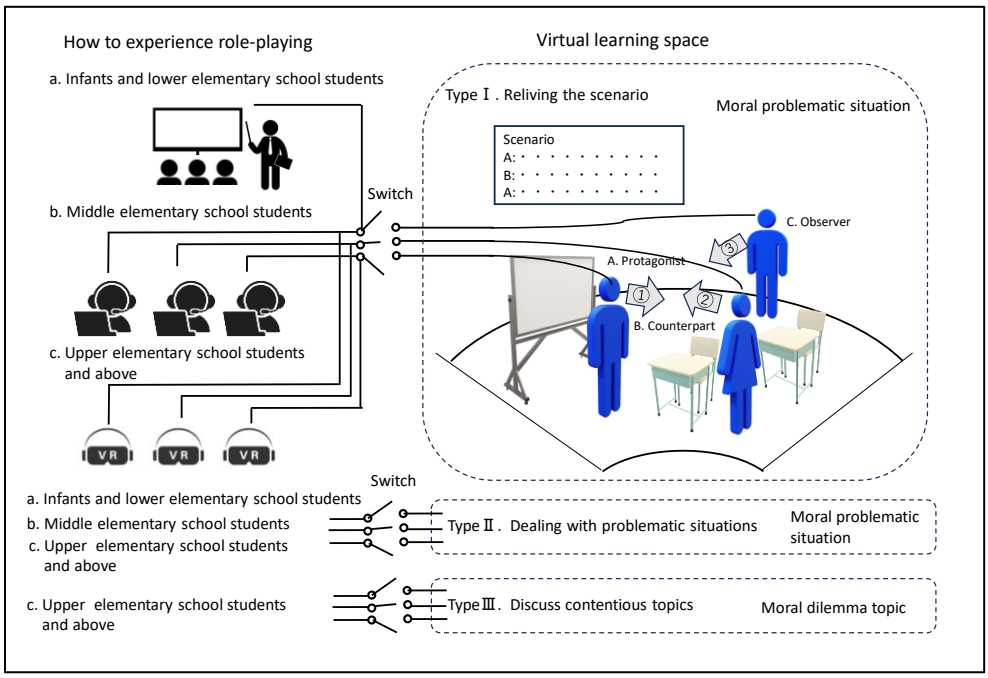

Figure 1 Virtual Learning Space

Experiment

Virtual learning space: In this experiment, a "gender role" is prepared to discuss the social roles of men and women. Participants are grouped in threes and rotate between three avatars: ① male avatar, ② female avatar, and ③ observer. For the observer, the discussion between the two avatars is monitored on the screen of a laptop PC. As the participants can only casually observe their avatar's external appearance in the mirror within the virtual space, it is difficult to maintain awareness of the avatar's gender. Therefore, participants are asked to design the avatar of their initial role to strengthen their awareness of the avatar's gender. A conversation between a man and a woman discussing gender roles is prepared as a scenario. To think from another person's point of view required imagining the scene as a witness from the other person's perspective (shift of viewpoint at the physical level) and inferring the feelings and thoughts of the other person (shift of viewpoint at the social level). Shifting perspectives at the social level requires the development of role-taking ability, which is the foundation of morality. According to Selman & Byrne (1974), there are five developmental stages of role-taking abilities from childhood to adolescence. Role-playing is an excellent teaching method that enables students to shift their viewpoints at the physical level and perceive scenes from the viewpoint of their character a certain story. We have focused on virtual space, where technology has made remarkable progress in recent years. By using a platform like Metaverse that allows the construction of virtual spaces at will, it is possible to set up a morally problematic situation in a virtual space, and learners can appear as avatars and role-play as if they were in that situation.

Procedure

1.Explanation of the purpose and procedure of the experiment

2.Explanation of how to operate the headset

3.Avatar Design
The avatar's entire body is mirrored in the virtual space, and facial features such as hair and eyes are designed, as well as clothing, ornaments, and other appearance features.
4. Explanation of assemble
After first entering a private office, the participants receive an explanation of the procedure for moving to the conference room.
5.Discussion in the conference room
Two avatars enter the conference room and engage in a scenario-based conversation. The observer observes the conversation through a laptop screen.
6.Rotation
Rotate the roles of avatars and observers; rotate three times so that three participants can experience all the roles.
7.Survey Responses
The questionnaire contained the following two questions, which were answered on a 5-point scale from 1 to 5 (1: disagree, 2: somewhat disagree, 3: undecided, 4: somewhat agree, 5: agree) using the 5-point scale method.

(Q1) Do you think you can think and speak from a male or female perspective?
(Q2) Do you think you can observe objectively as a third person?

Experiment

Elementary school students: October 15, 2023 (Sun.) 14:30-16:00 Number of participants: 18
Junior high school students: October 28, 2023 (Sat.) 14:30-16:00 Number of participants: 19
High school students: November 16, 2023 (Thurs.) 15:35-16:25 Number of participants: 20

Although the experiment proceeded according to the procedure, it took a considerable amount of time to operate headset. When the headset was worn, only the person wearing the headset could see the virtual space, making it difficult to provide specific operation instructions. Additionally, when the headset was removed and put back on, the position of the avatar in the virtual space sometimes shifted, requiring time to adjust. Furthermore, while some participants successfully completed the avatar design stage, they encountered issues proceeding to the personal office and then to the conference room The wifi connection was occasionally disrupted, preventing them from progressing to the conference room. As a result, time was consumed in equipment operation, and participants could only proceed to the second rotation. Consequently, only two of the three roles could be experienced.

Results and Discussion

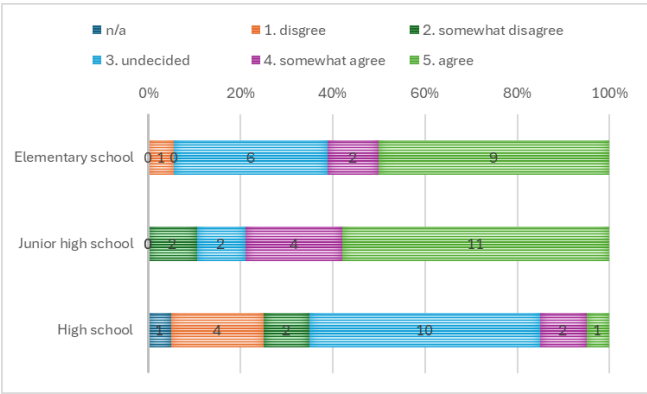

Figure 2 Respond of Q1

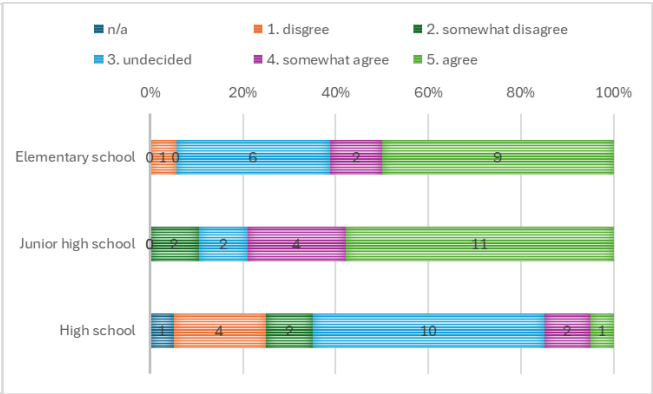

Figure 3 Respond of Q2

Figure 2 shows the percentage of responses to Question 1 of the questionnaire in a band graph for each elementary, junior high, and high school students. Eleven (61.1%) of the elementary school students, 15 (78.9%) of the junior high school students, and 11(55.0%) responded affirmatively to Q1. The fact that more than half of the responses were positive to the idea that being an avatar of the opposite gender to oneself allows one to put oneself in the other's shoes means that the elementary, junior high, high school students who served as subjects were rather accepted the validity of the activity. However, one of the reasons given for the negative responses was that they had not done it, which means that they were unable to participate in the discussion in the conference room. This was because after designing their avatars, they were stuck in the headset operation of entering their personal offices and then moving from there to the conference room.

Figure 3 shows the percentage of responses to Question 2 of the questionnaire in a band graph as well as Q1. Eleven (61.1%) of the elementary school students and 15 (78.9%) of the junior high school students responded affirmatively to Q2. Since the majority of the respondents were positive about the idea that observing the conversation between two avatars allows them to see things objectively as a third person. On the other hand, only 3(15.0%) of the high school students responded affirmatively. One of the reasons for the negative responses was the statement, 'Because I couldn't observe the conversation in the PC,' which indicates that the participant could not reach the conference room. As mentioned earlier, this was due to the fact that they got stuck or made errors in operating the headset when moving from the personal office to the conference room.

The above responses from the participants confirmed to some extend the possibility of role-playing in a virtual space. However, the operation of the headset required a certain degree of skill, and it was probably very stressful for the participants who wore the headset for the first time. Although a support person was present during the experiment, it was difficult to grasp what kind of problems were occurring because only the participant himself could see the screen of the virtual space when wearing the headset. Another problem was that once the participant removed the headset, the operation paused, and when the support person put it on again, the subject could not always see the same screen, which took a lot of time. Furthermore, in this experiment, we had six or seven groups of three people each, and each group had access to WiFi from three devices: two headsets and a laptop computer for observing the conference room. In total, 18 to 21 devices accessed the Wi-Fi, resulting in slow traffic and errors when moving from the personal office to the conference room in the virtual space. Therefore, a smoother communication environment is needed."

Conclusion

The research question was, "How does role-playing as an avatar in a virtual space affect the development of role-taking abilities?" The overall objective of the study was to 'to develop a virtual learning space and instructional methods for role-playing and to evaluate them through trial classroom practice.' In this essay, Type III of the three types of virtual spaces was set as a virtual learning space, and elementary, junior high, and high school students were given the opportunity to experiment with role-playing in a Type III virtual learning space. The purpose of the experiment was to gather feedback from the participants on whether discussions as avatars in a virtual learning space were an effective tool. As a result, we obtained rather positive responses regarding the idea that they could put themselves in the position of others by playing the avatar. However the positive responses that they could view things objectively as a third person were insufficient. On the other hand, it became clear that the difficulty of controlling the headset and the fragility of the communication environment made it impossible to adequately prepare a virtual learning space. and

In the future, it will be necessary to devise ways to make the operation of the headset smoother, as well as to make it easier to move to the conference room. Additionally, although this experiment dealt only with Type III virtual learning spaces, the development of Type I and II virtual learning spaces will be an issue to be addressed.

Acknowledgement

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Impact of Self-regulated Learning Readiness on Junior-high School Students' Performance

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This is a part of a study exploring the matching method for a system that extracts advice for students to become proficient in their self-regulation. In this presentation, we divided upper-elementary and junior high school students into four categories based on their responses to the self-regulated learning scale questionnaire conducted in the first semester of 2023. Then we collected the mathematics and English scores of junior high school students in each category and assessed their self-regulation. As a result, clusters with many students using shallow strategies had the lowest performance gains and lowest maximum scores in both mathematics and English. This indicates that different self-regulation skills or learning strategies can impact mathematics and English. On the other hand, for learning strategies that utilize planning and metacognition, it is suggested that advice that takes into account differences in subjects and grades is considered to be effective.

Keywords: Self-Regulated Learning, Private Tutoring School, Learner Model, Learning Strategy

Introduction

The authors of this paper are attempting to develop a system to support tutors at private tutoring schools, or Julu in Japanese, in improving their self-regulation skills as mentors for commuting students. In this report, we examine the direction of the development of an advising system focusing on self-regulation by comparing the results of tutoring students with our originally developed self-regulated learning scale (Matsuda et al., 2022, Matsuda and Kimoto, 2024).

Research Design & Methods

Purpose and Research Questions

The future goal of this study is to develop a learner model based on self-regulated learning scales, actual learning activities, and learning outcomes, and to explore matching methods to extract advice for commuting students. To this end, this presentation organizes the relationship between the results of the responses to the self-regulated learning scale and learning outcomes. Specifically, we aim to verify the area enclosed by the dashed line in the upper left of Figure 1 and explore the relationship between subjective self-level judgments of the components of self-regulation and grades as learning outcomes by matching responses to the Self-Regulated Learning Scale Questionnaire (SRLSQ) with respondents' grades. Our objectives are based on the following questions.

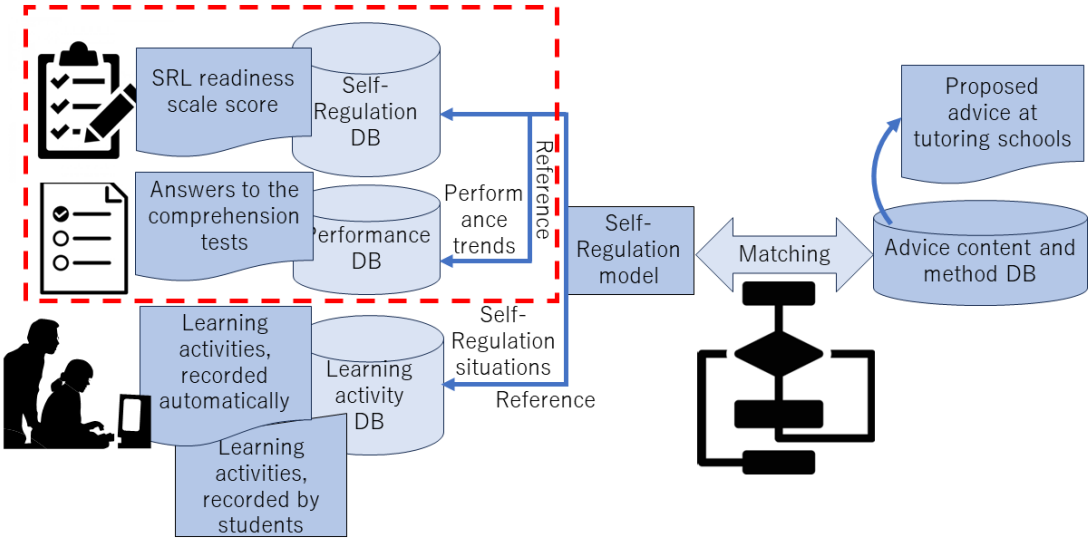
> Research Question 1: When commuting students are categorized based on their responses to the SRLSQ, what is the trend of their performance in each category?
> Research Question 2: What is the relationship between the responses to individual question items on the SRLSQ and students' grades?

The analysis based on these research questions was conducted on a subject-by-subject basis to determine how differences in the subjects may affect the results.

Research Design

The first data set to be analyzed comprised data from responses to a simplified version of the SRLSQ (five factors and 20 items) by Matsuda and Kimoto (2024). This survey was conducted from April to May 2023. Responses were received from 569 students, from 4th grade elementary school students to 3rd grade junior high school students attending private tutoring schools belonging to several Gakken group companies.

Figure 1
Entire image of developing system



The second data set comprised the comprehension test scores administered at the end of each subject unit. As this comprehension test could be repeated by students after studying video materials presented to them in response to their previous wrong answers, we used data on the difference between the initial score and the highest score (growth in grades) and the highest grade (equivalent to the final grade) in the first semester of 2023. The range of the data scores was 0–2. Using these data, the following analyses were conducted: 1) the respondents were categorized using cluster analysis based on the SRLSQ; 2) the self-regulation tendencies of each cluster were examined; and 3) the performance of students in each cluster were compared by subject.

Results

Cluster Analysis

As there were 569 respondents to be classified in the cluster analysis, denoting a large cluster, the number of clusters was determined to be four after drawing a dendrogram using hierarchical cluster analysis (Ward's method). Non-hierarchical cluster analysis (k-means method) was then used for classification.
The mean values for each self-adjustment factor for each cluster were characterized, as shown in Table 1. In this table, the weighted mean (μ) of the questionnaire items (5-point Likert scale) comprising each factor was used as the criterion, with μ≥3.50 being described as "high," 3.50>μ≥2.50 as "medium" and 2.50>μ as "low."

Table 1
Average value of students' answers in SRL readiness scale by clusters

Factors	Clusters			
	1 (n=149)	2 (n=212)	3 (n=125)	4 (n=83)
1. Planning	High	High	Middle	Low
2. Utilization of metacognition	High	High	Middle	Middle
3. Dependance on teachers	Low	Middle	Middle	Low
4. Test anxiety	Low	High	Middle	Middle
5. Shallow learning strategy	Low	Middle	High	Middle

Performance Comparison by Cluster

As the number of elementary school students who responded was less than one grade of junior high school students in the three grades from grades 4 to 6 combined, they were excluded from the grade comparison. Furthermore, mathematics (growth, *N*=317; highest score) and English (growth, *N*=312; highest score, *N*=317), to which many junior high school students responded, were included in the analysis. Because there were outliers in the scores and the growth tended to be larger for those with lower initial scores, we counted the number of respondents in each cluster for the highest and lowest scores by focusing on the growth and rank order of scores. The results are shown in Figures 2 and 3, with different trends observed for mathematics and English.

In mathematics, the number of students in the top 25% greatly exceeded the number in the bottom 25% in Cluster 1, whereas the number of students in the top and bottom 25% were almost equal in Cluster 2, and the number of students in the bottom 25% exceeded the top 25% in Clusters 3 and 4. This trend remained the same for both grade growth

and the highest scores. However, for English, the number of students in the bottom 25% greatly exceeded that of the top 25% in Cluster 1, and the top 25 exceeded that of the bottom 25% in Clusters 3 and 4. Furthermore, for the highest score in English, the ratio was the opposite of the growth.

Figure 2

a. Improvement in mathematics grades within the same unit b. Highest score for mathematics within the same unit

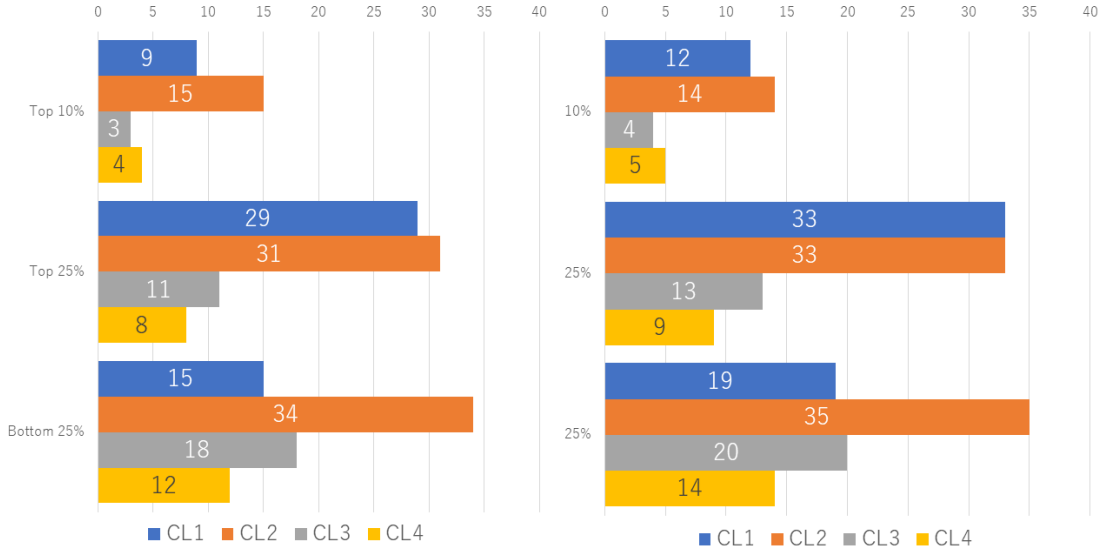
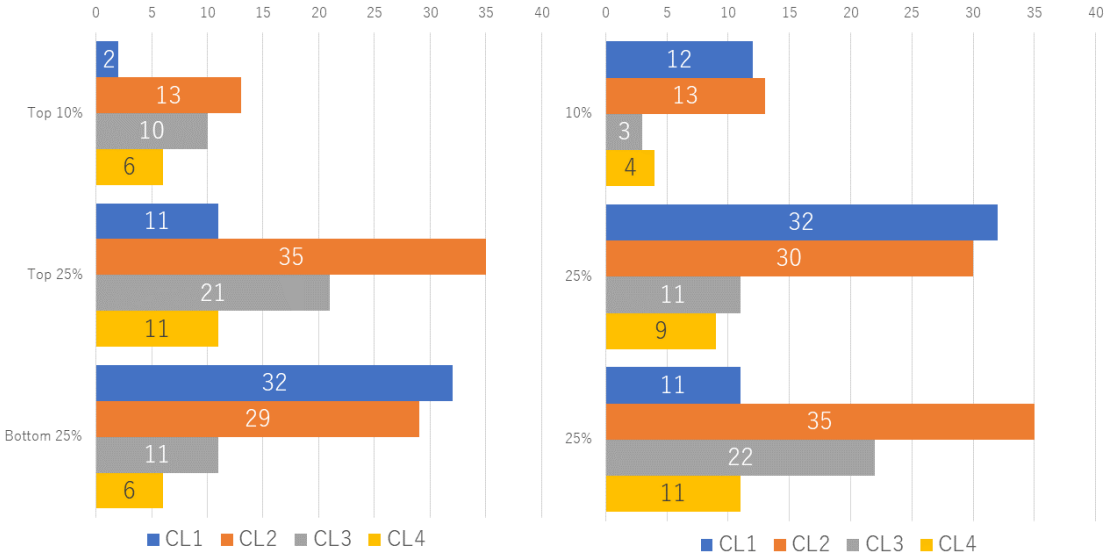


Figure 3

a. Improvement in English grades within the same unit b. Highest score for English within the same unit



Correlation between Responses to Each Question Item and Grades

To confirm the relationship between the SRLSQ and grades in more detail, the correlations between individual question items and grades were analyzed, and items with significant correlations at the 5% significance level were extracted, as shown in Table 2. Although all correlations were weak, positive correlations were found between the items comprising Factors 1 and 2 and grades, and negative correlations, indicated in the cells colored light blue, were found between the items comprising Factors 3 and 5.

Discussion

We now examine the two research questions of this study. First, when categorizing respondents based on their responses to the SRLSQ, the following hypotheses can be assumed from student performance:

Table 2

Correlations between answers for each question item and performance

Factors	Question Items	Average value		Max value	
		Math	Eng	Math	Eng
1. Planning	When I study, I make a plan prior to starting.				.116*
	When I study, I follow my own plans.		.112*		
	I make a plan before studying for the exam.	.122*		.121*	.149**
2. Metacognition	When I do not fully understand the content during class, I will understand it later.			.144*	.198*
	When asking a teacher, I ask them to give me hints on how to solve it myself, rather than answering it.			.144*	
	When I'm studying, I try to find out things I don't understand.			.156*	
3. Dependence on teachers	When I encounter something I don't understand, I ask the teacher rather than looking it up myself.			-.139*	
5. Shallow strategy	If the answer is correct, its reason doesn't matter for me.	-.135*	-.124*	-.142**	
	If the answer is correct, another way to solve the problem is not particularly important.	-.154**	-.174**	-.211**	-.182**
	I try to remember the answers to the questions that are likely to be tested.	-.113*		-.115*	-.174**
	If there is something I don't understand in my studies, I ask my friends for the answer.			-.142*	-.131*

Hypothesis 1. Clusters with shallower strategies will have lower grade growth and lower maximum scores in both mathematics and English.
Hypothesis 2. Different self-regulation skills and learning strategies will be effective in mathematics and English.
Hypothesis 3. Some items in the teacher-dependent and shallow strategies will have little impact on grades, while others will have a significant impact.

Considering the implications of these hypotheses in terms of the model formation that contributes to self-regulation support, it appears that support for pointing out and correcting problems in shallow strategies is necessary regardless of the subject, while advice based on subject differences is effective for learning strategies that utilize planning and metacognition.

Conclusion & Future Work

In this study, the self-regulation and grades shown in Figure 1 were examined for a limited period and only for two subjects. Naturally, the scope of the abovementioned considerations and hypotheses is limited, and long-term hypothesis testing using actual learning activity data is needed. Furthermore, in the future, we will seek specific advice and support activities to assist students in acquiring self-regulation skills. In doing so, we plan to establish a self-regulation model for learners, considering differences in subjects other than English and mathematics as well as differences in grade levels, and examine how to match this model with effective support methods.

Acknowledgments

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Future Career Prospects and Time Management Strategies of University Students

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In this study, we conducted a questionnaire survey of university students regarding time management and future career prospects. The results revealed the following 3 points. (1) Future career prospects had little impact on the trend in time management behavior. (2) The tendency to live for the day predicts wasting time on entertainment. (3) University students often regretted their use of time by failing to self-control and procrastinating on assignments. When switching moods and behaviors to work on assignments, they used strategies to prepare their learning environment and to think about future benefits. On the other hand, some students regarded procrastinating until just before the deadline of the assignments as a strategy. Further study is needed on the relationship between goal setting and time management.

Keywords: Future Time Perspective, Self-regulated Learning, Time Management

Introduction

Ensuring that university students have sufficient time to study is important for their success in university studies. In self-regulated learning research, time management is considered as one of the important learning strategies. Time management is defined as "the behavior of using time effectively to achieve goals" (Imura, *et al.* 2016). Time management requires a high level of metacognitive ability. It also requires motivation to manage time.
In goal setting in learning, it has been pointed out that it is effective for learners to set short-term goals (Zimmerman, 2008). On the other hand, as students begin to think about their future, long-term goals also become important (Husman & Shell, 2008). The concept of Future Time Perspective describes the time space that individuals consider when making decisions about the present, depending on how far into the future individuals plan, the clarity with which they perceive their future needs, and the extent to which the present is connected to the past and future (Husman & Shell, 2008). For university students, it is expected that their outlook on the kind of job they want to have after graduation will influence their focus on their studies at university and their time management behavior to secure time for their studies.
In this study, we aimed to clarify the following three points.
(1) Do university students' time management behavior differ depending on their future career prospects?
(2) Do trends in time management behavior predict time-wasting behavior?
(3) How do students think about the use of their time? Specifically, when do they think that they are not making good use of their time? How do they switch their moods and actions when they feel unmotivated?

Research Design & Methods

Procedure. Participants in this survey were university students. A web-based questionnaire was conducted in June 2024. Responses were collected anonymously. When the survey was conducted in class, it was made clear that the results would not affect the students' course grade, and responses were only collected with the students' consent.

Question Items. The Time Management Scale (Imura, *et al.*, 2016) was used to measure time management behavior tendencies. It consisted of 19 items divided into 3 factors: "Time estimation," "Time utilization," and "Taking each moment as it comes." Participants were asked to answer how much each item applied to them on a four-point scale from "1. Not at all true" to "4. Very true." In addition, for the 9 items regarding what you tend to spend too much time on in your daily life (time-wasting behavior), we asked for responses on a 4-point scale from "1. Not at all true" to "4. Very true."
Free-text items asked about (1) when they felt they were not using their time well and (2) how they switched their mood and behavior when they were unmotivated despite having things they had to do, such as university assignments. The face sheet items asked about their grade, gender and future career prospects.

Results

Valid responses and attributes. There were 163 respondents. As there were no incomplete responses, the number of valid responses was 163 (100 freshman, 21 sophomores, 22 juniors, 20 seniors or above; 49 male, 109 female, 5 no response). The future career prospects were as follows: 53 students said, "I have a specific job I want to do and an ideal image of what I want to become(Having ideal image group)"; 50 students said, "I have a specific job I want to do(One Job group) "; 21 students said, "I don't have a specific job I want to do, but I have decided on a type of industry(One industry group)"; 25 students said, "I have a few candidates for the type of industry I want to work in(Several industries group)"; and 14 students said, "I haven't decided on a specific job or type of industry I want to work in(No job or industry group)."

Time-wasting behavior. We conducted an exploratory factor analysis using the principal component method on 9 items of time-wasting behavior (Table 1). We judged that a 2-factor solution was appropriate based on the steep drop in the scree plot. After repeatedly conducting a factor analysis using the principal component method and Promax rotation while excluding items with a factor loading of less than 0.4 and items with multiple loadings, we obtained a 5-item, 2-factor structure (Table 2). Factor 1 consisted of 3 items related to socializing: "Chatting with friends online," "Playing with friends," and "Phoning friends." Therefore, it was named "Waste time on friendship(α =.75) ". Factor 2 consisted of 2 items related to entertainment: "Reading manga" and "Playing games." Therefore, it was named "Waste time on entertainment" (α = .55). The inter-factor correlation was .49.
The mean scores for each subscale were 2.4 (*SD* = 0.9) for "Waste time on friendship," and 2.2 (*SD* = 1.0) for "Waste time on entertainment" (Table 3).

Table 1

Time-wasting behavior: Mean and Standard deviation

	M	*SD*
(1) Watching videos	3.4	0.9
(2) Chatting with friends online	2.7	1.1
(3) Reading novels	1.8	1.0
(4) Playing with friends	2.6	1.1
(5) Watching TV	2.0	1.1
(6) Browsing and posting on SNSs	3.3	1.0
(7) Reading manga	2.2	1.2
(8) Phoning friends	1.8	1.0
(9) Playing games	2.1	1.2

Table 2

Time-wasting behavior: Results of factor analysis (Principal factor method, Promax rotation)

	Factor1: Waste time on friendship	Factor2: Waste time on entertainment
(2) Chatting with friends online	**.80**	-.06
(4) Playing with friends	**.77**	.05
(8) Phoning friends	**.56**	.05
(7) Reading manga	.04	**.63**
(9) Playing games	-.05	**.61**

The Time Management Scale. The coefficient alphas of the Time Management Scale were .75 for "Time estimation," .63 for "Time utilization," and .70 for "Taking each moment as it comes." The mean scores for each subscale of the Time Management Scale were 2.5 (*SD* = 0.5) for "Time estimation," 2.9 (*SD* = 0.5) for "Time utilization," and 2.3 (*SD* = 0.7) for "Taking each moment as it comes" (Table 3).

Table 3

Mean, standard deviation, and correlation

	M	*SD*	1	2	3	4	5
1 Time estimation	2.5	0.5	—	.62	.46	-.04	-.27
2 Time utilization	2.9	0.5		—	.56	.10	-.26
3 Taking each moment as it comes	2.3	0.7			—	.09	-.27
4 Waste time on friendship	2.4	0.9				—	.32
5 Waste time on entertainment	2.2	1.0					—

The time management and time-wasting behavior. To examine the influence of time management on time-wasting behavior, a regression analysis (stepwise) was conducted using the time-wasting behavior "Waste time on friendship" and "Waste time on entertainment" as objective variables (Y) and the 3 subscales of the Time Management Scale as predictors ("Time estimation" (x_1), "Time utilization" (x_2), and "Taking each moment as it comes" (x_3)). For the initial model Y=x1+x2+x3, model selection was performed using the information criterion BIC. As a result, Y = -x_3 was selected. The model determination coefficient R^2=0.07 was significant (F (1, 161) = 12.2, p = 0, *adjusted* R^2 = 0.06). For the main effect, the partial regression coefficient for "Taking each moment as it comes" is significant (b = -

0.38, t (161) = -3.49, p = 0, β = 0.27). It was found that "Waste time on entertainment" significantly decreased as "Taking each moment as it comes" increased. No model was selected for "Waste time on friendship".

Future career prospects and time management. To examine whether time management behavior trends differ depending on future career prospects, a one-way analysis of variance was conducted on the subscale scores of the Time Management Scale according to future career prospects (Table 4). As a result, a significant difference was found only in "Time estimation" (F (4, 158) = 2.65, p = 0.03, η^2 = 0.06). According to multiple comparisons using Holm's method, the mean of 2.6 for Having ideal image group was significantly greater than the mean of 2.2 for the One industry group (MSe = 0.29, p < .05).

Table 4

Results of analysis of variance

		Having ideal image group	One job group	One industry group	Several industries group	No job or industry group	F
	n	53	50	21	25	14	
1 Time estimation	M	2.6	2.4	2.2	2.4	2.4	2.65, p <.05
	SD	0.5	0.5	0.6	0.5	0.6	Having ideal image group > One industry group
2 Time utilization	M	3.0	2.9	2.9	3.0	2.9	0.32, p >.10
	SD	0.5	0.4	0.5	0.6	0.5	
3 Taking each moment as it comes	M	2.3	2.4	2.2	2.5	2.2	0.65, p >.10
	SD	0.7	0.6	0.4	0.8	0.8	

When they felt they were not using their time well. 183 valid responses were obtained from 163 participants. The free descriptions were classified by free coding. The results were classified into 4 categories: "Failure of self-control (73 responses)," "Demerits due to procrastination (50 responses)," "Failure of schedule management (34 responses)," and "Failure of time allocation (26 responses). "Failure of self-control" included "Lazy spending" and "Prioritizing what I want to do. "Demerits due to procrastination" included "Working just before the deadline" and "Not completing assignments by the deadline." "Failure to manage the schedule" included "Overscheduling" and "Not completing assignments as scheduled." "Failures in time allocation" included "Assignments took longer than estimated" and "Assignments took more time than necessary."

How they switch their mood and behavior. 189 valid responses were obtained from 163 participants. Free descriptions were classified by free coding. The results were categorized into the following 6 types: "Setting up the learning environment (51 responses)," "Thinking about future benefits (38 responses)," "Starting for now (33 responses)," "Refreshment (31 responses)," "Procrastinate (21 responses)," and "Making up my mind to do the assignment (15 responses). " "Setting up the environment" included "Moving to a place where I can concentrate," "Working with friends," and "Playing music." "Thinking about future benefits" included "Imagining future disadvantages" and "Preparing rewards." "Starting for now" included " Starting for now" and "Start with simple assignments." "Refreshment" included "Doing what I want to do first" and "Going to bed first." "Procrastinate" included "Putting off assignments and working on it just before the deadline" and "Waiting until I feel motivated." "Deciding to do the assignment" included "Deciding to do the assignment," "Setting a time and doing what I want to do first."

Discussion

Do University students' time management behavior differ depending on future career prospects? We assume that the reason why "Having an ideal image group" estimates their time is that their "ideal image" includes "an image of being faithful to one's profession," such as working with a vision for the future. Therefore, it is possible that they are taking actions to approach such an ideal image. In this analysis, only "One industry group" showed a significant difference. It is likely that "Several industries group" and "No job or industry group," who do not have a clear idea of their future career, have more opportunities to become aware of their future. Nevertheless, the experience of job hunting may have influenced the time management behavior of junior and senior students. In addition, it is necessary to reconsider how to ask about future career prospects.

Do trends in time management behavior predict time-wasting behavior? The higher the propensity to live for the day, the more time was wasted on entertainment. Since watching videos and browsing and posting on SNS had a ceiling effect and were excluded from the factor analysis, they could not include in the analysis of time-wasting

behavior. However, the free descriptions indicated that the participants often regretted wasting time by watching videos, browsing and posting on SNSs on their smartphones too much, even though they were aware that they had to do their assignments and other tasks. In addition, as a result of such procrastination, they often regretted working on assignments in a hurry just before the due date.
It has been pointed out that university students, who tend to be addicted to the Internet due to smartphone use, do not make progress in their learning due to lack of sleep, and their physical and mental health is adversely affected (Katayama & Mizuno-Matsumoto, 2016). Therefore, this study suggests that educating university students about time management will reduce excessive smartphone use and help them adapt to learning at university.

What switching strategies do university students use? There are two types of strategies for switching when one is unmotivated: physical and psychological. Physical strategies include preparing the learning environment and getting to a desk and starting an assignment. Psychological switching strategies included thinking, "I will be free when I finish this," "What if I fail the credit?"
On the other hand, there were also a few students who dared to procrastinate without switching. It is possible that the students consider procrastination as a "strategy." However, according to the free description of the students' failure in using time, it can be seen that they failed in self-control. They rush to complete assignments just before the deadline, but their goal is to complete the assignment. There is also the possibility of defensive procrastination as a form of self-handicapping. Therefore, it is difficult to say that this behavior is adaptive.

Conclusion

It is difficult to conclude from this study that future career prospects have a significant impact on time management. However, it does provide some suggestions that may contribute to improving the way university students use their time. Specifically, students who want to use their time better can be informed of how others are doing. Future work is to clarify how university students' time management strategies affect their actual performance, such as academic achievement.

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The Impact of Avatars Supporting Self-Regulation on Learning Experience in Metaverse

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Abstract This study examines the impact of self-regulated learning (SRL) support strategies and task types on college students' learning experiences in a metaverse learning environment (MLE). Sixty-six college students participated in a narrative-based metaverse game designed to teach basic economic knowledge. Participants were assigned to groups receiving SRL support via avatars or prompts. We collected learners' subjective perception and facial expression data. Results showed higher achievement with avatar-based SRL support. Task types affected mental effort, learning flow, and emotional perception differently. The study highlights the effectiveness of avatars in enhancing learning achievement and the importance of considering task types in MLE design, utilizing multimodal analysis for comprehensive insights.

Keywords: Metaverse, Self-regulation, Avatar, Prompt, Multimodal analysis

Introduction

The advancement of technology has introduced innovative methods for educational delivery, one of which is the metaverse learning environment (MLE). Metaverse is a term that means a virtual space that transcends the real world, and it refers to a virtual world where one can interact with others based on an avatar (Tilak et al., 2020). Users can freely move around the metaverse space and have joint experiences with others while interacting with other people's avatars through their avatars, which are their representatives in the metaverse (Bieńkiewicz et. al., 2021; Gursoy et al., 2022). Interacting with others in the metaverse allows users to perceive social presence, a sense of feeling as if they are actually with them (Sinatra et al., 2021). Additionally, in the process of freely moving through virtual space by manipulating the user's avatar, a sense of copresence, which is the sense of being in the same space as others, can be perceived (Kim et al., 2019). The senses such as social presence or coexistence perceived by users in the virtual world function to promote users' sense of immersion (López-Belmonte et al., 2022), so users can achieve a high level of satisfaction through avatar interaction and spatial movement in the metaverse. This study aims to explore college students' learning experiences by integrating self-regulated learning (SRL) support strategies within MLEs. Specifically, it investigates the effectiveness of narrative-based metaverse game learning for delivering basic economic knowledge to college students.

Research Design & Methods

A narrative-based metaverse game was designed to facilitate SRL among college students. In this study, we designed learning on financial investment for college students. Learning content was developed into three types of tasks according to the level of cognitive complexity suggested by Bloom's taxonomy and presented so that learners could learn on their own in the MLE(Boeren & Iguez Berrozp, 2022). The study involved 66 participants who were randomly assigned to either an avatar provision group or a prompt provision group. In the avatar provision group, SRL strategies were delivered by a peer avatar, while in the prompt provision group, SRL strategies were provided through on-screen pop-up messages. Figure 1 left shows the scene of peer avatar provision, and Figure 1 right shows provided by the prompt. Learners completed both knowledge comprehension and problem-solving tasks, with mental effort and learning flow questionnaires measuring subjective experiences. Objective experiences were assessed using eye-tracking and facial expression analysis, alongside an achievement evaluation. Data were quantified and statistically analyzed.

Figure 1

Supporting self-regulated learning strategies methods (L: Avatar, R: Prompt)

Results

The analysis revealed that learners receiving SRL support via avatars scored higher in achievement tests compared to those receiving support through prompts. However, other measured variables, such as mental effort and learning flow, did not significantly differ between the two groups. Task type influenced learners' experiences: problem-solving tasks required more mental effort and yielded higher learning immersion, whereas knowledge comprehension tasks resulted in higher positive emotion perception and lower cognitive load.

Discussion & Conclusion

The findings suggest that using avatars for SRL support in MLEs can enhance learning achievement. The differential impact of task types highlights the need to consider the nature of the learning task when designing MLEs. The study underscores the importance of multimodal analysis for a comprehensive understanding of learners' subjective and objective experiences in MLEs. This study demonstrates that social interaction through avatars in MLEs is effective for enhancing learners' SRL and achievement. The variation in experiences based on task types suggests the necessity of tailored learning designs in metaverse environments. The use of multimodal analysis provides valuable insights into the diverse aspects of learning experiences, contributing significantly to the design and implementation of MLEs.

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Exploring Features for Enhancing Metacognition During Note Revision and Review

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Not many studies have examined how to support note revision and review in note-taking functions. This study aimed to evaluate whether the visualization of others' note-taking situations (notes, important parts, and unclear parts) enhances self-regulated learning processes during the revision and review of their notes. We collected learners' think-aloud and note-taking log data during note revision and review and assessed them using a coding scheme. From the 21 participants' utterances mentioning visualization, we classified 193 coded events. The coding results revealed that learners engaged in self-regulated learning during note revision and review, triggered by the visualization of others' note-taking. Specifically, learners referred to others' unclear parts to enhance metacognition and cognition.

Keywords: Note-Taking, Note Revision, Metacognition, Self-Regulated Learning, Visualization

Introduction

Self-Regulated Learning

Recently, there has been an increasing need to promote self-regulated learning (SRL) to enable independent learner engagement. Learners proficient in SRL can effectively cycle through forethought, performance, and reflection (Usher & Schunk, 2018). Bannert et al. (2014) also considered the temporal nature of SRL processes and developed a coding scheme based on metacognition, cognition, and motivation. Van Der Graaf et al. (2021) evaluated SRL processes during writing using learning logs and think-aloud data with this scheme. Furthermore, Nilson (2013) proposed that learners can promote self-regulated learning (SRL), a skill increasingly emphasized in recent years, through activities improving note-taking.

Note-Taking Functions

Note-taking is one of the most common learning behaviors. Note taking has three functions: the encoding function of taking notes in class； the note revision function of adding new information to one's notes; and storage function of reviewing one's notes (Luo et al., 2016). Many studies of note-taking have focused on methods to support in-class note-taking. For example, distributing materials can facilitate learning, although it also reveals challenges such as the inability of learners to engage in high cognitive processes like elaboration and organization (Lannone & Miller, 2019).

Luo et al. (2016) argue that through the process of note revision, learners can create organized summaries, enabling more effective reviews. However, several challenges are observed in supporting note revision. Flanigan and Titsworth (2020) contend that in handwritten notes, learners can only note about 40% of the class content, and furthermore, recalling information not noted to revise the notes can be significantly challenging. Flanigan et al. (2023) further emphasized the importance of evaluating the note revision process based on learners' cognitive processes. Therefore,

it is essential to determine what is effective in supporting note revision and to evaluate this from the perspectives of cognitive and metacognitive processes.

Note-Taking Support System

In recent years, the widespread use of ICT has spurred active research in the field of learning analytics using educational data. We have been developing a note-taking web application called Nudge for Note-Taking Assist System (NoTAS), which utilizes tablet devices to support in-class note-taking (Kondo et al., 2023). Using collected notes and highlight logs, NoTAS visualizes the positions where other learners have written on their materials, thus facilitating support among learners. The information visualized includes notes, important highlights, and unclear highlights. Kondo et al. (2023) indicated that NoTAS visualization increased learners' motivation for note-taking and their' sense of classroom community and social presence. However, the effectiveness of visualizing others' abstract note-taking situations for note revision and review remains unclear.

Thus, this study aimed to evaluate whether the visualization of NoTAS enhances SRL processes during revision and review of their notes. We collected learners' think-aloud and note-taking log data during note revision and review and assessed them using a SRL coding scheme.

Methods

Procedure

We recruited undergraduate and graduate students enrolled in a science university in Japan. The experiment was conducted in October 2023 with 21 participants, 14 males and seven females, averaging 21.5 years old. The participants signed an informed consent form and then practiced the NoTAS system using an iPad 6th and a tablet pen. They then took a 30-minute class using NoTAS. Following that, they spent 15 minutes revising and reviewing their notes using NoTAS while engaging in thinking aloud. To ensure that the visualization and that we could properly evaluated NoTAS, we instructed our collaborators to highlights and write notes specific sections as set by the first author, making the relevant parts stand out. Finally, participants completed a test and a post-questionnaire.

Coding Think-Aloud Data

The participants' utterances during note revision and review were recorded and coded. We used a coding scheme to classify these utterances as SRL processes. This scheme is based on developed and used coding schemes by Bannert et al. (2014) and Van Der Graaf et al. (2021). The main categories include metacognition (MC), low cognition (LC), high cognition (HC), and motivation (MOT). Additionally, to classify mentions od others' note-taking visualizations, specific to our study, we added subcategories. Table 1 provides an overview of the subcategories. Note that the subcategories in bold were specifically added for this study. Using these categories, we evaluated the impact of NoTAS visualizations on SRL processes by classifying the types of visualizations referenced.

Table 1

Overview of the subcategories

Coding category		Description
Metacognition (MC)	Planning	Planning of proceeding
	Judgments of relevance	Judgments of relevance of information
	Monitoring	Monitoring one's own learning
	Peer monitoring	Observing and trying to understand others' learning behavior
Low cognition (LC)	First time reading	Reading the text out loud and superficial describing of figures
	Rereading	Rereading of text or figures
	Switching visualization	Turn the visualization function on or off
	Swipe pages	Navigate pages
	Highlighting important parts	Highlighting important parts
	Highlighting unclear parts	Highlighting unclear parts
	Noticing visualization	Noticing Changes in Visualization from Others' Note-Taking
High cognition (HC)	Elaboration	Connecting content-related comments and concepts; reasoning and association.
	Organization	Organizing of content by creating an overview
Motivation (MOT)	Motivation	Positive, negative, neutral motivational utterances in respect to task, person, situation

Results and Discussion

We observed utterances from 13 participants that referred to the visualizations. Descriptive statistics for the coded events corresponding to each type of visualization are shown in Table 2. The number of utterances for each category per type of visualization is as follows:

- Notes: MC= 16, LC = 29, HC = 5, MOT = 1
- Important highlights: MC = 8, LC = 22, HC = 0, MOT = 1
- Unclear highlights: MC = 26, LC = 60, HC = 25, MOT = 1

Table 2

Coding scheme for categorizing learners' think-aloud data as SRL processes

Coding category		Others' notes (n = 50)			Others' important highlights (n = 31)			Others' unclear highlights (n = 112)		
		n	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
Metacognition	Planning	1	0.05	0.21	0	0.00	0.00	4	0.19	0.50
	Judgments of relevance	1	0.05	0.21	7	0.33	1.49	1	0.05	0.21
	Monitoring	8	0.38	0.72	0	0.00	0.00	14	0.67	1.43
	Peer monitoring	6	0.29	0.63	1	0.05	0.21	7	0.33	1.08
Low cognition	First time reading	2	0.10	0.29	5	0.24	1.06	18	0.86	1.70
	Rereading	0	0.00	0.00	1	0.05	0.21	5	0.24	0.53
	Switching visualization	5	0.24	0.61	1	0.05	0.21	0	0.00	0.00
	Swipe pages	0	0.00	0.00	0	0.00	0.00	7	0.33	0.64
	Highlighting important parts	1	0.05	0.21	5	0.24	1.06	1	0.05	0.21
	Highlighting unclear parts	1	0.05	0.21	0	0.00	0.00	5	0.24	0.61
	Noticing visualization	20	0.95	1.81	10	0.48	1.71	24	1.14	1.64
High cognition	Elaboration	5	0.24	0.87	0	0.00	0.00	24	1.14	2.29
	Organization	0	0.00	0.00	0	0.00	0.00	1	0.05	0.21
Motivation	Motivation	1	0.05	0.21	1	0.05	0.21	1	0.05	0.21

Visualization of Others' Notes

From coding results, when participants noticed the visualization of others' notes, they became concerned about what others had written, contemplated what they themselves should write, and were encouraged to generate concrete examples. As participants could not see specific descriptions using NoTAS, metacognitive behavior may have been activated. Below, the SRL process sequence observed in a participant after noticing the visualization is presented.

> I wonder what everyone wrote here. (**Noticing visualization**)
> Learning through narrative and familiar stories with introductions, developments, twists, and conclusions. (**First time reading**)
> Ah, I see, perhaps they wrote something about motivation. (**Peer monitoring**)
> "Write 'motivation.'" (**Elaboration**)

This participant, after noticing what others were writing, read the text nearby. He inferred what others had written from the class material and wrote his own notes accordingly. However, as these visualizations are abstract, despite noticing them, some participants did not know how to effectively integrate this into their SRL process.

Visualization of Others' Important Highlights

Only three participants mentioned noticing the visualization of others' important parts. During note revision and review, they engaged in learning activities such as reading the text based on the visualizations, assessing its importance, and highlighting accordingly.

A potential reason why many participants could not effectively utilize these visualizations might be that they were occurring all over the material, which possibly made it difficult for them to feel genuinely supported by them. For example, although several participants did not explicitly mention that they referred to the visualizations, they often began their reviews with the text where important parts were visible. This suggests that they might have been subconsciously influenced by these visualizations, thereby regulating their learning accordingly.

Visualization of Others' Unclear Highlights

The coding results revealed that participants extensively utilized the visualization of others' unclear parts during note revision and review. Especially, when aware of such visualizations, they monitored whether they understood the section, read texts, moved to pages, and contemplated concrete examples, triggering various learning behaviors. Below, the SRL process sequence observed in a participant after noticing the visualization is presented.

> Unclear markers are placed on the "andragogical perspective," (**Noticing visualization**)
> but it is explained right below. (**Elaboration**)
> I drew the important highlight myself (in class). (**Monitoring**)
> I wonder if everyone was a bit unsure about the meaning of andragogy. (**Peer monitoring**)
> The material states it is a "theory to facilitate learning by leveraging adult characteristics," (**First time reading**, **Elaboration**)
> but perhaps some people did not quite understand that part. (**Peer monitoring**)

When this participant noticed the visualization, he checked the texts that could possibly explain it. He referenced the markers he had drawn during the class to confirm the information, reflecting on his in-class actions. Through these metacognitive activities, he was trying to interpret for himself why others had not understood the content. Therefore, it is suggested that visualizations of others' unclear parts most effectively promote the SRL processes during note revision and review.

Conclusion

In conclusion, we found that learners engaged in self-regulated learning during note revision and review, triggered by the visualization of others' note-taking situations. Specifically, learners referred to others' unclear parts to enhance metacognition (e.g., monitoring) and cognition such as reading and elaboration, thereby regulating their learning. However, because visualization of others' notes and important parts are often visible almost everywhere in the material, it might be challenging for learners to explicitly mention which visualizations they referred to. Nonetheless, despite the small numbers of codes, these visualizations also were suggested to support SRL.

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Integrating 21st century skills development with programming activities by video-game pedagogy

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The acquisition of the 4C skills (critical thinking, creativity, collaboration, and communication) is a necessity for every citizen of the 21st century. Under specific pedagogical conditions, these skills can be taught through programming. One of the keys to the success of such teaching lies in the pre-service teachers who will become the pillars of the education system, and the professional commitment of a pre-service teacher depends on his or her perceptions. Thus, this study seeks to determine the perceptions of pre-service teachers concerning the teaching of programming combining problem-solving and the use of video games to foster the development of 21st century skills.

Keywords: 21 century skills, Pre-service Teacher, Programming, Sandbox Game, Video game

Introduction

Pre-service teachers represent the future of the educational system. It is they who will play an important role in the acquisition of educational skills in the 21st century that are recognized as key to success in a technology-driven global society (Lapek, 2018). These include the 4C skills (Critical Thinking, Creativity, Collaboration, and Communication) and programming competence. Under the right educational conditions, the implementation of programming education from preschool to secondary school can positively impact the 4C competencies (Hu, 2023). To ensure that pre-service teachers are inclined to teach programming through a specific pedagogical strategy and thus participate in the development of 21st century skills, we need to ensure that their perceptions and motivations are optimal.

According to Romero and Vallerand (2016), the implementation of activities based on co-creation with technologies enables the development of 21st century skills, including critical thinking, communication, collaboration, and creativity. In this context, teaching programming based on co-creative problems requires a creative and reflective (critical thinking) approach to devising new and original solutions to problems. Lai and Wong (2021) confirmed that integrating collaboration into programming problem solving facilitates the acquisition of collaborative and communication skills. Liu et al. (2016) state that peer review activities foster critical thinking.

Several technological tools are available to implement co-creative problem-solving activities (Romero and Valleranc, 2016). Chang, Chung, and Chang (2020) confirmed the combination of problem-solving learning with the use of video games to overcome the complexity of programming. The use of video games promotes learning-by-doing, learning through trial and error, motivation, social openness, and the concretization of abstract concepts (Annart, 2019). However, the wide variety of tools available can make it difficult for educators to choose the right one (Silva and Silviera, 2020). One solution could be to consider a category of games that imposes no rules or limits and emphasizes creativity (Wingrave et al., 2012). This category of games is called "sandbox" and includes the game most widely played globally: Minecraft. Multiple studies have already demonstrated Minecraft's effectiveness in motivating young people to learn programming (Sun and Li, 2019), improving computational thinking concepts (Kurtay and Sober, 2022), and reinforcing 21st century skills such as creativity and critical thinking (Sun and Li, 2019).

Thus, this study analyzes pre-service teachers' perceptions of the impact of instructional programming that combines video games and creative problem-solving on the development of 21st century skills.

Research Design & Methods

Participants
The study involved 28 students in an education university: 12 pre-service teachers in primary school, 9 pre-service teachers applying to teach in junior high school, 3 pre-service teachers in high school, and 4 pre-service teachers who were undecided. Among the pre-service teachers, none engaged in the daily gameplay of sandbox video games. Of the pre-service teachers, 5 played these games regularly (several times a month), 5 had limited experience, 6 had past

experience, and 12 pre-service teachers have never played them. Regarding programming experience, only six pre-service teachers reported having studied programming languages such as Java, Shell, or JavaScript.

Experimental Procedure

The survey in this study was structured as a pre- and post-test. Except for the demographic questions in the pre-questionnaire, the same questionnaires were distributed at the beginning of the first session and end of the fourth session.

The experiment was conducting over four weeks in 90-minutes sessions. The first activity was an introductory session to the game Minecraft, and the next three were co-creative problem-solving activities in Minecraft. During these three activities, pre-service teachers conducted three creative problem-solving activities. In Minecraft, after building or destroying something, it is not possible to go back by clicking "ctrl + z." Thus, for each activity, the teacher created and provided different codes, allowing the construction zones to be reset. In addition, during all activities, the pre-service teachers had to build their individual constructions but were free to communicate and collaborate with their class neighbors.

Activities description

The first activity was an introductory session to the game Minecraft. The first 30 min was allocated for the pre-test, then during the next 60-minute session, the teachers followed Microsoft's introductory coding tutorials titled "Fundamentals of Programming 1."

The second activity involved the creation of coral-shaped structures to address the causes and effects of coral disappearance. The objective of the activity was established at the outset, and an example of the result was presented in Minecraft by the instructor. Before interacting with the video game, pre-service teachers were required to draw the shape of their structure on paper and write a construction algorithm.

The third activity consisted of setting up several aquariums in a previously constructed building to address the themes of living conditions and conservation of marine animals. The objective of the activity and the sub-steps necessary to achieve it were presented at the beginning. Before interacting with the video game, pre-service teachers were required to plan the layout of the aquariums on paper and write a construction algorithm. For this activity, pre-service teachers had access to the code for two versions of aquariums, allowing them to modify or draw inspiration from the code to create their own aquariums.

The fourth activity involved building several houses and respecting the wishes of the new town residents. First, the objectives and constraints of the activity were outlined at the start. Unlike the first two activities, which involved block-based programming, this activity required pre-service teachers to modify a Python code while accessing its block-based version. Before constructing each house, pre-service teachers were required to consider the modifications needed to the initial code on paper. At the end of the session, 10 min were dedicated to the posttest.

Figure 1

Illustrations of activities 2, 3, and 4

Measuring Tools

The questionnaire was based on a model for evaluating the potential of a game to develop the 4Cs (Thornhill-Miller et al., 2023) and was modified to analyze the perception of the impact of video game use in programming instruction on four 21st century skills (critical thinking, creativity, communication, and collaboration). In this model, each C is subdivided into five components. Initially, the grid works as follows: For each of the five components of each C, we evaluate the game on a list of sub-components using two yes/no scales, one for whether it is "possible" for that sub-component to manifest and one for whether that sub-component is "required for success" in the game. For the questionnaire in this study, we used the definition of each sub-component to construct a question in the format "*In my opinion, teaching programming with a video game enables ...,"* which was scored on a four-point Likert scale. Thus, the questionnaire comprised five questions related to each C.

Results

The analysis focuses on results collected before and after three problem-solving activities with programming on in the Minecraft video game. Multiple Kruskal-Wallis tests determined that there were no significant differences between student groups (based on faculty) in the pre-test results. Consequently, for subsequent analyses, the pre-service teachers will be considered a single unified group. The analysis of the results will be organized around the research question that we aim to address.

What is the perception of the pre-service teachers of the impact of teaching programming with a video game on 4C skills?

Comparing the pre-test averages with those of the post-test, two findings emerged: Results increased for the 4Cs and, except for creativity, for which the teachers outperformed, the averages stabilized. To confirm the significance of the increase in the means of each variable, a Wilcoxon test was performed, confirming the significance of the increase in three of the 4Cs. In other words, all three activities improved pre-service teachers' perceptions of the impact of teaching programming with a video game on 21st century skills for creativity ($z = 3.26, p = .00, r = .62$), critical thinking ($z = 2.55, p < .05, r = .48$), and communication ($z = 2.31, p < .05, r = 44$). This means that pre-service teachers feel that using video games to teach programming can lead to the development of 21st century skills.

Table 1

Results of 4C Model evolutions before and after activities

Perception that teaching programming with a video game can have an impact on 4C skills	*N*	Pre test Means	Post test Means	*z*	*p*	*r*
Creativity	28	15.86	17.61	3.26	0.00	.62
Critical Thinking	28	14.36	16.07	2.55	0.01	.48
Collaboration	28	15.64	16.57	1.46	0.15	.28
Communication	28	14.89	16.43	2.31	0.02	.44

Discussion

According to the results, pre-service teachers perceived the impact of teaching programming using video games on the development of creativity, critical thinking, and communication. The pre-service teachers' perceptions are in line with studies confirming that teaching programming with Minecraft helps develop these three skills (Aktaş Kumral and Çam, 2023; Sun and Li, 2019). It was only for the skill of Collaboration that the pre-service teachers do not seem to have been convinced. However, during the three creative problem-solving activities, pre-service teachers were free to communicate and collaborate with their neighbors, and the Minecraft video game is a tool that is conducive to the development of collaborative skills between users (Andersen and Rustad, 2022). However, as Lai and Wong (2021) have noted, the collaboration component must be included in the problem-solving process when teaching programming. Romero et al. (2016) also emphasized the collaborative aspect of co-creative problem solving to develop 21st century skills such as collaboration. Thus, allowing too much freedom for communication and collaboration does not seem sufficient. It is necessary to include moments of collaboration during creative problem-solving activities in the learning process.

Conclusion

With rapid advances in technology in recent years, the teaching of programming has become a priority and has been included in the educational curricula of many countries (European Commission, 2022). Individual teaching is easily perceived as difficult and meaningless by learners. Thus, it is necessary to include the teaching of programming in co-creative problem-solving activities with technologies to include the development of so-called 21st century skills. Four skills have been highlighted: creativity, critical thinking, communication, and collaboration, known as the 4Cs.

Among all the tools available for teaching programming, video games have proven to be effective in terms of learning and motivation. In recent years, as many games have been developed, it has become difficult for teachers to choose the right game for their specific teaching needs. This is how Minecraft, a sandbox game that that lets you choose your own objectives and teaching strategies adapted to any specific educational context, came to the attention of teachers and researchers. The game has proven its ability to develop disciplinary skills such as programming and cross-disciplinary skills (21st century skills) in a wide range of contexts, yet little research has focused on the acquisition of 21st century skills during programming activities in Minecraft.

Thus, this study aims to propose a pedagogical strategy for teaching programming with Minecraft to develop the four cores 21st century skills. This strategy consists of co-creative problem-solving programming activities with Minecraft. As pre-service teachers are the future of teaching, this study analyzes their perception of the impact of this strategy on the 4Cs. Following the implementation of the three activities, pre-service teachers' opinions were strengthened for all skills except collaboration. This may be because although pre-service teachers were free to collaborate with each other, no specific collaboration time was set aside during the activities. Thus, future studies should include collaboration moments in problem-solving co-creativity strategies.

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Multimodal Evidences for Human-Computer Interaction in the Metaverse-based Serious Game

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Abstract: With the advent of AI era, programming competence is regarded as one of core literacies. To motivate students to do coding or programming, serious games for programming education are gradually developed. However, most serious games for programming education were developed based on 2D environments. In the metaverse era, 3D environments are required to construct an immersive and enjoyable serious game for gamified programming learning. This study utilized the open-source version of the SecondLife Metaverse platform, i.e., OpenSimulator, to develop a serious game for Python programming education, whose gamification elements consist of goals, rules, challenges and tasks, feedback, competition and cooperation, and storytelling context. To investigate the usability and learning effectiveness of the metaverse-based serious game for programming education, this study selected 30 undergraduates as participants and divided them into 15 dyads to collaboratively play the serious game. During their playing, this study used Emotive EEG device, screen shooting, facial expression capturing , flow experience questionnaire, interview, and etc. to access the multimodal data. Using the activity theory as the multimodal data analyzing framework, this study found the tensions between players and the game to recognize the usability of the serious game.

Keywords: Multimodal Evidences, Human-Computer Interaction, Metaverse, Serious game, Activity Theory

Introduction

In the conventional learning paradigm, most students usually acquire programming skills from teachers' direct instruction or after-class self-study, which might be tedious and difficult for students. In order to make learning entertained, educational serious games for programming are springing up. As a well-known educational serious game, CodeCombat also has its own weakness, such as low flexibility, insufficient immersion, boring content design, unclear learning goals and indefinite game rules. However, with the advent of the Metaverse era, it is possible to improve the flexibility and immersion for players by merging the metaverse environment with educational serious game elements. Hence, this study utilized the OpenSimulator as the metaverse environment to develop a Python programming game involving bubble sort, selection sort, insertion sort and quick sort, which covers gamification elements such as learning goals, game rules, challenges and tasks, feedback, competition and cooperation, storytelling contexts and so on. To improve the usability of a serious game, this study firstly tested the user experience by analyzing the multimodal data consisting of EEG, clickstream, facial expression, flow experience questionnaire and interview. According to Zheng et al. (2020), this study used the activity theory as the qualitatively analyzing framework to recognize the tensions between subject (players), tools (game) and object (learning contents) during human-computer interactions. In light of tensions during human-computer interactions, this study will refine the metaverse-based serious game. This study intended to explore such following questions:
RQ1: What was the user experience when students collaboratively played the serious game?
RQ2: Could the serious game satisfy the flow experience of users?

Research Design & Methods

Development of the Metaverse-based Serious Game

The metaverse-based serious game was developed with reference to the following game playing flowchart as Figure 1. In this serious game, players assume as a computer engineer to participate in the programming test activity. They are required to challenge four levels, respectively bubble sort, selection sort, insertion sort, and quick sort. Each level matches one room which can provide learning resources and testing materials for players. After players finish experiencing four levels of challenges, they are required to enter into the assessment room to accomplish the test. If they successfully pass the four levels, players successfully finish the serious game. This serious game used the OpenSimulator-supported LSL script to construct the interactive and visualized demonstration environment for the sorting algorithms, where players can operate the buttons on the console to compare and move the sorting elements. In the metaverse environment, all procedures for processing sorting algorithm can be simulated, where players can get feedback from the screen on the meanings of operation steps and its accuracy, helpful for players to master all kinds of sorting algorithms.

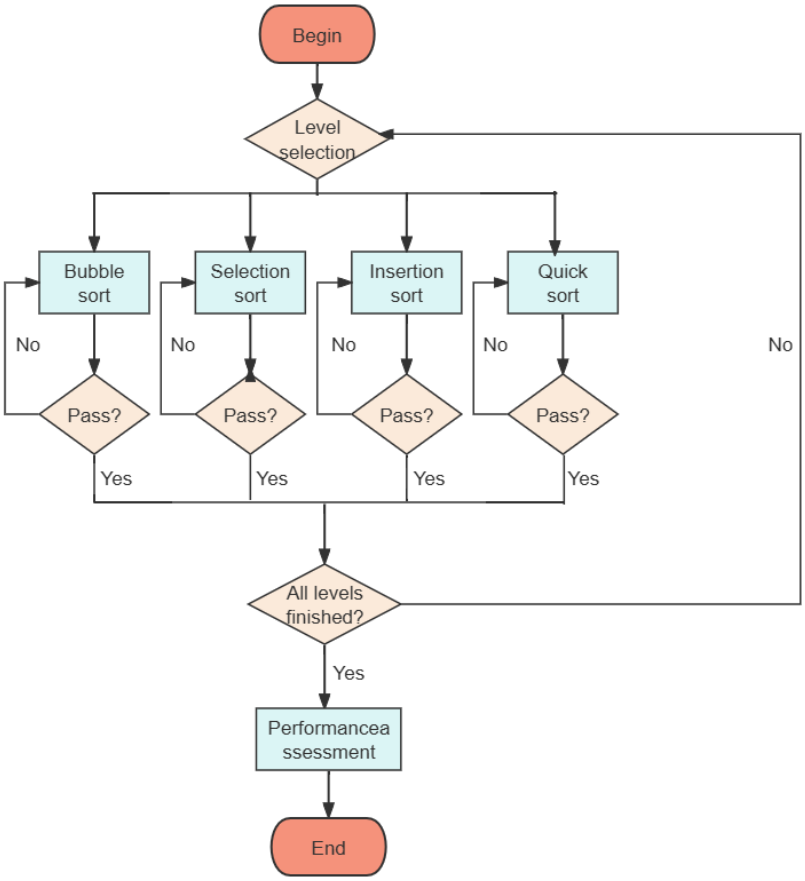

Figure 1. Game playing flowchart

The Metaverse-based Serious Game Environments

In this study, the metaverse-based serious game provides such a following storytelling context. In the future world, human beings never stop exploring the second home. In the year 2123 AD, human beings find the second livable planet about 50 billion light-years away from the Earth. Herein, mankind decides to select a portion of talents from around the world to go first and carry out preliminary construction on the planet. You and your partner have signed up for the program and are scheduled to undergo an assessment on algorithms and computational thinking. Can you pass the assessment smoothly and get the ticket to board the spaceship?

Step 1: Enter into the game

The player inputs ID and password to log into the game. In the game, the player's birth place is the basement gate in a red rectangle as shown in Figure 2. The player is guided by a robot to enter into the basement and looks for the

assessment place.

Figure 2. Game beginning scenario

Step 2: Select the game level

The player enters into the corresponding game level room and interacts with the robot guide. The robot guide informs the player of the game's basic background and rules, and then guides the player how to do the next step. The player controls the role with the guidance of the robot to enter into the transfer device corresponding to the game level. See Figure 3.

Figure 3. The game level selection scenario

Step 3: Experience the game

The serious game has four levels of algorithms, respectively bubble sort , selection sort, insertion sort, and quick sort. Their playing rules are almost consistent. Take the bubble sort game for example as shown in Figure 4. The player comes into the corresponding game level room by the transfer device in the game level selection place, where the player firstly interacts with the room's robot guide who informs the player of this game level's related matters. In the bubble sort game room, the scenario consists of the robot guide, interactive screen, console and fuels to be sorted. Specifically, the player needs to use the current sorting algorithm to operate the buttons on the console for comparing and exchanging the unsorted fuels above the screen so that the fuels can be sorted in some sequence in the end.

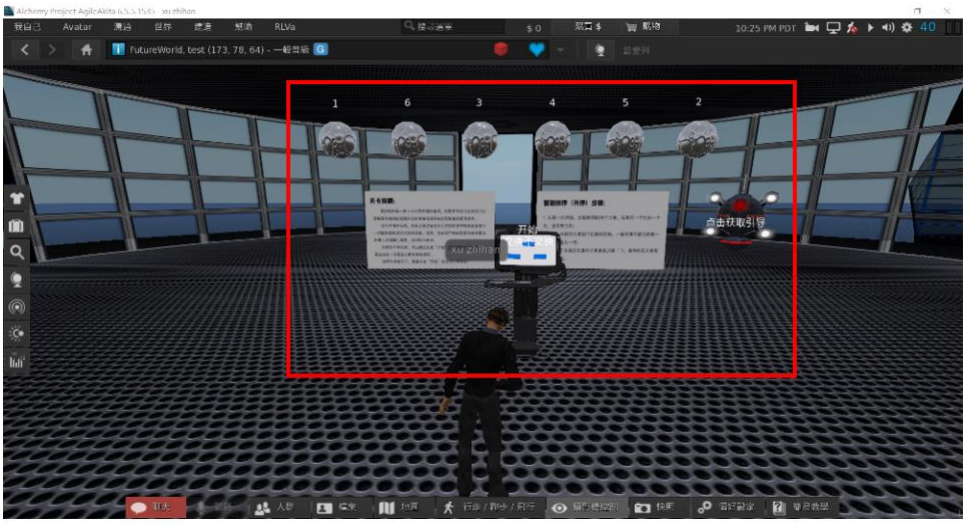

Figure 4. The bubble sort game beginning scenario

Step 4: Assess the performance

After the player finishes experiencing the four levels of games, he comes into the performance assessment place by the transfer device and interacts with the assessment robot. The robot will evaluate the player's overall performance with reference to each level's game playing performance. See Figure 5.

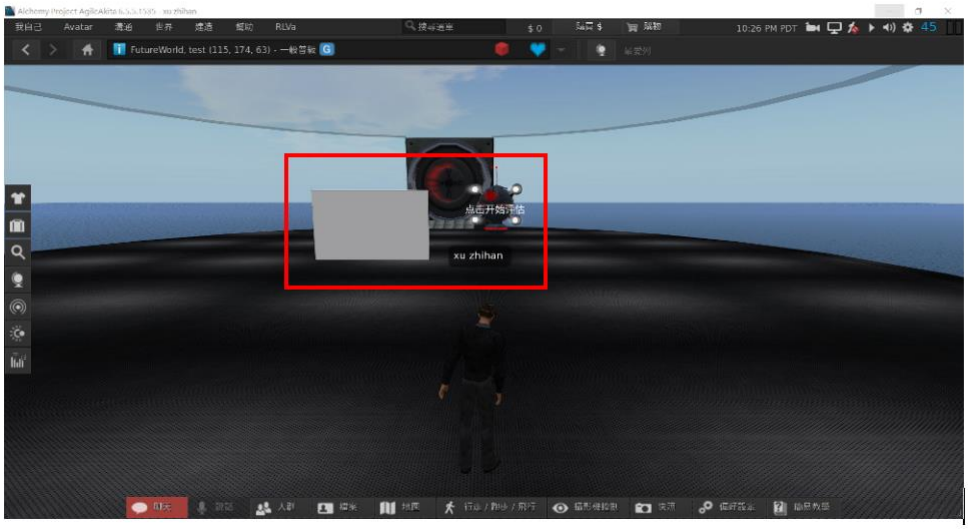

Figure 5. The performance assessment scenario

Step 5: End the game

If the player performs well, he smoothly passes the assessment, and the entrance of the passage will automatically open as shown in Figure 6. The player can enter into the spaceship through the passage, which means that the game is over.

Differences in Morality and Learning Performance Facilitated by Virtual Reality Technology

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Abstract. This study examined the differences in social skills and learning performance facilitated by virtual reality (VR) cooperative or competitive learning through learning materials utilizing VR technology. Participants entered a laboratory set up in a virtual space in pairs, consisting of Classroom A, which was arranged in a manner ready for class, and Classroom B, which was messy and unorganized. Each pair experienced (1) VR cooperative learning and (2) VR competitive learning in a random order and were then tasked with rearranging Classroom B in a manner similar to Classroom A. Participants answered questions on group cohesion, the Interpersonal Reactivity Index, and critical thinking attitude pre and post-experiment. Results showed that when participants experienced VR cooperative learning after VR competitive learning, the time required to clean and arrange the classroom decreased. This finding suggests that the sequence of learning activities affects learning outcomes and effectiveness.

Keywords: Competitive Learning, Cooperative Learning, Moral Education, Pair, Virtual Reality

Introduction

According to the Organisation for Economic Co-operation and Development (2015), non-cognitive abilities have a significant impact on the human lifespan, and these are nurtured by moral education. Therefore, the state of moral education in each country contributes to individuals living happy lives, which is an important theme to examine. In Japan, moral education classes have to date emphasized the "reading of feelings," with text reading as the main teaching method. In fact, compared to other subjects, moral education classes have seen little variation in teaching methods or materials development, and information and communications technology (ICT) is not often utilized. However, moral education in Japan was made a mandatory special subject in 2018. Furthermore, since tablets have been distributed to each child at school in recent years (under the Global and Innovation Gateway for All school concept), it is now possible to conduct classes using ICT, in particular, virtual reality (VR) technology.

The use of VR technology in educational settings has been widely established to be enjoyable in itself, thus enhancing learning motivation (intrinsic motivation) (Bailenson, 2017). In addition, it has been argued that VR experiences are more effective in promoting empathy than real-life experiences (Cotton, 2021) and that learning through simulations, simulated experiences, and role-playing can provide a different perspective from conventional learning methods (Fujisawa, 2023a). As related to moral education, several fundamental studies have shown that embodying an avatar in a virtual space facilitates the acquisition of another person's perspective (e.g., Herrera et al., 2018; van Loon et al., 2018). Additionally, in examining moral dilemma discussion (MDD), one of the popular methods of teaching moral education classes, it was found that experiencing MDD in a virtual space decreases heart rate (predicting non-utilitarian judgments) (Francis et al., 2016) and increases other-perspective-taking (Fujisawa, 2023b). As for role-playing, another popular method of teaching moral education classes, fantasy, which is one subscale of the Interpersonal Reactivity Index (IRI) (Davis, 1983), is enhanced when participants embody avatars and play roles in a virtual space (Fujimoto et al., 2023).

In addition to moral education, VR technology is also suitable for collaborative learning (Ademola, 2023). VR-based cooperative games have been shown to improve social skills in children with high-functioning autism aged 10–14 years and in native English-speaking children aged 7–11 years (Craig et al., 2016; Ke & Moon, 2018). Fujisawa (2024), who examined cooperative learning using a giant VR maze with university student pairs, found that group cohesion increased after cooperative learning, whereas perspective-taking, empathic concern, and objectivity increased depending on the condition, and there was no difference between the VR/head-mounted display and VR/desktop conditions in terms of learning completion (being able to escape the maze).

Therefore, this study developed VR collaborative learning materials focusing on moral content (cleaning up a classroom), which enabled cooperative and competitive learning, and empirically examined their educational effects regarding morality and learning performance using a VR/desktop.

Research Design & Methods

Participants and procedure

The study participants were 24 female undergraduate students recruited through an announcement. Prior to the experiment, a virtual space "ayalab Ready for a lesson!" was developed, in which students could clean up the virtual classroom. There were two classrooms in the virtual space: Classroom A, which contained all the necessary classroom equipment (e.g., ball, cleaning tools, blackboard eraser, attendance book, projector) and was in an organized condition (e.g., all curtains open, cleaning locker door closed); Classroom B was 90° away from Classroom A, and its equipment was not arranged perfectly, some curtains were closed, and cleaning locker doors were still open. The participants were asked to arrange Classroom B so it was ready for class to begin, referring to Classroom A. In the experiment, the participating pairs were randomly assigned to either a cooperative/competitive learning condition (CO/COM condition), in which VR cooperative learning occurred first, followed by VR competitive learning, or a competitive/cooperative learning condition (COM/CO condition), in which VR competitive learning occurred first, followed by VR cooperative learning. In both conditions, the participants took a pretest and were then given a tablet individually to confirm how to operate it. All participants were asked to use an elementary-school-boy avatar. Trial 1 was then conducted as a cooperative clean-up in pairs under the CO/COM condition, and a clean-up competition with a pair under the COM/CO condition. After self-reporting the completion of cleaning in Trial 1, the participants responded to the post-Trial 1 questionnaire. In Trial 2, the participants competed to clean up with a pair in the CO/COM condition and to clean up cooperatively as a pair in the COM/CO condition. After self-reporting on the completion of Trial 2, participants completed the post-Trial 2 questionnaire.

Measurements

The IRI (Davis, 1983): This scale was used to assess multidimensional empathy and consists of 28 items with four subscales: perspective-taking, fantasy, empathic concern, and distress. Items are rated on a 5-point Likert scale ranging from "does not describe me well" to "describes me very well." Higher total scale scores indicate higher levels of empathy, and higher subscale scores indicate a higher tendency in that dimension.
Critical Thinking Attitude Scale (Kusumi & Hirayama, 2013): This scale was used to measure critical thinking attitude; it consists of 12 items with four subscales: attitudes toward logical thinking, inquisitiveness, objectivity, and emphasis on evidence. The α coefficients for each of the levels of interpretation were .83, .63, .80, and .80, respectively.
Group cohesion: Eight items were selected from the 20-item Group Attitude Scale (Evans & Jarvis, 1986) to assess group cohesion. The response options are "agree" and "disagree." The higher the score, the less attracted an individual was to the group. The α coefficient for the eight items was .97.

Coding
Time spent cleaning: The time taken from the start of cleaning the classroom's equipment to the end of the self-reported cleanup period was measured.
Number of items forgotten to be put away: The number of items forgotten to be put away was counted after the participant's self-report at the end of the clean-up.

Results

The basic statistics of subscales of the IRI, group cohesion, and critical thinking attitude are presented in Tables 1 and 2. The average time spent cleaning up at Time 1 was 391.7 (85.0) seconds for the VR/CO condition, and 604.1 (153.9) seconds for the VR/COM condition. At Time 2, the mean time spent cleaning up was 356.8 (82.4) seconds for the VR/CO condition and 231.5 (67.0) seconds for the VR/COM condition. The mean number of items forgotten to be put away at Time 1 was 1.0 (1.6) for the VR/CO condition and 1.6 (2.4) for the VR/COM condition. The mean number of items forgotten at Time 2 was 0.3 (0.7) for the VR/CO condition, and 0 (0) for the VR/COM condition. Corresponding *t*-tests were conducted for time of survey (Trials 1 and 2) under experimental conditions (VRCO/COM and VRCOM/CO) with respect to the time spent cleaning and the number of items forgotten to clean. The results showed no significant differences between the VRCO/COM conditions. However, in the VRCOM/CO condition, the time required to clean up was significantly different ($t(11) = 10.0$, $p = .001$). Regarding the number of items forgotten to be put away, the VRCOM/CO condition showed a significant trend ($t(11) = 2.1$, $p = .06$), suggesting that the condition in which participants experienced cooperative VR learning after competitive VR learning may have decreased the number of items forgotten to put away.

A two-factor analysis of variance (ANOVA) was conducted for each subscale of group cohesion, critical thinking attitude (attitude toward logical thinking, inquisitiveness, objectivity, and emphasis on evidence), and IRI (perspective-taking, fantasy, empathic concern, and distress) based on time of survey (pre- and post-Trial 1) and experimental conditions (VRCO/COM and VRCOM/CO). The results showed a significant trend for the main effect of time of

survey on attitudes toward logical thinking with respect to critical thinking attitudes ($F(1, 22) = 3.0$, $p < .10$, $\eta^2 = .12$). Scores were higher at post-Trial 1 than at pretest. For IRI, the main effects of time of survey and experimental condition concerning fantasy and time of survey regarding empathic concern were significant (time of survey in fantasy: $F(1, 22) = 4.7$, p = .04, $\eta^2 = .18$; condition of fantasy: $F(1, 22) = 5.3$, $p = .03$, $\eta^2 = .20$; time of survey in empathic concern: $F(1, 21) = 3.4$, $p = .08$, $\eta^2 = .14$). Fantasy scores were higher at post-Trial 1 than at pretest. The empathic concern score was lower at post-Trial 1 than at pretest. There were no significant differences in group cohesiveness.

To examine Trial 2, I conducted a two-factor ANOVA for each subscale of group cohesion, critical thinking attitude (attitude toward logical thinking, inquisitiveness, objectivity, and emphasis on evidence), and IRI (perspective-taking, fantasy, empathic concern, and distress) in terms of time of survey (post-Trial 1 and post-Trial 2) and experimental condition (VRCO/COM and VRCOM/CO). The ANOVA results for the two factors showed that the main effect of time of survey on critical thinking attitudes was significant ($F(1, 22) = 7.0$, $p = .02$, $\eta^2 = .24$). Scores were higher after Trial 2 than after Trial 1. For IRI, there were significant main effects of the experimental condition of fantasy and time of survey for empathic concern (fantasy: $F(1, 22) = 5.5$, $p = .03$, $\eta^2 = .20$; empathic concern: $F(1, 21) = 25.2$, $p < .001$, $\eta^2 = .55$). Empathic concern score was lower after Trial 2 than after Trial 1. There was a significant interaction between time of survey and experimental condition of distress ($F(1, 22) = 7.2$, $p = .02$, $\eta^2 = .25$), with a decrease after Trial 2 in the VRCO/COM condition and an increase in the VRCOM/CO condition. There were no significant differences in group cohesion.

Table 1

Basic statistics of subscales of Critical Thinking Attitude

	Condition	Attitude toward logical thinking		Inquisitiveness		Objectivity		Emphasis on evidence	
		M	SD	M	SD	M	SD	M	SD
Pretest	CO/COM	11.8	3.0	12.3	1.9	12.6	2.3	12.1	1.8
	COM/CO	10.6	2.8	12.7	2.1	12.8	2.6	12.0	2.7
After Trial 1	CO/COM	12.3	2.3	12.3	1.8	13.3	2.0	11.6	1.8
	COM/CO	11.3	3.2	12.7	2.4	12.9	2.6	12.3	2.3
After Trial 2	CO/COM	11.9	2.4	13.2	1.5	13.3	2.2	11.6	2.5
	COM/CO	11.7	2.7	13.3	1.8	13.2	2.3	12.7	2.5

Table 2

Basic statistics of IRI and group cohesion

	Condition	Perspective-taking		Fantasy		Empathic concern		Distress		Group cohesion	
		M	SD	M	SD	M	SD	M	SD	M	SD
Pretest	CO/COM	22.1	3.4	20.9	3.4	18.9	2.4	21.1	3.7	33.5	8.8
	COM/CO	21.9	3.9	23.9	3.8	18.4	1.4	21.8	3.8	35.5	5.6
After Trial 1	CO/COM	22.7	2.3	21.3	3.4	18.0	2.4	19.9	3.8	34.2	6.8
	COM/CO	22.6	4.1	24.8	3.7	18.0	1.0	21.7	4.6	35.1	7.3
After Trial 2	CO/COM	22.5	2.8	21.0	3.5	20.9	3.9	20.7	3.7	33.8	6.7
	COM/CO	22.8	4.2	24.7	4.8	21.6	2.1	21.0	5.2	36.6	5.2

Discussion

This study examined the differences in morality and learning performance fostered by cooperative and competitive learning using VR technology.

According to the results, the time required to clean up after the VR cooperative learning experience was the same as that required to clean up after the VR competitive learning experience. However, the results suggest that the number of forgotten pieces decreased in the condition in which participants experienced VR cooperative learning after they experienced VR competitive learning. These results suggest that when VR competitive and cooperative learning are incorporated, the learning performance may be enhanced when VR competitive learning is experienced first.

Group cohesion was not related to VR cooperative or competitive learning in either Trial 1 or 2. On the other hand, regarding IRI, fantasy increased and empathic concern decreased after Trial 1 in both VR cooperative and competitive learning. It is possible that because of the first learning session, the participants learned the new task imaginally. It is also possible that the participants were so focused on the new task that they did not have time to consider the other participant pairs. Regarding the attitude toward critical thinking, the attitude toward logical thinking increased after

Trial 1, suggesting that the participants were thinking more. After Trial 2, the inquisitiveness of the critical thinking attitude increased, suggesting that the participants were more motivated, even though it was their second time learning. Regarding the IRI, empathic concern decreased after both trials. Distress decreased in the condition in which competitive learning was experienced after cooperative learning and increased in the condition in which cooperative learning was experienced after competitive learning, suggesting that cooperative learning first may cause less distress.

Conclusion

The present study not only compared the differences between VR cooperative and competitive learning but also examined these learning sequences from the perspective of learning performance and morality. These results suggest differences in these learning sequences. Therefore, it was considered crucial to examine not only the learning methods but also the order in which they were used. The results suggest the possibility that this VR learning material can be used in moral education classes by setting an appropriate learning sequence. However, the number of participants in this study was small, and there is room for further research on the reproducibility of the results.

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Utilizing Digital Twins in the Design and Development of XR Content for ESD

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Abstract *This study explores the integration of Extended Reality (XR) and Digital Twin technologies into Education for Sustainable Development (ESD) to enhance climate education. Creating immersive, interactive experiences using real-world data aims to increase student engagement and deepen understanding of complex environmental issues. The research focuses on designing and developing XR and Digital Twin-based instructional content that simulates real-world scenarios and visualizes dynamic data. This approach is expected to foster critical thinking and problem-solving skills. An expert evaluation with five professionals assesses the content's educational effectiveness, refining it based on feedback. The findings suggest that XR and Digital Twin technologies can significantly enhance ESD by providing engaging, effective learning environments and preparing students to address global sustainability challenges. This research highlights the transformative potential of advanced technologies in ESD, offering novel ways to engage learners and apply knowledge in real-world contexts.*

Keywords: Extended Reality (XR), Digital Twin Technology, Education for Sustainable Development (ESD), Immersive Learning, Usability Evaluation

Introduction

Education for Sustainable Development (ESD) has emerged as a critical component of the global educational agenda, aiming to equip learners with the knowledge, skills, values, and agency necessary to address interconnected global challenges such as climate change, biodiversity loss, unsustainable resource use, and social inequality (UNESCO, 2024). Integrating ESD into the K-12 curriculum involves embedding key sustainability concepts across various subjects, including mathematics, science, English, and social studies (Zguir, Dubis, & Koç, 2021). This interdisciplinary approach allows students to understand the delicate balance between human activities and the natural world, promoting a holistic understanding of sustainability.

In South Korea, the government has actively promoted ecological transition education by amending the Basic Education Act to include ESD principles across all subjects (Min, 2023). This initiative encourages experiential and hands-on learning activities that connect students to real-life applications, enhancing their engagement and competence in climate response and ESD principles.

To effectively promote ESD goals, students must engage in self-regulated and self-directed learning, developing applicable knowledge and problem-solving skills in real-world contexts (Riess et al., 2022). This approach roots learning in authentic research questions and real-world applications, particularly relevant for addressing urgent global crises such as climate change.

Local and global climate data has never been more accessible, making climate change literacy and numeracy critical for achieving cross-disciplinary educational objectives (Prazian & Prykhodko, 2023). Digital Twin technology, which involves creating virtual replicas of physical entities and synchronizing real-world data with these models, offers significant potential for enhancing ESD. This technology enables real-time reciprocal reflection of information between the real and virtual worlds, facilitating data-driven inquiry and experiential learning (Kuehner, Scheer, & Strassburger, 2021).

When combined with Extended Reality (XR) technologies, Digital Twins provide immersive, multisensory learning experiences that can enhance cognitive and emotional engagement (Reiners et al., 2021). By receiving real-world information in an XR environment, learners can better understand complex environmental issues and develop critical thinking and problem-solving skills.

This study aims to explore the integration of Digital Twin and XR technologies into ESD instructional content for the K-12 curriculum. The research focuses on designing and developing XR and Digital Twin-based content that simulates real-world environmental scenarios and visualizes dynamic data, enhancing students' understanding of climate change impacts. The study includes an evaluation involving five experts to assess the educational effectiveness of the developed content and refine it based on expert feedback.

This research is guided by the following questions:

RQ1: What considerations are involved in the design and development of ESD content integrating Digital Twin and XR technologies?
RQ2: How does the process of designing and developing ESD content for climate change education using these technologies unfold?
RQ3: How do experts evaluate the educational effectiveness of XR and Digital Twin-enhanced ESD content?

By addressing these questions, this research aims to demonstrate the potential of advanced technologies to transform ESD, providing engaging and effective learning environments that prepare students to address global sustainability challenges.

Research Design & Methods

This study employed the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) developed by Dick and Carey (Dick, & Carey, 1978) to design and develop ESD content integrating Digital Twin and XR technologies.
Analysis: The initial phase involved a comprehensive analysis of ESD content requirements, targeting students and integrating ESD principles into the curriculum standards of various subjects. The analysis underscored the necessity of employing digital twin technology to access real-world data and augmented reality technology to provide immersive experiences of real-world phenomena within virtual environments. This phase aimed to identify the specific educational needs and gaps in the current curriculum related to climate change education.
Design: During the design phase, the objectives for the ESD content were delineated. The primary objective was to enable students to identify regions in South Korea where carbon neutrality is not effectively achieved, thereby gaining insights into the concept and practical strategies for achieving carbon neutrality through data-driven investigative activities. The design process adhered to the PPDAC (Problem-Plan-Data-Analysis-Conclusion) model, a structured framework widely used for data-driven learning and statistical reasoning. This model facilitated the design of instructional activities that promote critical thinking and problem-solving skills.
Development: The development phase entailed the creation of the XR educational content using Unity, a versatile cross-platform game engine, to construct interactive 3D environments. Real-time carbon emissions and absorption data were stored and managed using Google Sheets, which were dynamically integrated into the XR environment via Unity Web Request. Photon, a multiplayer networking framework, enabled remote and collaborative learning experiences. The content was designed to be accessed through Microsoft HoloLens2 headsets, offering an untethered extended reality experience. The XR environment allowed students to explore and analyze regional carbon emissions and absorption data, providing an engaging, hands-on learning experience.
Implementation: In the implementation phase, the developed XR content was deployed to the participants, who interacted with the content using HoloLens2 headsets. Training sessions were conducted to ensure the participants were proficient in using the XR technology. This phase was crucial for testing the effectiveness of the educational content in a real-world setting.
Evaluation: The evaluation phase incorporated both formative and summative assessments. Formative assessments included continuous feedback from five experts in environmental science, technology, and education throughout the development and implementation phases. These experts, selected for their extensive knowledge and experience, provided valuable insights into the content's educational effectiveness. Summative assessments involved expert reviews to evaluate the overall impact of the XR content on educational outcomes. The expert panel's feedback highlighted various strengths and areas for improvement.

Results

Analysis: The analysis phase identified a significant need for enhancing climate change education in response to increasing greenhouse gas emissions. The South Korean government's '2050 Carbon Neutrality' initiative and mandatory ecological transition education underscore the importance of integrating real-world phenomena and data into the curriculum. The ESD content developed for high school students (K10-12) in South Korea was designed to align with Social Studies, Common Science, and Earth Science curricular standards.
Design: The content was designed to help students identify regions in South Korea where carbon neutrality efforts were insufficient. Utilizing the PPDAC cycle, the instructional design focused on enabling students to develop practical strategies for achieving carbon neutrality through data-driven inquiry and analysis.
Development: The primary development tool was Unity, which facilitated the creation of the user interface and XR

interactions. Real-time carbon emissions and absorption data were managed using Google Sheets and dynamically integrated into the XR environment. Photon was used to support remote collaboration among learners. The ESD content featured data maps, pop-up windows, and interactive elements to visualize data and provide instructional guidance. This structure enabled students to understand regional carbon emissions and develop strategies for achieving carbon neutrality.

Implementation & Evaluation: The implementation involved deploying the XR content and conducting participant training sessions. The evaluation phase featured independent expert reviews to assess the content's educational effectiveness. The expert panel highlighted strengths such as enhanced data literacy, the ability to simulate real-world phenomena in virtual environments, and an improved understanding of regional carbon emissions. Areas for improvement included clarifying the real-time application of data, incorporating the latest simulation data, enhancing real-time integration with actual objects, validating and expanding the content to address current social issues, and providing intermediate learning steps to facilitate problem-solving.

Discussion

This study investigated the integration of Digital Twin and Extended Reality (XR) technologies into Education for Sustainable Development (ESD) to enhance climate education. The primary objective was to develop immersive and interactive educational experiences that leverage real-world data to increase student engagement and improve the understanding of complex environmental issues. The evaluation conducted with five experts provided valuable insights into the effectiveness and potential of this innovative approach.

The findings from this study highlight several key points. First, combining XR's immersive nature and the real-time data provided by Digital Twin technology significantly enhanced student engagement. Participants reported that the interactive and multisensory experiences made learning more enjoyable and meaningful. Engaging with real-world data in a virtual environment facilitated a deeper understanding of environmental issues, with students demonstrating improved critical thinking and problem-solving skills. Experts in education and technology provided positive feedback on the developed content, recognizing its potential to enhance ESD significantly. They recommended incorporating the most current data and expanding content to cover additional sustainability topics for greater impact and relevance (Laurie et al., 2016; Riess et al., 2022).

Integrating Digital Twin and XR technologies into ESD offers several educational benefits. Immersive technologies can significantly enhance student engagement and motivation, making learning more interactive and enjoyable (Bucea-Manea-Ţoniş et al., 2020; Reiners et al., 2021). Utilizing real-world data allows students to apply theoretical knowledge to practical scenarios, thereby developing practical skills and a deeper understanding (Madni, Madni, & Lucero, 2019). The data-driven approach also encourages critical thinking and problem-solving, fostering important 21st-century skills (Padmanabhan & Singh, 2016; Hopkinson & James, 2010).

However, the study has limitations. The expert panel size of five is relatively small, limiting the generalizability of the findings. Future research should include larger and more diverse samples to validate the results. Additionally, this study focused primarily on climate change education. Future research should explore the integration of these technologies across a broader range of ESD topics and educational contexts. The need for continuously updated data was also highlighted, indicating the importance of maintaining the relevance and impact of the content (Zhou, 2023).

Future research should aim to expand the scope of content to include more sustainability topics and apply these technologies in different educational settings to explore their versatility and scalability. Longitudinal studies are needed to assess the long-term impact of Digital Twin and XR technologies on students' knowledge, skills, and attitudes toward sustainability. Enhancing the interactivity and real-time data integration features will provide a richer and more engaging learning experience.

Conclusion

This study demonstrated the potential of integrating Digital Twin and Extended Reality (XR) technologies into Education for Sustainable Development (ESD) to create engaging, data-driven educational experiences. Using real-world data in an immersive virtual environment enhanced students' understanding of complex environmental issues and improved their critical thinking and problem-solving skills. The findings underscore the effectiveness of these advanced technologies in increasing student engagement and motivation in learning about sustainability.

This research's key contributions include highlighting an innovative approach to ESD by combining advanced technologies to create interactive and immersive learning environments. The study provides practical insights for educators and curriculum developers on integrating these technologies into their teaching practices to enhance learning outcomes. Integrating Digital Twin and XR technologies into ESD represents a significant advancement in leveraging technology to address global sustainability challenges. These technologies can be crucial in preparing students to tackle complex environmental issues effectively by continuously refining and expanding this approach and providing adequate support for educators.

In conclusion, this study demonstrates the significant potential of Digital Twin and XR technologies to transform ESD by creating engaging, immersive, and data-driven learning environments. Future research should focus on expanding the scope and content of these technologies, conducting longitudinal studies, and enhancing interactivity to maximize

their educational impact. This approach not only enhances student engagement and understanding but also prepares them to address the pressing sustainability challenges of the future.

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Enhancing Evaluation Framework for XR-Based Education and Training[1]

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Abstract.
In the current landscape where XR technology is being increasingly integrated into education and training programs, evaluating their effectiveness becomes paramount. This study delves into the crucial area of evaluating XR-utilized education and training programs, focusing on delineating what aspects should be evaluated and how. Drawing from a comprehensive literature review, we initially crafted a preliminary draft of evaluation domains for XR-based education, which underwent refinement through expert reviews, culminating in the finalization of the XR-based education and training evaluation framework. Our research identified four primary domains within this framework: evaluation purposes, methods, contents, and techniques. Evaluation purposes were bifurcated into assessing the education and training process itself and gauging its outcomes. Evaluation methods encompassed bio-data measurement, AI technology utilization, activity assessment, and stealth evaluation. Evaluation contents were further categorized into assessing knowledge, social, emotional, and performance dimensions, along with evaluating the quality of learner experiences and their problem-solving abilities in tasks. Evaluation techniques included personalized assessment leveraging artificial intelligence, emotion analysis through affective computing, and data collection and analysis via sensor-based performance assessment. These findings not only provide a structured framework for evaluating XR-based education and training programs but also serve as a foundational guide for stakeholders seeking to measure their effectiveness.

Keywords: XR(eXtended Reality), Evaluation Framework, XR-Based Learning

Introduction

In recent years, XR (Extended Reality) technologies, encompassing Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), have garnered attention as innovative tools in the field of education and training. XR technologies provide immersive learning environments that enhance learner engagement, visualize complex concepts, and afford experiences akin to real-world scenarios(Johnson-Glenberg, 2017, Kim, 2021). Concurrently, efforts to integrate XR into educational and training programs have escalated, underscoring the critical need to assess their efficacy(Choi et al., 2022, Lim et al., 2022).

The rationale for establishing an evaluation framework when designing and producing XR-based educational and training programs is underpinned by several scholarly considerations. Firstly, such a framework offers criteria for systematically measuring program effectiveness. Evaluating effectiveness is essential for assessing growth across cognitive, affective, and psychomotor domains of learning (Ormell, 1974), thereby substantiating the extent to which XR education and training effectively achieve diverse learning objectives. Secondly, an evaluation framework plays a pivotal role in delivering ongoing feedback to learners. Continuous feedback enhances understanding, fosters learning motivation, and promotes self-directed learning (Black & Wiliam, 1998). Within XR education and training contexts, evaluation provides opportunities to optimize the learning process by delivering real-time feedback to learners. Thirdly, an evaluation framework can contribute to personalizing the learning experience. Tailoring educational content to match learner achievements and learning styles proves effective; thus, evaluation within XR education and training can

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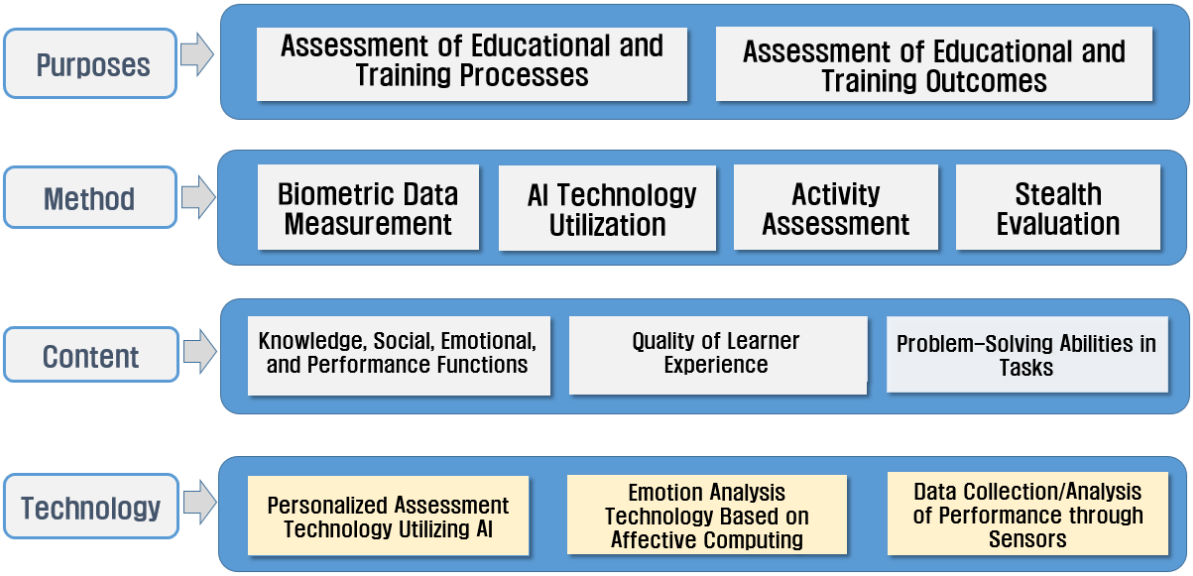
maximize individual learning outcomes by offering customized learning paths aligned with each learner's proficiency and requirements (Ryan & Deci, 2000).
Therefore, establishing a rigorous evaluation framework is imperative during the planning and development phases of XR-based educational and training programs. This study seeks to explore pivotal facets in evaluating XR-based education and training programs from an academic standpoint, aiming to propose a comprehensive evaluation framework encompassing objectives, methodologies, content, and techniques. Through systematic literature review, initial framework drafting, and expert validation, the finalized framework will provide valuable guidelines to stakeholders seeking to methodically measure the effectiveness of XR-based education and training programs.

Research Design & Methods

Procedure and method. The research process for developing an evaluation framework for XR-based education and training proceeded in three stages. Firstly, an analysis of prior studies and exploration of evaluation cases in XR-based education were conducted, followed by a literature review focused on evaluation, resulting in the initial draft of the XR-based education evaluation framework. Secondly, expert reviews were conducted on the developed XR-based education evaluation framework to derive modifications and enhancements. Particularly, experts emphasized clarifying the scope between subdomains rather than overarching domains. Thirdly, based on these inputs, the research team finalized the XR-based education evaluation framework through team meetings. The research identified four main domains of the XR-utilized education and training evaluation framework: evaluation purposes, methods, contents, and techniques. The XR-utilized education and training evaluation framework developed in this study is illustrated in the following Figure 1.

Figure 1
Evaluation Framework for XR-Based Education and Training



Results

When planning and developing XR-based education and training programs, the evaluation domains to consider include four areas: evaluation purposes, evaluation methods, evaluation contents, and evaluation techniques. The detailed items within each domain are as follows.

1. Evaluation Purposes

In XR-based education, it is essential to clearly define the purpose of evaluation. Evaluation purposes can be broadly categorized into two dimensions. Firstly, evaluation aims to gauge the extent of achieving educational objectives, serving as indicators of educational outcomes. The purpose of evaluation establishes the definition of evaluation content and methods, forming the foundational premise for selecting evaluation technologies. Therefore, in XR-based education, it is crucial to consistently articulate and clarify evaluation purposes from the planning stages of instruction. Firstly, evaluation of the educational and training process focuses on learners' experiences within XR classes. Process evaluation occurs during XR classes. Secondly, evaluation of educational and training outcomes centers on the effects

generated by XR education. Outcome evaluation takes place after the conclusion of XR classes. It is imperative to clearly define these evaluation purposes.

2. Evaluation Methods

The evaluation methods in XR-based education can take various forms. These methods vary depending on the level of content planning and the technological feasibility for implementation. Evaluation methods should be selected appropriately based on the content and technological readiness. Moreover, evaluation methods can be singularly used or mixed with various approaches. Firstly, evaluation through the utilization of biometric sensors involves collecting data generated by various biometric sensors used in XR classroom environments and evaluating them for assessment purposes. Secondly, evaluation methods utilizing AI technologies involve developing models that predict elements used to assess learners using AI technologies and evaluating these predictions with actual data. Thirdly, activity assessment methods encompass evaluating tasks performed by learners in XR classrooms, including assessments of interactions with objects within the XR environment. Essentially, this involves assessing activities conducted during XR sessions. Fourthly, stealth assessment methods refer to covert evaluation techniques where learners are assessed without their awareness. These evaluations are based on learners' natural behaviors and performance capabilities, enabling the collection and processing of data to infer learners' proficiency levels and provide feedback throughout the learning process.

3. Evaluation Contents

Evaluation content in XR-based education varies based on the direction of instructors or educational institutions and the level of technological implementation. Firstly, assessments of learners' knowledge, social-emotional aspects, and performance functions in XR-based education can involve quizzes and exams to gauge theoretical understanding of the learning content covered in XR-based education. Additionally, evaluations can assess factors such as the degree of learner engagement and interest, self-efficacy, and participation in XR-based education, including collaborative aspects and active feedback in group settings. If the primary focus of XR-based education involves mastery of specific skills, evaluations can also assess performance capabilities through the use of XR tools or platforms. Secondly, assessments of the quality of learners' experiences encompass evaluating various dimensions of experiences occurring during the learning process in XR-based education. The quality of experience (QoE) includes the overall service experience, including pleasure and discomfort felt by learners throughout their interactions with XR-based educational technologies. This assessment is subjective and objective, measuring how learners perceive or experience interactions with XR technologies and defining QoE through self-report surveys and metrics to evaluate technical quality. Thirdly, assessments of learners' problem-solving abilities in tasks evaluate the extent to which learners apply XR technologies to perform projects or practical exercises. Problem-solving abilities extend beyond basic performance functions and may include creativity and technical skills, potentially resulting in evaluated scores. Systematically organizing the process of resolving project-based tasks or showcasing them in portfolios can serve as tools for evaluating the problem-solving process.

4. Evaluation Technologies

In XR-based education, diverse technologies are required depending on the evaluation content. Firstly, for knowledge acquisition assessment, personalized evaluation using artificial intelligence involves leveraging learner data to gauge their learning levels. This includes collecting data on learner-related variables such as age, education level, learning styles, as well as logs of learning activities, study time, learning media, and volume. Analyzing these learning experiences necessitates big data-driven technologies for predicting learning outcomes and recommending optimized learning paths. Secondly, for socio-emotional assessment, emotion analysis based on affective computing includes technologies for facial expression recognition analysis, sentiment analysis through text mining, emotion analysis via speech recognition, and emotion analysis based on biometric identification during learning using wearable devices. Thirdly, biometric technologies for gaze tracking, heart rate monitoring, and skin conductance responses can be employed. For activity assessment, technologies involve collecting and analyzing data through sensors to assess performance based on established criteria and various data collection methods.

Discussion and Conclusion

This study proposes a systematic evaluation framework for assessing the effectiveness of education and training programs utilizing XR technology. Based on the research findings, the following conclusions can be drawn: Firstly, clearly defined evaluation objectives and methods are essential for evaluating the effectiveness of XR-based education and training programs. The utilization of advanced technologies such as biometric data measurement serves as a critical component of these evaluations. Secondly, evaluation content should comprehensively assess learning outcomes not only in terms of knowledge transfer but also across social, emotional, and performance dimensions. Evaluating the quality of learner experiences and their problem-solving abilities is integral to this multifaceted approach. Thirdly, personalized assessment technologies utilizing XR can propose tailored learning paths based on individual learner characteristics and needs, thereby contributing to maximizing learning outcomes. These research findings provide

practical guidelines for the application of XR technology in the field of education and training, serving as foundational data crucial for future research and industrial applications.

While this study proposes an evaluation framework for education and training programs utilizing XR technology, several limitations should be considered: Firstly, continuous updates and developments are necessary to reflect the latest technologies and trends. Further research and expansion are needed to explore new evaluation criteria and methodologies alongside the advancement of XR technology. Secondly, this study focused on specific learning contexts and technological environments, necessitating more in-depth research into the applicability across diverse educational fields and environments. Exploring detailed application strategies and measurement metrics tailored to each field's characteristics is essential. Thirdly, empirical studies are required to investigate the specific applicability and effective implementation strategies of the proposed evaluation framework. Exploring various challenges and solutions that may arise in the actual educational settings is crucial. Recognizing these limitations and overcoming them will contribute to the development of sustainable methodologies for effectively utilizing XR technology through deeper analysis and practical application in future research.

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Examining the Educational Impact of Editing Techniques: A Focus on Jump Cuts in Video Content

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This study investigated the impact of video editing techniques (jump cuts, speed adjustments) on comprehension and subjective evaluations of educational videos. 148 university students watched recorded lectures with varied captions. Video 1 (declarative knowledge-focused) was presented at normal and 1.5x speeds. Video 2 (Procedural knowledge-focused) had three conditions: jump cuts, 1.5x speed, and both. Comprehension tests and surveys revealed no significant differences between conditions, but mean score differences emerged between groups preferring Video 1 or 2. Students who preferred Video A tended to have higher scores on Video A. Jump cuts did not negatively affect learning, suggesting learner preferences for faster speeds may depend on video content.

Keywords: online learning, Video speed, video contents

Introduction

Even before the COVID-19 pandemic, online learning was becoming more accessible due to the spread of smartphones and the increasing speed of the internet. However, the pandemic greatly accelerated the adoption of online learning, making it a common mode of education today (Dinmore, 2019; Pokhrel and Chhetri, 2021). The diversification and sophistication of video content that learners regularly engage with has been accelerated by the proliferation of video platforms such as YouTube and TikTok. Among teenagers and those in their twenties, daily usage of video streaming services exceeds 100 minutes on holidays (Ministry of Internal Affairs and Communications Information and Communications Policy, 2023). In parallel, video editing software has also evolved, simplifying the addition of animated captions and jump cuts, enabling not only professionals but also the public to readily edit and distribute videos.

In the research on video speed, the impact of varying learning speeds on learning outcomes remains a subject of debate. Some previous studies suggest that learning speeds up to double speed do not affect learning outcomes, while others indicate that even 1.5x speed may have an impact (Nagahama and Morita, 2017; Song et al, 2018). Additionally, there are reports of differences in learning outcomes depending on students' majors (Mo et al, 2022).

While previous research has primarily focused on the impact of different viewing speeds on learning outcomes, the influence of video editing elements has not been adequately addressed. Therefore, this study examines how video editing techniques, such as jump cuts, affect learners' subjective evaluations, in addition to viewing speed. Specifically, we first aim to clarify the impact of increased viewing speed on the learning experience by comparing learners' subjective evaluations using videos at normal speed and 1.5x speed. Next, we will investigate the effect of jump cuts on learning by comparing learners' subjective evaluations of videos with jump cuts, videos with jump cuts at 1.5x speed, and videos at 1.5x speed without jump cuts. We hypothesize that jump cuts will increase learners' perceived engagement and enjoyment but may negatively impact their comprehension, especially at higher speeds.

Research Design & Methods

The participants were 148 first-year undergraduate students from a private university. On day one, there were 57 male and 13 female participants. On day two, there were 58 males and 19 females, with one participant not reporting their gender. 95.3% of the participants were 19 years old or younger. Participants viewed two types of lecture videos: Video A, focused on memorization of informational content (e.g., historical events and terms), and Video B, focused on procedural learning (i.e., educational content creation methods). Both videos consisted of slides with a narrator explaining the content, but the speaker did not appear on screen. All videos were presented on YouTube with a

standardized loudness level of Loudness-15LUFS to mitigate potential biases caused by variations in loudness (Asutay & Västfjäll, 2012). The video speed was adjusted during the rendering process.
Video A had a duration of 7 minutes and 55 seconds at normal speed and 5 minutes and 17 seconds at 1.5x speed. Video B had a duration of 7 minutes and 53 seconds at normal speed, 6 minutes and 33 seconds with jump cuts, 5 minutes and 16 seconds at 1.5x speed, and 4 minutes and 22 seconds with both jump cuts and 1.5x speed. Each video contained 18 manually created animated captions, with the presence or absence of additional animations and sound effects randomly assigned. The caption display time was set to 4 seconds at normal speed.
After completing a pre-questionnaire, participants viewed Video A on their smartphones. They were randomly assigned to either the normal speed group (N = 78) or the 1.5x speed group (N = 70). Upon viewing Video A, each participant completed a comprehension test and a subjective evaluation of the video. The test consisted of 10 True/False and multiple-choice questions, but due to an error in one question for each test, only 9 questions per test were scored. The subjective evaluation was based on a 5-point Likert scale adapted from the studies by Nagahama & Morita (2017). In the subjective evaluation stage after watching video B, respondents were asked which was easier to listen to, video A or video B.
Subsequently, participants viewed Video B. They were randomly assigned to one of three groups: the jump cut group (N = 62), the 1.5x speed group (N = 43), or the jump cut 1.5x speed group (N = 43). The jump cut group viewed Video B with jump cuts at normal speed, the 1.5x speed group viewed the original Video B at 1.5x speed, and the jump cut 1.5x speed group viewed Video B with jump cuts at 1.5x speed. After viewing Video B, they completed a comprehension test and a subjective evaluation of the video, similar to those for Video A.

Results

Analysis of average scores

An independent samples t-test revealed no significant difference in mean comprehension scores between the normal speed group (N = 78, M = 6.90, SD = 1.46) and the 1.5x speed group (N = 70, M = 7.24, SD = 1.45) for Video A, $t(146) = -1.65$, $p > .10$. A one-way ANOVA was conducted to examine potential differences in mean comprehension scores across the three video conditions (jump cut, 1.5x speed, and jump cut at 1.5x speed) for Video B. The results revealed a significant main effect of video condition, $F(2, 145) = 5.54$, $p < .01$, $\eta^2 = 0.2764$. Tukey's HSD post hoc tests indicated no significant differences between any specific conditions.

Analysis of subjective evaluation scores

A one-way ANOVA was conducted to examine the effect of three video speed conditions (1.5x speed, jump cut, and jump cut at 1.5x speed) on mean subjective evaluation scores for Video B. The scores for each are shown in Table 1. According to the ANOVA, there was a significant main effect of video speed condition, $F(2, 145) = 5.54$, $p < .01$, $\eta^2 = 0.2764$. Tukey's HSD post hoc tests indicated that the 1.5x speed condition differed significantly from the jump cut at 1.5x speed condition ($p < .05$), and the jump cut condition also differed significantly from the jump cut at 1.5x speed condition ($p < .05$). However, there was no significant difference between the 1.5x speed and jump cut conditions ($p > .05$).

Table 1

Summary of average subjective evaluation scores

	Movie A		Movie B		
questionnaire	Normal Speed (N=78)	1.5x Speed (N=70)	Jump Cuts (N=43)	1.5x Speed (N=62)	Jump Cut at 1.5x Speed (N=43)
I understood the learning content.	3.86 (0.75)	3.87 (0.72)	3.93 (0.70)	4.05 (0.82)	4.00 (1.05)
The level of the learning content was appropriate for me.	3.79 (0.76)	3.80 (0.84)	3.95 (0.69)	3.97 (0.89)	3.91 (0.95)
The speaker's explanation was easy to understand.	4.17 (0.71)	4.21 (0.80)	4.12 (0.54)	4.21 (0.93)	4.19 (0.93)
The explanation was thorough.	4.31 (0.67)	4.30 (0.84)	4.26 (0.66)	4.39 (0.64)	4.21 (0.94)

I was interested in the learning topic.	3.64 (0.99)	3.66 (0.92)	4.12 (0.70)	3.97 (0.92)	3.93 (1.10)
I would like to learn more about the learning topic in the future.	3.73 (0.94)	3.76 (0.82)	3.77 (0.81)	3.82 (0.93)	4.30 (0.71)
I was able to concentrate during the lecture.	4.00 (0.81)	4.16 (0.75)	4.02 (0.83)	4.05 (0.86)	4.35 (0.81)
I experienced eye strain while watching the video.	2.90 (1.31)	2.96 (1.20)	2.81 (1.12)	2.87 (1.34)	2.65 (1.25)
The flickering of the screen bothered me.	2.68 (1.17)	2.54 (1.25)	2.70 (1.06)	2.50 (1.33)	2.58 (1.2)
I focused on the audio information while watching the video.	3.54 (0.95)	3.73 (1.09)	3.33 (0.94)	3.52 (0.99)	3.19 (1.14)
I had difficulty hearing the audio information.	2.87 (1.18)	2.70 (1.29)	2.77 (0.95)	2.74 (1.30)	3.21 (1.34)
The audio was easy to hear.	3.90 (0.92)	3.89 (1.11)	3.84 (0.95)	4.00 (0.89)	3.74 (1.09)
I focused on the visual information while watching the video.	3.92 (0.94)	3.99 (0.99)	3.53 (1.14)	3.89 (1.01)	3.93 (0.94)
I had difficulty following the text information with my eyes.	2.97 (1.15)	2.87 (1.18)	3.02 (1.14)	2.84 (1.36)	2.88 (1.31)
The video was easy to see on my smartphone.	4.04 (0.83)	4.09 (0.88)	3.93 (0.86)	4.10 (0.82)	4.02 (1.01)
The presentation speed was fast.	2.97 (1.02)	3.11 (1.23)	2.88 (1.00)	2.84 (1.28)	3.35 (1.17)
There were parts where I wished the explanation was slower.	3.01 (1.15)	2.96 (1.26)	2.98 (0.96)	2.82 (1.22)	3.12 (1.22)
The presentation time was appropriate.	3.74 (0.89)	3.76 (1.24)	3.67 (0.78)	3.56 (1.02)	3.65 (1.04)
I would like to continue learning at this presentation speed in the future.	3.78 (0.75)	3.71 (1.08)	3.51 (1.03)	3.61 (1.09)	3.47 (1.14)
The caption format was familiar.	4.01 (0.76)	4.11 (0.97)	3.88 (0.79)	3.92 (0.84)	3.88 (1.05)
The slide + caption format was new.	3.72 (0.94)	3.51 (1.14)	3.72 (0.83)	3.53 (1.08)	3.60 (1.00)
There was not enough text on the slides.	3.12 (1.06)	3.09 (1.15)	2.98 (0.71)	3.15 (1.19)	3.23 (1.15)
There were too many figures and tables on the slides.	3.13 (1.06)	3.33 (1.18)	3.42 (0.79)	3.27 (1.09)	3.53 (0.96)
The lecturer's voice bothered me.	2.49 (1.09)	2.43 (1.25)	2.65 (1.02)	2.55 (1.26)	2.86 (1.21)
The video cuts were distracting.	2.49 (1.13)	2.24 (1.13)	2.63 (1.00)	2.56 (1.28)	2.49 (1.20)

( ) indicates standard deviation. Rounded to three decimal places.

To conduct a more detailed analysis of subjective evaluations for Video B, we divided participants in each speed condition into two groups based on their preference for either Video A or Video B. A Mann-Whitney U test was conducted to analyze whether there were significant differences in mean scores on subjective evaluation items for Video B between these two groups. The results are presented in Table 2. In the 1.5x speed group (N = 43), the mean score on the Video A comprehension test for those who preferred Video B (N = 15) was 6.39 (SD = 1.40), while the mean score for those who preferred Video A (N = 28) was 7.13 (SD = 1.31). There was a marginal trend toward significance (U = 140, p = .0751). In the jump cut group (N = 62), the mean score on the Video A comprehension

test for those who preferred Video B (N = 18) was 7.18 (SD = 1.43), while the mean score for those who preferred Video A (N= 44) was 8.00 (SD = 1.00). This difference was significant at the 5% level (U = 264.5, p = .0413). Preference for Video B did not affect the scores, and there were no significant differences between the groups.

Table 2

Preference scores for the video among the three groups who watched Video B

	Select Video A		Select Video B	
	Video A scores	Video B scores	Video A scores	Video B scores
1.5x group in video B	7.13 (1.31)	7.20 (1.17)	6.39 (1.40)	6.71 (1.98)
Jump cuts group in video B	8.00 (1.00)	7.67 (1.56)	7.18 (1.43)	7.59 (1.57)
Group watching at 1.5x speed with jump cuts in video B	7.36 (1.54)	7.29 (1.48)	6.76 (1.48)	7.11 (1.96)

( ) indicates standard deviation. Rounded to three decimal places.

Discussion

The results from Videos A and B suggest that the use of jump cuts does not significantly alter the scores. Similarly, there were almost no differences observed in the subjective evaluations. However, there were differences in mean scores regarding the preference between Video A and Video B, particularly for learners who watched Video B at 1.5x speed or with jump cuts. In the free-response comments, some participants in these groups stated that they preferred Video A because it was slower. This suggests that shortening the video length with jump cuts may yield similar results to increasing the overall video speed in terms of learner preference. Some participants who preferred Video B commented that it was "shorter," "showed the steps," or "felt easier to follow." These reasons, along with the fact that Video B explained procedural content, suggest that the type of video being watched may also influence how presentation speed affects learning.

Conclusion

The results of this experiment showed that adjusting the speed with jump cuts did not make a difference to the score. Therefore, incorporating jump cuts to highlight key learning content may enable shorter learning times if the content is clearly presented. However, this study has limitations. It remains unclear how faster speeds, such as 2x or 2.5x, would impact learning, and whether the combination of jump cuts and animated captions is essential for achieving similar effects. Further research is needed to comprehensively evaluate the potential of video editing techniques to facilitate faster learning.

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Development and Evaluation of the Tool for Supporting ill-Structured Problem-Solving Processes

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Abstract The development of problem-solving skills is becoming increasingly important, and is also a goal of the Japanese common subject of informatics. Information science requires students to deal with problem solving that combines the use of information with unstructured problem solving as encountered in everyday life. As support for unstructured problem solving, prompts have been used in practice. However, the effectiveness of prompt research has not been clarified for problem solving as in everyday life, because the effectiveness of prompt research has only been clarified in academic fields. Therefore, in this study, a system that displays prompts in line with the problem-solving process taught in information science is developed, and the effectiveness of the prompts is examined.

Keywords: Information utilize, Problem-solving process, Prompts,

Introduction

Around the world, there is a growing demand for the development of problem-solving skills, such as 21st century skills (Griffin et al., 2011). In Japan, problem-solving skills have become a key learning objective (Ministry of Education, Culture, Sports, Science and Technology, 2018). In the field of Information, the focus is on utilizing information and information technology to address problems. Moreover, the scope of problems addressed extends to daily life and social issues. These problems are often categorized as ill-structured problems (Jonassen, 1997).

Effective development of problem-solving skills entails teaching the problem-solving process (Mayer & Wittrock, 2003). Tamaki & Watanabe (2023) founded that learners in the high evaluation group were more likely to clarify situational information and actively seek additional information than learners in the low evaluation group.

Previous research has investigated the efficacy of question prompts in supporting problem-solving. King (1991) demonstrated that question prompts can monitor learner's own problem-solving process. Ge & Land (2003) developed and tested the effectiveness of question prompts to help solving ill-structured problems in the context of information systems. Additionally, Chen (2010) highlighted the necessity of question prompts in navigating through ill-structured problem-solving procedures. These studies suggested the potential of question prompts to facilitate solving ill-structured problems. However, these findings have not been applied to general problem-solving scenarios, such as those encountered in daily life. In this study, we aim to develop and evaluate a tool designed to support ill-structured problem solving in secondary education. The tool integrates question prompts to support learners in this process.

We conducted a comparative analysis of problem-solving processes with and without the question prompts, evaluating learners' problem-solving process and problem-solving solutions.

Research Design & Methods

Participants

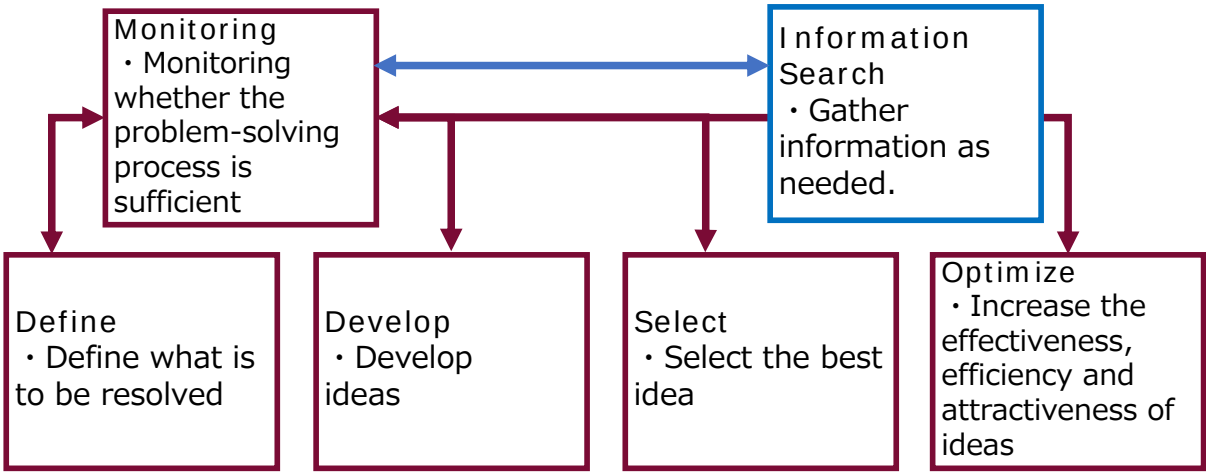
Practice was carried out with first-year high school students. The participants were taking the common subject information science subject 'Information 1'. Only students who consented to the collection of data were included in the study. They were informed that they could request to be excluded from the data collection at any time.

Problem-solving System

In this practice, a system was developed in which prompts were displayed to support the problem-solving process. The problem-solving process was defined based on the one guided in the practice of Tamaki and Watanabe (2023), as shown in Figure 1. It consists of four iterative problem-solving processes: definition, generation, selection and optimisation. Within the problem-solving process, a monitoring problem-solving process is included to reflect on the own problem-solving process as appropriate. In addition, a problem-solving process for collecting and utilising information is also included, if necessary.

Figure 1

Problem-solving process



Prompts have been developed to support these six problem-solving processes. One column of prompts is shown in Table 1. Three types of prompts are available. As it is said that unstructured problem solving is difficult, prompts are provided to (1) support the problem solving process, (2) support the problem solving process, (3) support the problem solving process, (4) support the problem solving process, and (5) support the problem solving process. It has also been suggested that information utilization combined with information retrieval during the problem-solving process is effective, so (2) prompts for information retrieval during the problem-solving process have been set up. Furthermore, as it is suggested that iterative rather than linear problem-solving processes are desirable, (3) prompts were developed to facilitate the transition between each problem-solving process.

Table 1

Problem-solving prompts

Problem-solving Process	Content
Define	● What results would you like to see? ● What needs should be met? ● Are there conditions to be met? ● Can the definition be broken down into smaller elements? ● What other definitions might be needed from an information search? ● Can the definition be broken down into smaller elements?
Develop	● Are there any other ideas? ● Are there any other ideas that could solve the problem? ● What other solutions might you be able to find from the information search? ● Have you reviewed and thought about what you have defined?
Select	● What are the differences between the ideas you have chosen and other ideas? ● What do you think is the best thing about the idea you chose? ● How did you choose the idea? How did you select the ideas and are there any mistakes in the process? ● How did you choose the ideas and are there any mistakes in the process? ● Have you reviewed and thought about what you have defined? ● Have you reviewed and thought about what you have defined? ● What are your thoughts on the definition?

Optimize	● Is the solution likely to be a satisfactory solution to what you thought of in the definition? ● Could you foresee areas that could still be changed when the solution is implemented? ● What is the best way to achieve this? ● Is the solution a solution to what you have defined? ● Are you able to use the good points from the other ideas that have come up so far?

Using this system, learners engaged in problem solving. In order to compare the effect of the prompts, a system was also developed without prompts.

Procedure

The teaching was carried out using four lessons of 50 minutes each. First, a pre-questionnaire survey was conducted to determine the learners' confidence in problem solving. Next, the problem-solving process shown in Fig. 1 was taught. The problem-solving processes were explained using a PowerPoint presentation. Learners were then randomly assigned to groups of four or five and engaged in problem solving. The problem-solving subject was Problem A, shown in Table 2. The groups were randomly assigned to use the system with prompts or without prompts. After solving the problem, the groups presented their solutions to each other and the two groups were voted on. The following week, the same problem-solving and pre-questionnaire was conducted, with or without prompts. The problem-solving task then was Problem B, shown in Table 2.

Table 2
Problem-solving object

Problem A
Read the conditions below and create your tour! Let's create a tour for a group of tourists from the USA who are coming to Japan to see the sights! Meet at Umeda station at 10am and plan an itinerary that takes one day to complete. First time in Japan They like Japanese culture and want to go sightseeing so that they can feel the culture of Japan. I would like to eat something for lunch that makes me feel Japan. Let's create a tour and decide on the selling points that will be our selling point!
Problem B
Sister City Promotion Programme The City of London (UK) is one of Tokyo's sister cities. You have been asked to plan a one-day sightseeing itinerary as part of a sister city promotion project organised by the Tokyo Metropolitan Government. Please find out the advantages of the sister cities, set up a uri and make a plan so that more Tokyo residents will want to participate in the project. The event is scheduled to be held in July. Please plan to visit at least three places. Paddington Station will be the meeting and disbanding point.

Results

The problem-solving process was observed and the number of ideas generated during problem solving was measured. The results, and the number of ideas generated, showed that the group with prompts had an average of 10.13 ideas, while the group without prompts had an average of 8.08 ideas.

The dialogue during the problem-solving process was also observed to investigate what kind of dialogue was encouraged when the prompts were read out. From this, it was confirmed that the problem-solving process was monitored within the group. Specifically, it was observed that the participants reflected on the problem-solving process and checked whether they were able to discuss the problem-solving process within the group without excesses or deficiencies.

In addition, we observed that the prompts prompted the participants to search for information. Specifically, the prompts encouraged the participants to discuss the information they needed at that moment, and they were observed to perform detailed information retrieval.

Furthermore, dialogue showing difficulties in problem solving appeared only in the unprompted group. On the other hand, dialogue indicating that problem solving was completed appeared only in the group with prompts.

Conclusion

In the common subject of information science, guidance on the problem-solving process is required. In order to support this instruction, prompts were developed and their effectiveness was verified in this study. The results suggest that the prompts are effective.
For example, monitoring was encouraged, the problem-solving process was made more precise, and the students were seen to search for information in more detail. Furthermore, it was suggested that the prompts facilitated problem solving and completion. On the other hand, only the group without prompts showed difficulties in the problem-solving process. This indicates that prompts can support the problem-solving process.

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Early Childhood Educational Interactive Materials Utilizing IoT and Evaluation by Childcare Providers

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Abstract…Amidst the rapid advancement of ICT education utilization, various applications are being announced daily. In modern education, the utilization of ICT has become essential. Through its utilization, many educational benefits such as deepening understanding, satisfying curiosity, and connecting to problem-solving have been achieved. In this modern era where ICT education utilization has progressed significantly, attention turns to its trends in early childhood education. The utilization of ICT in early childhood education is mostly observed in administrative aspects. However, activities involving the use of ICT with children in daily childcare routines are still limited. We, the authors, have been working on strategies for utilizing ICT in childcare for many years. This paper reports on the development proposal of early childhood educational interactive materials utilizing IoT and the evaluation of these materials by childcare providers.

Keywords: Early childhood education, Effective use of ICT in childcare, Hands-on experience, IoT (Internet of Things)

Introduction

Early Childhood Education and ICT

The authors have been conducting research on the integration of ICT in early childhood education for young children since 2015. This research was initiated by the observation that there are significantly fewer examples of ICT use in daily childcare (education) for young children in Japan compared to its more widespread adoption in elementary schools and beyond. In a survey conducted by the authors on the use of ICT in early childhood education, it was found that only a few respondents were opposed to the idea. However, a significant number of respondents emphasized the importance of "real-life experience" in early childhood. Many were open to the use of ICT in childcare but were uncertain about the most effective ways to implement it. This indicated that while there is a growing interest in incorporating ICT into early childhood education, its practical application remains limited.

The authors posit that "actual experience" is crucial for the successful integration of ICT in early childhood education. Addressing this need is essential for the advancement of ICT usage in this field. Recognizing the importance of experiential learning, the authors have developed IoT-based educational materials aimed at enhancing interactive learning experiences for young children. These materials are designed to go beyond traditional audiovisual tools, offering a more immersive and engaging way for children to interact with educational content.

This paper reports on the development of these IoT-based educational materials and their evaluation by caregivers. The authors have proposed a novel approach to "IoT educational utilization," which seeks to combine the benefits of ICT with the experiential learning crucial to early childhood education. By integrating IoT technology, the authors aim to create a more dynamic and responsive educational environment that can better engage young children and support their developmental needs.

The study highlights the potential of IoT to transform early childhood education by providing interactive, hands-on learning experiences that align with the developmental stages of young children. Through the evaluation conducted by caregivers, the paper examines the practical implications of using IoT in early childhood settings and explores the ways in which these technologies can be effectively integrated to enhance the learning experience. The findings suggest that while traditional ICT tools have primarily focused on visual and auditory stimulation, the inclusion of IoT opens up new possibilities for physical interaction and sensory engagement, making learning more holistic and impactful.

In conclusion, the authors assert that the future of early childhood education lies in the thoughtful integration of ICT and IoT, with a strong emphasis on creating authentic, experiential learning opportunities. This paper aims to contribute to the ongoing discourse on educational technology by providing insights into the development and evaluation of IoT-based teaching materials, ultimately advocating for a more interactive and engaging approach to early childhood education.

ICT Education Utilization

Use of ICT in Early Childhood Education. In today's "Information Society", the integration of Information and Communication Technology (ICT) across various fields has become a common phenomenon, primarily aimed at reducing workloads and improving efficiency. In education, numerous reports have highlighted the positive impacts of ICT on fostering independence, enhancing problem-solving skills, and promoting deep learning. However, in early childhood education, the application of ICT has been largely limited to administrative tasks, with its use in direct educational interactions with young children being exceptionally rare.

While the effective use of ICT for administrative purposes, such as attendance management and event photo purchasing systems, significantly alleviates the workload of busy childcare providers, should its utilization be confined to administrative functions alone? The Global and Innovation Gateway for All (GIGA) School Program and Reiwa Era Japanese-style school education initiatives (2021) have established the infrastructure for one ICT device per student in elementary and higher education institutions. This infrastructure has sparked a wave of innovation in ICT applications, leading to rapid research, development, and reporting on its educational uses.

In contrast, early childhood education has lagged in this wave of ICT integration, with limited incorporation of ICT into daily educational practices. Since 2015, the authors have been investigating the potential of ICT in early childhood education, prompted by concerns that Japan's early childhood education system lags significantly behind elementary and higher education levels in ICT utilization.

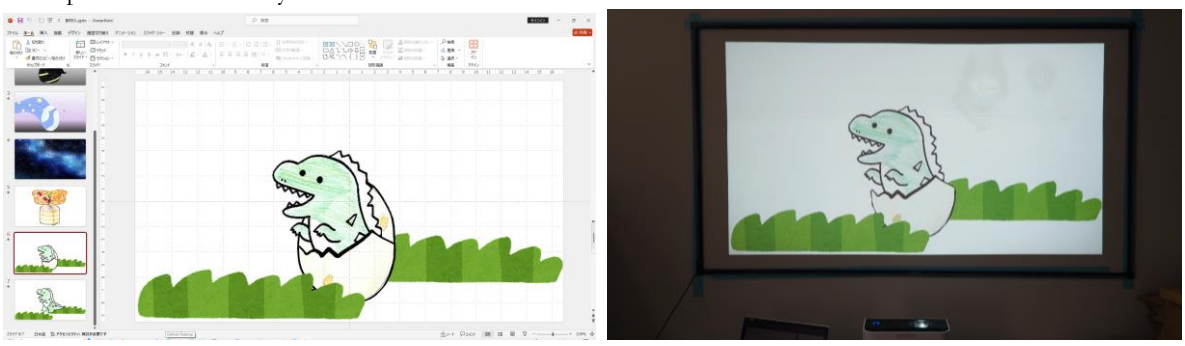
A survey conducted by the authors among childcare providers revealed minimal opposition to the use of ICT in early childhood education. However, a majority emphasized the necessity of "real-life experiences" during early childhood. While there is interest in integrating ICT into childcare, many educators are uncertain about its practical application, highlighting a gap between interest and actual implementation.

The authors propose that the key to successful ICT integration in early childhood education lies in addressing the need for "real-life experiences." Only by meeting this requirement can the full potential of ICT in early childhood education be realized. This paper reports on the development and evaluation of IoT-based educational materials for early childhood education, created by the authors as part of their initiative for "IoT educational utilization." This effort aims to enrich and innovate early childhood education through the application of advanced technological solutions

ICT Childcare Utilization for Young Children - ICT Educational Material ePicture-Story Show. Since 2015, the authors have continued to focus their research on the use of ICT in early childhood education. Therefore, we thought it was necessary to develop educational materials that would be closely related to daily childcare activities. The authors have taken on this challenge and developed an electronic picture-story show using PowerPoint as an ICT-based educational material. Therefore, we thought that PowerPoint would be relatively easy to understand, despite the reticence to use ICT. In the storytelling using picture books and picture-story shows that are used in daily work, the picture books and story-story shows are replaced with electronic picture-story shows (picture books) developed by the authors. The appeal of the ePicture story show (picture book) lies in its ability to realize animations and sounds corresponding to the characters and scenes in the story, which is impossible to achieve with ordinary picture books and picture storytelling. We have created an educational material that allows the reader to not only listen to a story, but also to become more familiar with the story through animated expressions, creating an environment that allows the reader to become immersed in the story.

Figure 1

Example of ePicture Story show.



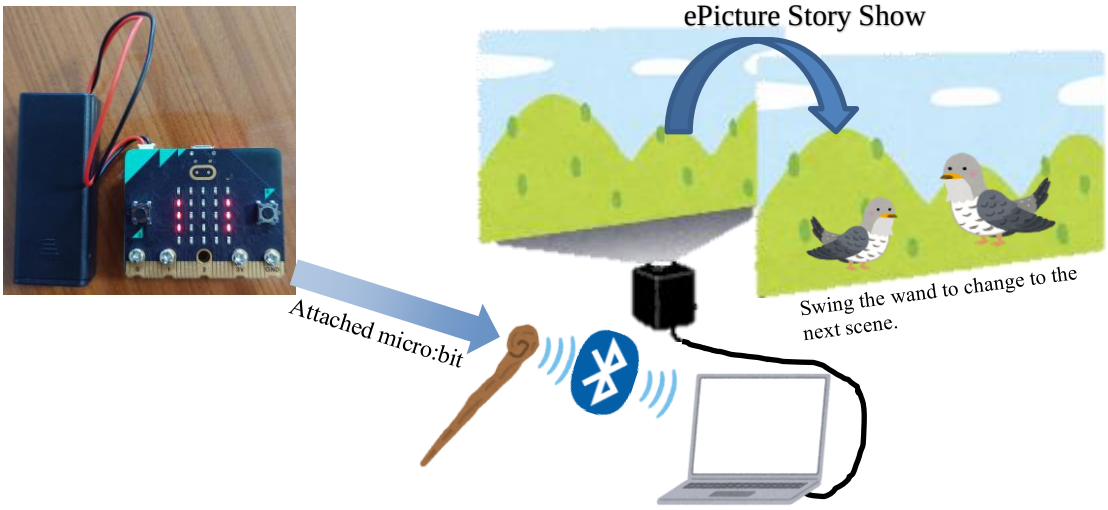
The ePicture-story show using PowerPoint, which the authors have been developing, has shown certain results. Childcare providers also evaluated the ePicture-story show, saying that while large picture books are easy for young children to read, they are heavy and difficult to read to them, ePicture-story shows can be projected larger than large picture books and can be used with a large group. On the other hand, while the animation and the ability to produce sounds that match the situation and timing of the story were seen as appealing, others said that regular picture books and picture story shows were sufficient in other respects and that they would not go out of their way to actively use ePicture-story shows. This reluctance is an extremely valuable opinion. The reason for this opinion is that young children are more inclined to "watch" and "listen" whether the storytelling environment uses regular picture books or picture story shows or ePicture-story shows, and they do not feel the appeal of using ePicture-story shows. In other words, the key to success in the use of ICT in early childhood education is not only the use of ICT, but also the fulfillment of the "play" aspect that supports the development of young children.

Hands-on ePicture-Story Show: IoT Utilization in Childcare. The authors conducted research to address the shortcomings of ePicture-story shows mentioned in the previous chapter. As a result, they concluded that it would be possible to incorporate a new "experience" essential in early childhood education. In this enhanced electronic picture-story show, when the wizard waves his wand, children watching in real life can wave their wands, triggering the transition to the next scene in the electronic picture-story show. To realize this mechanism, the authors decided to use the micro:bit, which employs an accelerometer to detect the wand's movement. This device sends a signal via Bluetooth to a computer, simulating an Enter key press, thereby advancing the PowerPoint slide to the next scene.

In the various stories used for storytelling in early childhood education, many "waving motions" are involved, such as a wizard waving a wand or a sword. Since the waving action moves the story to its next development, it becomes easy for young children to predict the story's progression. By actively participating in the story using this material, children can be more engaged and involved in the narrative.

Figure 2

Picture of IoT Material and the image of using.



Evaluation of IoT Materials by Childcare Providers. The authors had the opportunity to gather evaluations of the developed teaching materials from childcare providers. The theme of the ePicture-story show was "Eggs." The story revolves around various things emerging from an egg. The illustrations used in the story were created by students aspiring to become nursery school teachers. The intended use of the teaching material involves attaching a micro:bit with a teaching material program to a hammer-like object. Using an accelerometer, various objects emerge from the egg when the hammer-object is shaken. The ePicture-story show is not only animated but also includes sounds that match the animation, aiming to further engage the audience in the story.

The authors asked childcare providers to try out this educational material and give us their opinions. Some of the childcare providers were familiar with electronic picture storytelling, having seen it performed by the authors in the past, and some had experience creating their own electronic picture stories when they were students. However, this was the first time anyone had seen and used IoT educational materials.

Some of the comments received were:

"I don't know how it works, but it's interesting."

"It will lead to the creation of a storytelling environment in which children can participate, rather than just watch."

"Because adults are so fascinated with it, children will be even more interested in it."

The authors had expected to receive some comments on the lack of material, but it seems that the participants were interested in the material itself, which responds to their physical movements and then responds back to them. Above all, as mentioned in the comments we received, the statement that children are more interested in IoT educational

materials because adults are fascinated with them" suggests that the IoT educational materials developed by the authors have high expectations for the future.

Also discussed the possibility of using compass sensors in future sensor-based teaching materials, such as those that detect when a person turns to the right or left. Additionally, we considered teaching materials that do not respond to small sounds made by one person (e.g., clapping), but respond to the next action when multiple people clap their hands in unison to produce a loud sound. The participants evaluated those educational materials leading to cooperative learning through multiple collaborations that trigger the next scene are very appealing.

Conclusion

In this paper, we have discussed the IoT educational materials proposed and developed by the authors and their subsequent evaluation. Our research emphasizes the necessity of integrating IoT with ICT education, rather than using it as an isolated tool. While most current ICT educational materials primarily focus on audiovisual stimulation, engaging mainly the visual and auditory senses, our approach aims to transcend these limitations by incorporating interactive, sensor-based experiences that engage children more holistically.

The use of ICT in education is still in its formative stages. However, it represents a crucial step towards the seamless integration of advanced technologies, which are essential for ushering in the era of Society 5.0 into the educational landscape. By fostering a more interactive and immersive learning environment, these technologies can significantly enhance the educational experience for young children, making learning more engaging and effective.

Our findings suggest that the integration of IoT into early childhood education holds immense potential for creating dynamic and responsive learning environments. This potential is further supported by positive feedback from caregivers, who noted the increased engagement and interest of children when using IoT-enhanced educational materials. Such feedback underscores the value of continuing to develop and refine these technologies.

Moving forward, we plan to expand our research and development efforts to include more advanced IoT educational materials. These materials will utilize a broader range of sensors beyond accelerometers, such as compass sensors and sound detectors, to create even more interactive and cooperative learning experiences. By doing so, we aim to facilitate the development of educational tools that not only capture children's attention but also promote collaboration and active participation.

In conclusion, the integration of IoT with ICT in early childhood education represents a significant and valuable advancement in educational technology. Our research and development efforts demonstrate the potential to transform traditional educational methods, making them more interactive and responsive to the needs of young learners. As we continue to innovate and explore new possibilities, we believe that these efforts will contribute to a richer, more engaging educational experience that aligns with the technological advancements of Society 5.0.

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Technology Integration in Hospitality Education: A Case of BPH

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Abstract

Technology integration is now pervasive across all fields and industries. Extensively discussed in the literature for its effectiveness, enhancement, and efficiency, technology integration has become a fundamental component of hospitality education, aimed at preparing future leaders in the industry. This paper investigates the impact of technology integration in the context of the Bachelor in Professional Hospitality (BPH)[i] program and explores how this integration contributes to developing BPH students into future hospitality leaders. To achieve this objective, a survey was conducted using purposive sampling with BPH students, and focus group discussions (FGDs) were held to assess its impact. Additionally, interviews with faculty members provided further insights into its effects. This paper also aims to offer a blueprint for a performative approach to technology integration in hospitality education, serving as a conclusion that initiates further research.

Keywords: Blueprint, Hospitality Education, Technology Integration,

Introduction

Recent advancements in educational technology have renewed interest in integrating three specific elements: Technology, Pedagogy, and Content, as outlined by Koehler and Mishra (2009). Mishra and Koehler (2009) further organized these into Technological Knowledge, Pedagogical Knowledge, and Content Knowledge, collectively termed Technological Pedagogical and Content Knowledge (TPACK). TPACK builds on Shulman's concept of Pedagogical Content Knowledge (PCK), emphasizing instructors' understanding of how to integrate technology into classroom instruction. The TPACK framework addresses the complexity of teaching by simultaneously integrating technology and pedagogical strategies to enhance instructors' competencies in technology integration (Bajracharya, 2019). Therefore, in this study, technology integration is defined as the implementation of technological resources and pedagogical strategies to deliver content knowledge in classroom instruction.

Numerous studies highlight the importance of technology integration to enhance teaching and learning effectiveness, flexibility, and classroom interactions (Bajracharya, 2021). It helps students understand the subject matter and increases engagement. Tools like YouTube videos, educational blogs, social media, software, and applications encourage learning beyond the classroom and improve critical thinking and communication skills. Thus, technology integration can enhance effectiveness, enhancement, and efficiency during teaching and learning.

This paper investigates the impact of technology integration in the Bachelor in Professional Hospitality (BPH) program and its contribution to developing future hospitality leaders. The study addresses two primary research questions: (i) How has technology integration impacted teaching and learning in the BPH program? (ii) What key leadership skills are fostered by technology integration?

To answer these questions, focus group discussions (FGDs) were conducted with students and faculty (for RQ (i)), and a Likert scale survey was administered to BPH students (for RQ (ii)).

The FGDs revealed that the integration of technology through platforms like MOODLE and G-Meet, both in physical and online classes, enabled students to acquire substantial content knowledge and hands-on experience via internships starting from the third semester. This blended learning approach allowed students to attend college physically once a week while participating in online classes and industry internships for the remaining days. Consequently, technology integration facilitated continuous teaching and learning, even with a demanding schedule of one physical classroom session and six online sessions per week. Additionally, students reported that balancing university education and real-world internships from the second semester onward enhanced their time management skills.

Faculty feedback indicated that technology integration allowed for the use of diverse teaching resources, enriching students' knowledge, competencies, and mindsets beyond the traditional classroom environment. Faculty also noted that BPH students developed superior exploratory competencies compared to those in programs relying solely on physical classroom instruction.

Further survey results (N=57) reveal that technology-integrated teaching and learning significantly enhances several key leadership skills. Notably, data-driven decision-making abilities, self-directed learning, and communication and collaboration skills were markedly improved. The integration of technology into the BPH program provided students with the tools and opportunities to engage in real-time data analysis, fostering a culture of informed decision-making. This technological immersion also promoted self-directed learning, encouraging students to take initiative and responsibility for their

own educational journeys. Enhanced communication and collaboration skills were another major benefit, as students regularly interacted with peers and instructors through various digital platforms, honing their ability to work effectively in team settings.

Additionally, the survey indicated that students developed a high level of digital fluency, which proved beneficial in their workplace environments. This digital fluency encompassed the ability to seamlessly adapt to new technologies, a crucial skill in the rapidly evolving hospitality industry. Students reported feeling more confident and competent in navigating and utilizing new technological tools and systems, which enhanced their overall workplace performance. This adaptability not only made them more efficient in their current roles but also prepared them to tackle future technological advancements with ease. The integration of technology in the BPH program thus not only enriched the students' educational experiences but also equipped them with essential skills for their professional careers

The integration of technology in the Bachelor in Professional Hospitality (BPH) program has had a significant positive impact on both teaching and learning processes. The use of platforms like MOODLE and G-Meet has enabled students to acquire substantial content knowledge and practical experience through a blended learning approach, combining physical classroom sessions with online classes and industry internships. This integration has fostered continuous learning, improved time management skills, and allowed for a more flexible and interactive educational environment. Faculty feedback also highlights that technology integration has enriched students' knowledge, competencies, and mindsets by providing access to diverse teaching resources and promoting exploratory learning beyond traditional classroom settings.

Based on the findings of this study, it is recommended that educational institutions adopt and expand technology integration within their programs to enhance teaching effectiveness and student engagement. Emphasizing the development of key leadership skills such as data-driven decision-making, self-directed learning, and communication and collaboration skills should be prioritized. Additionally, fostering digital fluency among students will prepare them to adapt to new technologies in the workplace,

ensuring they remain competitive in the rapidly evolving hospitality industry. Institutions should continue to support and invest in technological infrastructure and training for both students and faculty to maximize the benefits of technology-integrated education.

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[i] The Bachelor in Professional Hospitality is a full-time undergraduate program designed and developed by Kathmandu University, Nepal. This program is the first of its kind in Nepal to adopt an experiential approach, with students attending college in their first semester and participating in internship placements in the hospitality industry starting from the second semester. This innovative program ensures that students will graduate with their Bachelor's degree after acquiring at least three years of industry experience.

XR educatinal-technology framework development and requirement analysis

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Abstract.
With the development of XR technology, the amount of content utilized in education and training is increasing. Although research has been conducted centering on XR technology, there is a need for research on content development and design while applying it to education and training. In this study, we defined XR learning-technologies for education and training and revised and developed a framework. We developed four levels of XR learning technologies for user behavior and intervention based on 17 experts. We checked the CVR values to confirm the appropriateness of XR learning-technologies; examined the current technology level and technology importance to identify differences; and prioritized technology development according to Borich needs. As a result, we developed four stages of XR learning based on the characteristics of behavior relevance, gesture interactivity, and immersion, and found that the CVR values of the XR learning technology framework were statistically significant. Among the XR learning technologies, gesture recognition and location recognition were identified as technologies that urgently need to be developed. The results of this study can be used as a design and development guide when developing XR training technologies and content.

Keywords: XR(eXtended Reality), Educational Technology, Requirement Analysis, Framework

Introduction

Extended reality (XR, eXtended Reality) is a technology that collectively refers to virtual reality (VR), augmented reality (AR), and mixed reality (MR). Various industrial uses are expanding, from educational fields such as medical training and military training to games, sports viewing, mobility services, prototype development, and maintenance such as remote repair. In particular, for future talent Digital capabilities such as AI and big data are in demand, and accordingly, advancement of educational content and methods is required (Korea Ministry of Science and ICT, 2020). One of the ways to solve this problem is an educational approach using XR technology. XR has the characteristics of ultra-realism that stimulates the multi-senses of VR, AR, and MR technologies, allowing you to experience highly immersive learning similar to the real thing. Additionally, users have the advantage of being able to experience interaction with multiple people rather than alone in a virtual environment where social activities, learning, and play are possible through 5G's fast network and smart glasses. In particular, as the speed of data transmission increases due to the development of 5G technology, interaction between content, learners, and instructors becomes possible, and interest and attempts are being made to apply this to education to confirm educational effectiveness.
However, limitations of XR technology in the education field include cognitive burden, difficulty in long-term use, lack of educational content, burden of equipment purchase costs and difficulty in management, and the need for high technical skills to implement XR (Pimentel, et al., 2022). In other words, XR technology is developing technical elements and content through various studies, but it is difficult to confirm the educational effect because it is developed for research purposes and applied for a short period of time. Additionally, due to the broad concept and technology spectrum of AR, VR, and MR, XR technology has limitations in its active application in educational settings. To solve this problem, recent studies are attempting to develop design guidelines. Yang, Zhou, and Radu (2020) analyzed 70 previous studies and identified six areas (physical accessibility of learning content, formality of learning scenarios, social interactivity, and learner initiative) to design educational experiences using XR, the degree of virtuality of the learning experience, and learning evaluation) guidelines were developed. In addition, Suh Hee-jeon (2008) and Pimentel and his colleagues (2022) report the characteristics and important technologies for designing meaningful learning experiences using XR technology, particularly emphasizing immersion, interaction, and visualization technologies. Previous studies presented design guides focusing on the features and advantages of XR technology rather than the spectrum of XR technology, so there are limitations in concrete application in educational settings.

Therefore, in order to increase the applicability of XR technology in educational settings, this study presents a framework from the perspective of XR educational technology and based on this, confirms the current development level and importance of XR educational technology and helps engineers and teachers who want to develop XR educational technology. We aim to provide practical and effective suggestions to companies and institutions. In this study, we will focus on interaction recognition technology among XR education technologies.

Research Design & Methods

Procedure and participants. To achieve the purpose of this study, we developed a draft XR educational technology framework through literature research and interviewed three experts (a representative of an XR education and training company, a university professor majoring in XR technology development, and a teacher with experience in research on the use of XR educational technology). The framework was modified through focus group interview. After securing the feasibility of the XR framework, a survey was conducted regarding the current technology level and awareness of importance. A total of twice Delphi rounds were conducted with a total of 17 experts using the derived XR education technology framework. In a Delphi study, the size of the panel is appropriate to consist of 10 to 20 people to reach a consensus among experts (Okoli, Pawlowski, 2004). In this study, a total of 17 experts were selected by dividing them into a total of 5 domains. Specifically, the participants in this study include 4 engineers and professors who research and develop XR technology, 4 corporate educators and trainers who provide education and training using XR technology, and 3 current teachers who are educational designers using XR technology. Also 4 researchers from university and government agencies in the field of education and training using XR technology, and 2 experts in industries where XR technology is applied responded.

Research Tools. To conduct this study, Johnson-Glenberg, Birchfield, Tolentino, & Koziupa (2014) developed Texanomy for collaborative activities in an environment using MR technology, and Johnson-Glenberg (2017) developed it into an XR environment (AR, VR, MR) were modified and supplemented. Texanomy is divided into 4 levels (1st degree-4th degree) depending on the degree of movement, and each level divides content according to 3 components (Sensorimotor engagement, Gestural congruency, and Sense of immersion). Looking at the components, Sensorimotor engagement refers to the degree to which the whole body or limbs are mapped, Gestural congruency refers to the consistency of operating the system with gestures, and Sense of immersion refers to interaction. This study used Johnson-Glenberg's (2017) XR learning experience by modifying the taxonomy for design. In order to survey the current level and importance of XR educational technology, a survey was conducted focusing on interaction technology. XR education and training content includes interaction at various levels. Interaction occurs through the response of the instructor, learner, and system according to the goal or model of education. As for the interaction technology used in this study, six interaction recognition technologies (gesture recognition, voice recognition, touch recognition, face recognition, location recognition, and biometric recognition) were derived from previous research (Porcino et al., 2022; Mitra & Acharya, 2007; Kabir et al., 2007; Qiwen et al., 2016; Sharif et al., 2017; Manesis & Avouris, 2005) and used in the survey.

Data analysis method. Data collection for analysis was conducted online from September to October 2023. CVR values were calculated to verify the validity of the XR educational technology framework. In the Delphi survey, experts' agreement on content validity was confirmed by calculating the CVR value suggested by Lawshe (1975), and since there were 17 panelists, .52 was used as the minimum standard to determine whether to adopt it (Lawshe, 1975). After confirming validity, a questionnaire was constructed so that one respondent would respond to both the current technology level and importance in order to confirm the perception of XR educational technology experts. A paired samples t-test was conducted to test the differences in the perceptions of XR educational technology experts. Next, Borich needs analysis and The Locus for Focus Model were applied to derive needs priorities for each detailed factor. Borich's formula calculates the degree of demand by multiplying the total difference value by subtracting the current level from the importance of each item by the average value of importance and then dividing by the total number of cases. At this time, it can be interpreted that the larger the size of the calculated demand coefficient, the higher the priority of the request.

Results

1. Validation of the XR educational technology framework

The first and second Delphi surveys were conducted on the XR educational technology framework. As a result of the first Delphi survey, opinions on the level of immersion and interactivity were presented, and these were reflected and finally derived as shown in <Table 1>.

Table 1 *Delphi results on XR educational technology framework (n=17)*

XR educational technology framework validity	*M*	*SD*	*CVR*
The framework of XR educational technology is valid.	4.6	0.62	0.88

2. Differences in perception of the current technology level and importance of interactive recognition technology among XR educational technology experts

Descriptive statistics on the current technology level and perception of technology importance for XR education technology and the results of paired-sample t-test analysis of the differences are shown in <Table 2>. The importance awareness of gesture recognition and location recognition was higher than the current technology level, and the difference was found to be statistically significant (**p** <.05). The perceived importance of voice recognition, face recognition, and biometric recognition was higher than the current technology level, but the difference was not statistically significant. The current technology level for touch recognition was found to be higher than the importance of the technology.

Table 2 *Descriptive statistics and difference analysis of current technology level and importance of XR education technology (n=17)*

Interactive Recognition Technology	Current Tech Level(A)		Technology Importance(B)		*(*A)-(B)/*n*		Borich Needs	
	M	*SD*	*M*	*SD*	Mean Difference	*t*-Value	coefficient value	Priority
Gesture Recognition	3.494	0.50	4.588	0.51	1.094	.744*	5.020	1
Voice Recognition	3.876	0.70	4.118	0.93	0.241	.523	0.993	5
Touch Recognition	4.435	0.79	4.176	0.81	-0.259	-1.387	-1.081	6
Facial Recognition	3.559	0.79	4.059	0.66	0.500	.134	2.029	4
Location Recognition	3.806	0.81	4.529	0.80	0.724	.203*	3.277	2
Biometric Recognition	3.124	1.11	3.765	1.20	0.641	.076	2.414	3

*p <.05

As a result of expert Delphi on interaction recognition technology according to the XR educational technology framework, there were multiple responses as shown in <Table 3>. Gesture recognition technology, location recognition, biometric recognition, and facial recognition (eyes, facial expressions) were answered as technologies required as mobility and immersion increase. However, touch recognition and voice recognition appeared to be technologies required in content or environments with low mobility and immersion.

Table 3 *Relationship between XR educational technology framework and interactive recognition technology (n=17) (n(%))*

Interactive Recognition Technology	Level1	Level2	Level3	Level4	Total
Gesture Recognition	2(1.30)	5(3.25)	8(5.19)	10(6.49)	25(16.23)
Voice Recognition	3(1.95)	7(4.55)	10(6.49)	8(5.19)	28(18.18)
Touch Recognition	4(2.60)	11(7.14)	6(3.90)	6(3.90)	27(17.53)
Facial Recognition	3(1.95)	6(3.90)	6(3.90)	10(6.49)	26(16.88)
Location Recognition	2(1.30)	3(1.95)	5(3.25)	14(9.09)	24(15.58)
Biometric Recognition	1(0.65)	5(3.25)	5(3.25)	12(7.79)	24(15.58)
Total	15(9.74)	37(24.03)	40(25.97)	60(38.96)	154(100)

Discussion and Conclusion

This study presents an XR educational technology framework to utilize XR technology, which is one of the educational methods and technologies that can improve the digital capabilities required for future talent, in educational settings, and examines the current technology level and technology importance of interactive recognition technology. The difference was analyzed. The implications based on the main results of this study are discussed as follows. First, the

XR educational technology framework was divided into four levels according to the operation level, interaction level, and immersion level. To test the validity of the proposed framework, a Delphi was conducted with 17 experts, and the final draft was finalized. Second, as a result of testing the difference between the current technology level and technology importance of interaction recognition technology based on the XR educational technology framework with guaranteed validity, gesture recognition and location recognition were statistically significant, but voice recognition and touch Recognition, facial recognition, and biometric recognition were not statistically significant. Interactive recognition technology, where the recognition difference was statistically significant, is an area with a high demand for development. Additionally, if interpreted as an XR educational technology framework, it can be interpreted that the higher the immersion and the higher the movement, the more required the technology is. In particular, touch recognition can be interpreted as an area with high technological completeness, as the current technology level appears to be higher than its importance.

Interaction in XR technology is the act of a user accessing and changing the contents of the environment, objects and information within it in various ways within a virtual environment or mixed reality environment, and exchanging and influencing information with other users. Because it refers to the act of giving, it is an important XR education technology in confirming learning effects. The research results conducted in this study will be able to provide practical implications on how to classify XR educational technology into the technological concept spectrum of XR (AR, VR, MR) and how to develop and apply it appropriately. Since this study derived interaction recognition technology through literature analysis, it has the limitation of not considering detailed interaction recognition technology. In the future, it is necessary to analyze the requirements for educational technology suitable for the XR educational technology framework by detailing the detailed interaction recognition technology.

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Development and Effectiveness of a Food Education Support System

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There is a global need for improving food education. In Japan, the Basic Law on Shokuiku (Food Education) was created in 2005, and educators have become more active in promoting food education for children since then. In a previous study using a food education system that gave nutritional advice based on several days of meals, it found that the system was easy to use and made people more aware of their eating habits. However, no major diet improvements were seen, likely because participants weren't motivated. To improve this, we developed a food education support system with a function to present possible future diseases caused by nutritional excesses or deficiencies. The results with high school and elementary students showed increased awareness but no large changes in eating habits. Future efforts will focus on studying eating patterns to suggest specific improvements.

Keywords: computer education, food education, eating habits, nutritional, consciousness raising

Introduction

Background

Food education is becoming a pressing issue worldwide (Marie, 2014). In Japan, the Basic Law on *Shokuiku* (Food Education) was enacted in 2005 (Ministry of Agriculture, Forestry and Fisheries, 2005), and educators have become more active in promoting food education for children since. The law requires the development of efficient and effective materials that can be easily utilized by anyone. In this context, it has been reported that computer-based food education has a stronger motivational effect on improving dietary habits than general food education (Johannes, 1999).

Issue in Computer-Based Food Education

In a previous study using a food education support system (Sakurai 2022), nutritional assessment and advice were provided based on multiple days of dietary data, with breakfast, lunch, dinner, and snacks as the four meals for one day. The results showed a high usability of the food education support system and an improvement in awareness of dietary habits and dietary content. However, no specific improvements in dietary content were observed. One possible reason for this is that the participants were not highly motivated to improve their diet. They may have struggled to envision the future consequences of their current dietary habits due to a sense of continuity.

Purpose

In this study, we developed a food education support system with a function to present possible future diseases caused by nutritional excesses or deficiencies. The purpose was to develop a system that would encourage people to change their dietary behavior.

Research Design & Methods

System Overview

The food education support system used in this study is based on the system named "What would you like?" (Takahashi, 2011), a food education support system in Japan. For this study, a function to present possible future

diseases caused by nutritional excesses or deficiencies was added. The system was developed to run in a web browser using HTML, CSS, and JavaScript. It can be used anywhere with Internet access. Additionally, MySQL and PHP were used in the system to store the selected foods as data.
The system consists of four main stages. In the first stage, a learner registers personal data such as height and weight (Figure 1). In the second stage, the learner chooses meals (Figure 2). In the third stage, the learner learns about the nutritional information of the chosen meals (Figure 3). In the fourth stage, the learner learns about the advice to improve the diet for the meals (Figure 4, 5). In this study, we added the function of showing possible future illnesses, as shown in Figure 5.

Figure 1

Personal Data Registration

Figure 2

Food Setting

Figure 3

Daily Nutritional Assessment

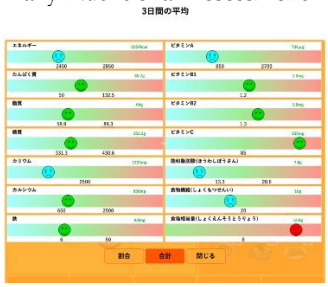

Figure 4

Advice

Figure 5

Food and Risk Presentation

Experimental Summary

The purpose of this study is to promote behavioral changes in diet by using a system that adds a new functionality to the food and risk presentation screen to present possible future diseases caused by excess or deficiency of nutrients. Two experiments were conducted, one with elementary school students and the other with high school students.
The subjects of the first experiment were 16- to 17-year-old Japanese high school students. IDs prepared in advance were assigned to the students, and computer-based food education classes were conducted using these IDs. After the nutrition education class using the system, a questionnaire (Table 1) survey was conducted to evaluate the system and investigate the effectiveness of food education. The higher the number on the questionnaire, the higher the evaluation. The questionnaire conducted in this experiment is presented as Questionnaire 1.

Table 1

Contents of Questionnaire 1

Question Number	Question Content
1	Do you think that through using this system you will think better about food? (1: Disagree 5: Agree)
2	Which of the following screens do you find most helpful in improving your diet? (choose one from A: Advice Screen B: Daily Nutritional Assessment Screen C: Food and Risk Presentation Screen)
3	Which of the following screens was the most impressive function? (choose one from A: Advice Screen B: Daily Nutritional Assessment Screen C: Food and Risk Presentation Screen)
4	Which of the following functions do you think are needed in the following advice? (choose one from A: Advice Screen B: Daily Nutritional Assessment Screen C: Food and Risk Presentation Screen)

Question Number	Question Content
5	Do you feel that your awareness of food has changed through this system? (1: Disagree 5: Agree)
6	Do you think you will change your dietary behavior through this system? (1: Disagree 5: Agree)

Before the second experiment, the food and risk presentation screen was modified (figure 6). The second experiment was conducted with elementary school students aged 11 to 13. IDs prepared in advance were assigned to the students, and computer-based food education classes were conducted using these IDs. Questionnaires were sent to the students after the food education class using the system improved from the first experiment and one week after the class, to evaluate the system and to investigate the effectiveness of the food education. The higher the number, the higher the evaluation. Questionnaire 2 (Table 2) was the same-day questionnaire conducted soon after the experiment, and Questionnaire 3 (Table 3) was the questionnaire conducted one week after the experiment.

Figure 6

Modified Food and Risk Presentation

Table 2

Contents of Questionnaire 2

Question Number	Question Content
7	Which of the following screens had the most impressive function? (choose one from A: Advice Screen B: Modified Food and Risk Presentation Screen C: Daily Nutritional Assessment Screen)
8	Which of the following screens do you find most helpful in improving your diet? (choose one from A: Advice Screen B: Modified Food and Risk Presentation Screen C: Daily Nutritional Assessment Screen)
9	Do you think that through this system you will be able to think better about food? (1: Disagree 5: Agree)

Table 3

Contents of Questionnaire 3

Question Number	Question Content
10	How is your awareness of dietary content? (1: Low 5: High) (1) Before food education class (2) After food education class
11	Choose the function of this system that has improved your awareness of eating habits. (choose one from A: Advice Screen B: Modified Food and Risk Presentation Screen C: Daily Nutritional Assessment Screen)
12	Did your diet change after the food education class? (1: No 5: Yes)
13	Did the "Show Risks of Nutritional Intake" functionality help you change your diet? (1: No 5: Yes)

Results

The results of each questionnaire are as follows (Table 4). Questions with answers A, B, and C are shown as percentages (Table 5, 6).

Table 4

Result of Questionnaires

Question Number	Mean	Standard Deviation
1	4.47	0.83
5	4.18	0.85
6	4.39	0.72
9	4.23	0.90
10 (before class)	3.15	1.00
10 (after class)	4.06	0.61
12	3.46	1.06
13	4.12	0.84

Table 5

Result of Questionnaire 1

Question Number	A	B	C
2	42.9%	46.4%	10.7%
3	46.4%	35.7%	17.9%
4	41.0%	41.0%	17.9%

Table 6

Result of Questionnaire2

Question Number	A	B	C
7	16.0%	16.0%	68.0%
8	28.0%	20.0%	52.0%
11	27.3%	12.1%	60.6%

Conclusion

The results showed that the food education support system in this study successfully raised awareness about food education. However, it did not lead to specific changes or actions regarding dietary content. In other words, the system was not effective in motivating students to improve their dietary habits. This may be due to the lack of specific instructions for dietary improvement related to the disease and the students' inability to act on their own. As a future task, we will conduct a more detailed investigation of dietary trends to propose specific improvement plans.

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A Proposal of Design Principles for Face-to-face Classes as Blended Learning in Correspondence High Schools

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The purpose of this study is to propose a prototype of design principles for face-to-face mathematics classes in correspondence high schools, based on a qualitative analysis of the design and implementation. This study was conducted in 2022 with 270 students taking the required "Mathematics 1" course in a correspondence high school in Japan. To qualitatively analyze the effectiveness of the design and implementation of the face-to-face classes, open-ended questionnaires surveys were conducted with students. The open-ended data were analyzed using the thematic analysis. As a result of the analysis, this paper proposes "implementation of personalized instruction with consideration of interpersonal relationships" and "implementation of self-paced learning" as prototypes of design principles for face-to-face classes in correspondence high schools. A future work is to verify and improve the prototype of the design principles proposed in this paper in multiple cycles of design research.

Keywords: Correspondence High Schools, Blended Learning, Design-Based Research, Mathematics education, Personalized Instruction

Introduction

Blended learning is defined as a thoughtful integration of classroom face-to-face learning experiences with online experiences (Garrison & Kanuka, 2004). The advantages and benefits of the blended learning approach in optimizing teaching and learning have been revealed in numerous influential studies (Dziuban et al., 2018). The main challenge that learners face in the online part of blended learning is self-regulation, which includes procrastination (Rasheed et al., 2020). Therefore, face-to-face instruction of blended learning should be designed to support the challenges of the online part.

Most of correspondence high schools in Japan are classified as blended learning because they are offered not only through online self-learning but also through some required face-to-face classes. Although correspondence high schools are primarily self-learning, they also enroll students with low self-regulation skills. Recent Japanese correspondence high schools are expected to play an inclusive role for diverse students such as those with school refusal, developmental disabilities, and mental health problems, due to their flexible learning system in terms of time and place.

In blended learning for diverse students, it is important to personalize instruction to address individual differences. Watson & Watson (2016) introduced the Personalized System of Instruction (PSI) (Keller, 1968) as one model of personalized instruction. The canonical version of PSI proposes the following five essential elements (Purao et al., 2017): 1) availability of written materials, 2) discrete content units for which learning objectives can be defined, 3) self-paced learning, 4) unit mastery as a prerequisite for moving on to the next unit, and 5) human proctors as arbiters of unit mastery. PSI has been shown to be effective in many educational settings, particularly universities (Kukik et al., 1979; Mannion et al., 2023), and has been applied to distance education (Grant & Spencer,2003).

Blended learning using PSI has been practiced in Japanese correspondence high schools. Kato et al. (2022) designed face-to-face blended learning classes using PSI in mathematics at a correspondence high school. The quantitative analysis showed that students were highly satisfied and motivated to learn, and the course dropout rate improved. However, the challenge is that no qualitative analysis was conducted and design principles for face-to-face classes in correspondence schools were not considered and proposed. The purpose of this study is to propose a prototype of design principles for face-to-face mathematics classes in correspondence high schools, based on a qualitative analysis of the design and implementation.

Methods

The primary goal of DBR is to design learning opportunities and produce theories of learning related to those opportunities through iterative cycles of design, implementation, analysis, and redesign (The Design-Based Research Collective, 2003). In this study, only one cycle of design, implementation, and analysis was conducted, and a prototype design principle was considered from the results.

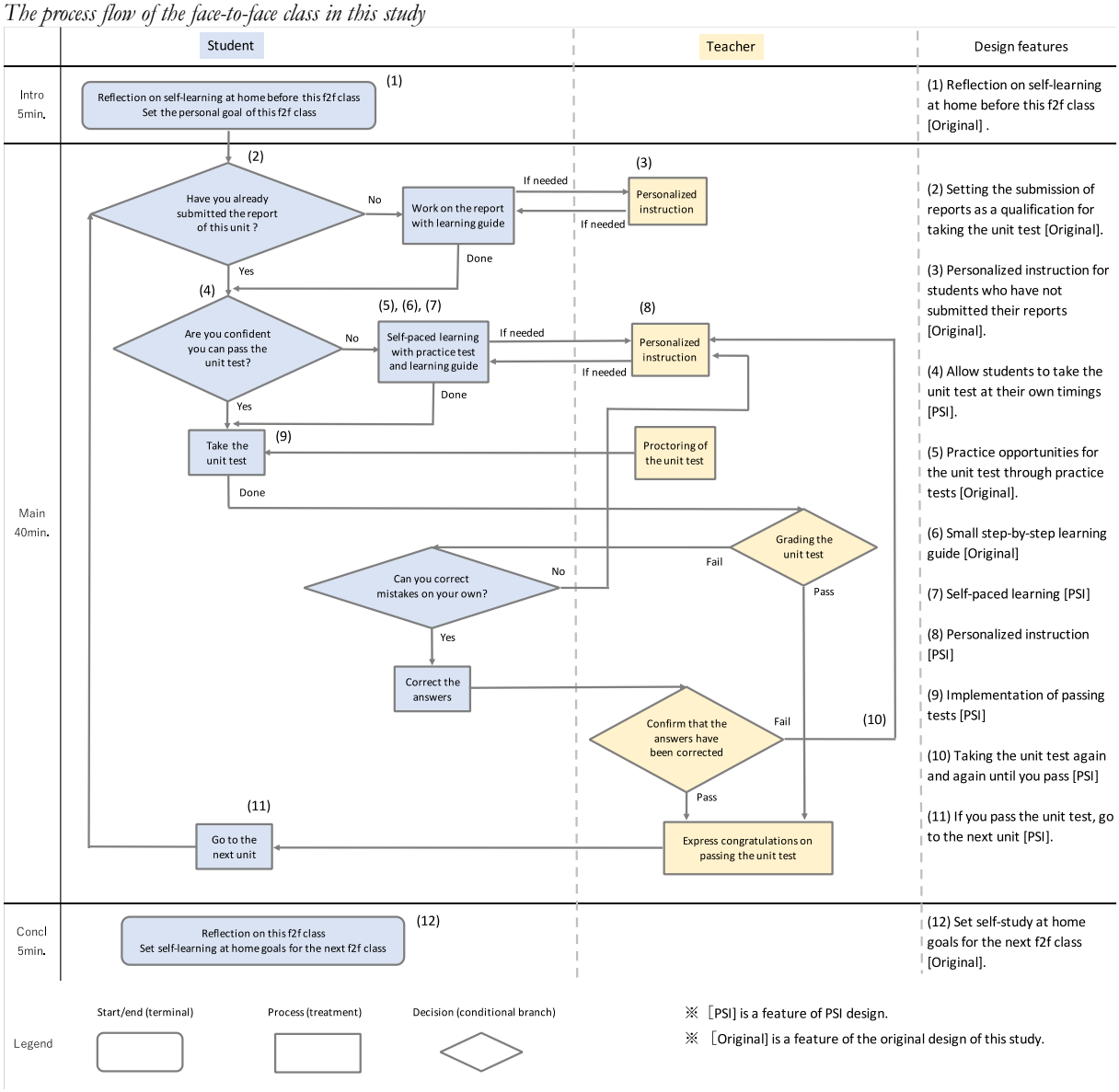
This study was conducted in 2022 with 270 students taking the required "Mathematics 1" course at a correspondence high school in Japan. In this course, the three requirements for course completion were: 1) passing nine practice problem reports, 2) attending at least three face-to-face classes, and 3) scoring at least 30% on the regular examinations. Each face-to-face class lasted 50 minutes and was taught by two teachers, one of whom was the first author with a maximum of 40 students.

Figure 1 shows the process flow of the face-to-face class in this study. The face-to-face class was designed with the following three intentions: 1) to adapt students from diverse academic backgrounds, 2) to promote self-learning at home before and after the face-to-face class, and 3) to consider students' difficulties in mathematics. The design of the face-to-face classes in this study included 12 features ((1) ~ (12) in Figure 1), six features (4), (7), (8), (9), (10), and (11) in Figure 1) were PSI's, while the other six features ((1), (2), (3), (5), (6) and (12) in Figure 1) were original to this study. PSI is not only simply implementation of the original model but requires adaptation to the context of practice (Purao et al., 2017). Hence, the design of the face-to-face class in this study included not only the features of PSI, but also the original features of this study.

Personalized instruction in face-to-face classes in this study were implemented in consideration of the students' difficulties with interpersonal relationships. Student with school refusal tend to be overly sensitive to their interpersonal relationships (Inoko et al., 2011). Therefore, it is assumed that personalized instruction that takes

Figure 1

The process flow of the face-to-face class in this study



interpersonal relationships into consideration is necessary in correspondence high schools where many students have experienced school refusal. Osato & Ogawa (2013) reported face-to-face seating during interviews increases anxiety compared to side-by-side and right-angled positions. Therefore, personalized instruction in this study was conducted standing in a side-by-side or right-angle position rather than face-to-face. During personalized instruction, positive feedback was actively provided to help students feel more confident in mathematics. In addition, during personalized instruction, attention was paid to eye contact, gaze, posture, facial expression, and loudness of voice, referring to the non-verbal counseling techniques of The Japan Institute for Labor Policy and Training (2016).

In order to qualitatively analyze the effectiveness of the design and implementation of the face-to-face classes, open-ended questionnaire surveys were conducted with students. The questionnaire surveys were conducted once at the end of the first and second semester, respectively. The questionnaire survey included three items: 1) good points of the face-to-face classes, 2) bad points of the face-to-face classes, and 3) other impressions of the face-to-face classes. The free response data were analyzed using the thematic analysis. Thematic analysis was conducted with reference to Braun & Clarke (2006). Specifically, the analysis was conducted in four stages: 1) repeated perusal of descriptive data, 2) coding, 3) extraction of themes by classifying similar codes, and 4) evaluation and improvement of the fit between descriptive data, codes, and themes. 1) to 3) were conducted by the first author, and 4) was conducted collaboratively by the authors.

Results & Discussion

Responses to the open-ended questionnaire survey were obtained from 45 students in the first semester and 23 students in the second semester, for a total of 115 items. Table 1 shows the five themes resulting from the thematic analysis of the free-response statements, the codes classified into each theme, and the number of occurrences of each code ([theme] and <code> (number of occurrences)). Three of the themes were based on positive description: [Elaborating design of face-to-face classes], [Consideration and devices of personalized instruction] and [Other effects], and two were based on negative opinions: [Learning needs not being addressed] and [Differences in views of learning]. In some cases, only one code was assigned to each description, while in other cases, multiple codes were assigned to each description. Below, this paper discussed the top three codes that received 10 or more positive descriptions.

The top two codes that occurred most frequently were <Personalized instruction> (28), <Self-paced learning> (13), which belong to [Elaborating design of face-to-face classes]. The most frequent positive description of <Personalized instruction> suggests that the need for and effectiveness of personalized instruction in the design of face-to-face classes is high in correspondence high schools because of the diverse academic backgrounds of the students enrolled there. U.S. Department of Education (2017) defined that personalized learning refers to instruction in which the pace of learning and the instructional approach are optimized for the needs of each learner. Therefore,

Table 1

The five themes obtained, the codes classified into each theme, and the number of occurrences of each code

P or N	[Thema]	<Code> (the number of occurrences)
P	Elaborating design of face-to-face classes	Personalized instruction (28), Self-paced learning (13), Implementation of unit tests (9), Practice opportunities through practice tests (3), Easy-to-understand self-learning materials (3), Self-learning at home to pass unit tests (2), Unit tests that can be taken as many times as needed until passed (1), Taking the unit test after submitting a report (1)
P	Considerations and devices of personalized instruction	Kindness of teachers (10), Clarity of personalized instruction (7), Politeness of personalized instruction (6), Positive feedback from teachers (5), Teaching method of giving hints and making students realize by themselves (2)
P	Other effects	Enjoyment of face-to-face classes (6), Experience with fresh face-to-face teaching style (2), Overcoming math difficulties (2), Comfortable learning environment (2), Face-to-face classes in general (2), Overcoming math dislike (1), Overcoming math anxiety (1), Overcoming examination anxiety (1)
N	Learning needs not being addressed	Requests for advanced learning content (3), Anxiety about passing the unit tests (2) Difficulty taking the unit test due to many students (2), Requests for improvements to practice tests (2), Difficulties of the unit tests (1), Resistance to the method of taking the unit tests (1), Requests for more opportunities for face-to-face instruction (1), Difficulty of the learning content (1), Long waiting times (1), Nervousness (1), Requests for paper materials (1)
N	Differences in views of learning	Requests for lecture-style face-to-face classes (2), negative effects of complete mastery learning (1), confusion about using tablet devices (1), limited opportunities for face-to-face classes (1)

P: Based on positive description, N: Based on negative description

self-paced learning is considered an essential component of the implementation of personalized instruction. In addition, since students' daily self-paced learning at home is self-paced learning, implementation of self-paced learning is a suitable design for face-to-face classes at school.

The third codes that occurred most frequently was <Kindness of teachers > (10), which belong to [Considerations and devices of personalized instruction]. Many students in correspondence high schools have experienced school refusal, and students with school refusal tend to be overly sensitive to interpersonal relationships (Inoko et al., 2011). Personalized instruction in this study were implemented in consideration of the students' difficulties with interpersonal relationships. The large number of positive descriptions of <teacher kindness> suggests that interpersonal considerations are important when personalized instruction is conducted in face-to-face classes at correspondent high schools.

Conclusion

Based on previous discussions, this paper proposes "implementation of personalized instruction with consideration for interpersonal relationships" and "implementation of self-paced learning" as prototypes of design principles for face-to-face classes in correspondence high schools. A future work is to verify and improve the prototype of the design principles proposed in this paper in multiple cycles of design research.

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Effects of SVVR-Based QOO Strategy and Learning Motivation on Cognitive Load and Cognitive Engagement

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Pre-service teachers suffer from a lack of maker education environments (i.e., Makerspaces). To solve this problem, this study designed and developed spherical video-based virtual reality (SVVR), and proposed a QOO (Question, Observation, Organization) strategy to support pre-service teachers' maker education. Hence, this study aimed to examine the effects of SVVR-based QOO strategy and learning motivation level on cognitive load and cognitive engagement. 64 pre-service teachers participated in this quasi-experimental study. The experimental group employed the SVVR-based QOO strategy and the control group employed the SVVR-based conventional strategy. The results demonstrated that SVVR-based QOO strategy had no significant effect on students' cognitive load and cognitive engagement. Furthermore, pre-service teachers with high levels of motivation had significantly lower cognitive load and higher cognitive engagement than those with low levels of motivation. There was no interaction effect between independent variables. This study provides some implications for promoting maker education among pre-service teachers.

Keywords: Cognitive Engagement, Cognitive Load, Learning Motivation, Maker Education, SVVR-based QOO Strategy

Introduction

The rise of the Maker movement has globally contributed to the prevalence of Maker education. Maker education is a new type of educational practice which aims to foster creativity (Jia et al., 2021). It views learning as a shared, social process based on the design and production of physical objects (Halverson & Sheridan, 2014). Despite the fact that K-12 education has established many Makerspaces and actively promoted maker education, there is still a shortage of teachers for maker education. Therefore, it is necessary to cultivate pre-service teachers in colleges and universities to engage in maker education. However, the insufficient construction of the makerspaces in colleges and universities is one of the most important factors limiting the cultivation of pre-service teachers for maker education. In order to immerse pre-service teachers in a makerspace to experience the maker education, this study used spherical video-based virtual reality (SVVR) to present authentic contexts. SVVR is a new and innovative learning tool with simple operation, low cost, and great potential. SVVR provides learners with an immersive virtual experience by embedding 360-degree spherical videos or photographs in VR glasses (Yang et al., 2024). According to the constructivism learning theory, the Question, Observation and Organization (QOO) strategy was also proposed for instructors to guide students in SVVR-supported learning process (Chien & Hwang, 2022). The aim of this study was to investigate the effects of SVVR-based QOO strategy on cognitive load and cognitive engagement while considering pre-service teachers' learning motivation level. There are two research questions: (1) What effects do SVVR-based QOO strategy and learning motivation on cognitive load? (2) What effects do SVVR-based QOO strategy and learning motivation on cognitive engagement?

Research Design & Methods

SVVR-based QOO Strategy. The researchers utilized Eduventure-VR (https://www.vr.ev-cuhk.net/?lang=zh) to build an SVVR-based makerspace from 360-degree panoramic pictures taken at an elementary school. According to the Constructivism Learning Theory and previous studies (e. g., Chien & Hwang, 2022), SVVR-based QOO strategy was proposed for the instructor to guide pre-service teachers in SVVR-supported learning processes. During the "Q-

question" phase, the instructor provided guiding questions, which could help pre-service teachers understand the main points of observation when learning in the SVVR environment. In the "O-observation" phase, using cell phones and HMDs, participants were placed in a 360-degree human-recorded real-world environment, where they were able to observe the makerspace from all directions and acquire Maker learning knowledge. The participants worked in small groups. In the "O-organization" phase, each group discussed what they had learned, searched for more information on the Internet, and ultimately generated collaborative mind maps. Then, the group presented their mind maps.

Participants. Sixty-four pre-service teachers from a university in Zhejiang Province took part in this study, including 33 in the control group and 31 in the experimental group. The participants were divided into high and low groups based on the median of learning motivation (*Median* = 23), with 33 students with high motivation level and 31 students with low motivation level. None of the participants had used SVVR before the experiment.

Instruments. The questionnaire used to measure Learning Motivation was adapted from Pintrich et al.'s (1991) extrinsic motivation section and Wang and Chen's (2010) intrinsic motivation section, and consisted of six questions (e.g., "In maker learning, I prefer course material that really challenges me so I can learn new things"). The Cognitive Load questionnaire was adapted from the scale proposed by Hwang et al. (2013), consisting of eight items (e.g., "The learning content in this learning activity was difficult for me"). The Cognitive Engagement Questionnaire was adapted from the scale designed in Elmaadaway (2018) and Jamaludin and Osman (2014), and consisted of seven questions (e.g., "I always ask the instructor about difficult content"). All three questionnaires used a 5-point Likert scale. The Alpha values for these questionnaires were 0.69, 0.88, and 0.81, respectively.

Experimental Procedure. This study employed a quasi-experimental design. One week prior to the experiment, the participants completed the learning motivation questionnaire. During the experiment, the participants in both groups were trained to use the Eduventure mobile app and VR glasses. Next, the experimental group implemented the SVVR-based QOO strategy to learn about maker knowledge, and the control group employed the conventional SVVR-based strategy. At the end of the experiment, the participants completed questionnaires on cognitive load and cognitive engagement.

Results

Analysis of Cognitive Load

As shown in Table 1, the two-way ANOVA results indicated that the SVVR-based QOO strategy had no significant effect on cognitive load, $F = .31$, $p > .05$. Specifically, there was no significant difference in cognitive load between the control group ($M = 20.64$, $SD = 5.73$) and the experimental group ($M = 20.39$, $SD = 4.88$). The participants with high levels of learning motivation ($M = 18.82$, $SD = 4.57$) had significantly lower cognitive load than those with low levels of learning motivation ($M = 22.32$, $SD = 5.48$,), $F = 7.76$, $p < .01$. The value of *partial* η^2 was .114, which means a medium effect size. Additionally, there was no interaction between SVVR-based QOO strategy and learning motivation in terms of cognitive load, $F = .50$, $p > .05$.

Table 1

Two-way ANOVA results of cognitive load

Source	*SS*	*df*	*MS*	*F*	*p*	*partial* η^2
Strategy	8.09	1	8.09	.31	.578	.005
Learning motivation	200.30	1	200.30	7.76**	.007	.114
Strategy * Learning motivation	12.99	1	12.99	.50	.481	.008
Error	1549.09	60	25.82			

** $p < .01$.

Analysis of Cognitive Engagement

As demonstrated in Table 2, the results showed that the SVVR-based QOO strategy had no significant effect on cognitive engagement, $F = .14$, $p > .05$. Specifically, there was no significant difference in cognitive engagement between the control group ($M = 25.06$, $SD = 3.44$) and the experimental group ($M = 24.39$, $SD = 3.84$). The participants with high levels of leaning motivation ($M = 26.24$, $SD = 3.58$) displayed significantly more cognitive engagement than those with low levels of leaning motivation ($M = 23.13$, $SD = 2.96$,), $F = 13.64$, $p < .001$. The value of .185 for *partial* η^2 illustrates the large effect size. Additionally, there was no interaction between SVVR-based QOO strategy and learning motivation in terms of cognitive engagement, $F = .82$, $p > .05$.

Table 2

Two-way ANOVA results of cognitive engagement

Source	*SS*	*df*	*MS*	*F*	*p*	*partial* η^2
Strategy	1.51	1	1.51	.14	.713	.002
Learning motivation	150.73	1	150.73	13.64***	.000	.185
Strategy * Learning motivation	9.02	1	9.02	.82	.370	.013
Error	663.19	60	11.05			

Discussion & Conclusion

This study explored how SVVR-based QOO strategy and learning motivation influence pre-service teachers' cognitive load and cognitive engagement. It, including 64 participants, was conducted through applying a quasi-experimental design. Two-way ANOVAs were implemented to analyze the two research questions. The following is a discussion of the research findings.

The results showed that the SVVR-based QOO strategy had not significant effect on cognitive load and cognitive engagement. The findings seem to contrast with previous studies (e. g., Chien & Hwang, 2022), which found SVVR-based QOO strategy significantly improved the students' world cultures presentation performance in terms of accuracy, organization, and relevance. These results may be due to the fact that both groups of students were learning with SVVR for the first time. The participants had a strong curiosity about SVVR technology and this curiosity could help them actively use their working memory to understand (and process) instructional materials and encode the information they were about to acquire in order to store it in their long-term memory, so the emergence of the new technology may have weakened the QOO strategy. Meanwhile, this might also be due to the short duration of the experiment. The study also showed that the participants with high motivation levels had significantly lower cognitive load and higher cognitive engagement than those with low motivation levels. Highly motivated learners displayed high willingness to invest their efforts in learning tasks and often had clear goals, which helped them focus their attention and resources on relevant information and processes, resulting in lower cognitive load and higher cognitive engagement.

However, this study has some limitations. First, the duration of the experiment was short. Second, all participants were experiencing SVVR for the first time. Therefore, future studies may consider extending the duration of the intervention and allowing participants to become more familiar with SVVR in order to investigate the effectiveness of QOO strategy.

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Developing a Teacher Training Program to Enhance Teachers' XR Competency : Applying the RPISD Model

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Abstract
Extended Reality (XR) technologies offer transformative opportunities for education, but schools face challenges in implementation due to their complexity and teachers' lack of experience. This study developed a training program to enhance teachers' XR competencies using the Rapid Prototyping Instructional Systems Design (RP-ISD) model. The process involved analysis, design, iterative usability tests for refinement of prototypes, development, and implementation. Repeated usability tests verified its validity and applicability. The XR training program is expected to support teachers in providing immersive learning experiences, thereby improving education quality. The developed 'Administrator Manual, Instructor Manual, and Learner Manual' will offer clear guidance throughout the training process, enabling teachers to use XR technologies effectively in classrooms. This contribution is anticipated to significantly promote the adoption of XR in educational practices.

Keywords: Extended Reality, RP-ISD, Teacher Training Program, Teacher's XR Competency, XR

Introduction

XR(eXtended Reality) is becoming an essential element for improving the quality of education in schools by overcoming spatial constraints and providing authentic experiences that can motivate learners and encourage their participation(Cárdenas-Sainz et al., 2023; Eames & Aguayo, 2020). However, despite teachers' high recognition of the usefulness and effectiveness of XR technology, they are unable to actively utilize new XR technologies in the classroom due to low self-efficacy in XR usage(Jang et al., 2020) and lack of practical experience. Considering the complexity of XR technology and the specificity of its educational application, the development of training programs requires the assistance of content experts and a systematic instructional design approach. Therefore, this study aims to develop a training program to enhance teachers' XR technology utilization competency using the RP-ISD(Rapid Prototyping Instructional Systems Design) model, and to validate its effectiveness and applicability through usability evaluation.

Research Design & Methods

The training program to enhance teachers' XR utilization competency was developed by applying the RP-ISD(Rapid Prototyping Instructional Systems Design) model as an instructional systems design methodology. The RPISD model is an alternative instructional systems design model to traditional ISD models which focus on the step-by-step characteristics of instructional systems design. In the context of corporate education, it rapidly creates prototypes through continuous interaction with various educational stakeholders, and develops user-centered educational

programs through iterative usability evaluations(Lim & Yeon, 2015). Accordingly, this study analyzed the target learners(teachers) and context of the educational program following the RP-ISD model's procedures, and developed a teacher training program through continuous interaction with clients, experts, and learners via iterative prototype design and usability evaluations.

Results

In this research, the Rapid Prototyping Instructional Systems Design (RP-ISD) model was applied to develop a training program aimed at enhancing teachers' XR competencies. The process involved several stages: initial meetings to set project goals, extensive needs analysis including performance, discrepancy, and context analyses, and iterative design phases. Multiple prototypes were developed, each refined through successive usability tests involving stakeholders such as clients, Subject Matter Experts(SME), and field experts. This approach ensured the training program was both effective and tailored to real-world educational needs and to the school field, demonstrating the adaptability and benefits of the RP-ISD model in developing educational training programs.

Table 1

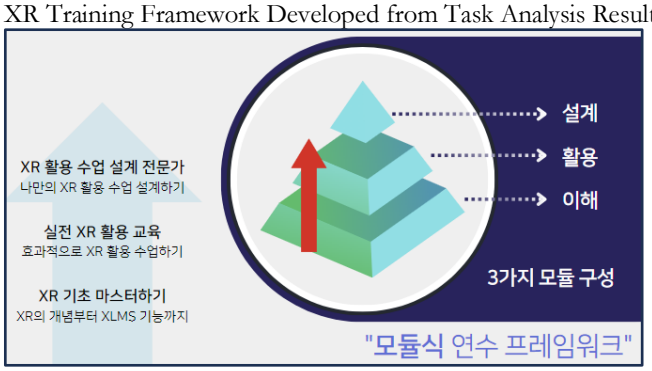
Implications Derived from Needs Analysis Results

Implications	*Needs Analysis Results*
Challenges in XR Utilization	-Difficulties arise from various aspects including hardware, software, usability challenges, sales policies, copyright issues, lack of awareness about XR, and inadequate educational utility.
Considerations for Training Program Design	-Focus on the functional aspects of using XR and XLMS. -Practicum-oriented teacher training. -Need to integrate the training with the subject content managed by the teachers. -Setting training durations that consider realistic school schedules (within 2 hours). -Development of training materials that can be effectively used in the school environment.
Need for Technical Support and Infrastructure Improvement	-Sufficient availability of devices (at least two persons per device). -Systematic management is necessary to ensure the continuity and sustainability of the training. -Demand for education on how to use the devices.

Training Objectives Derived from Task Analysis:
The instructional goal 'Teachers can effectively manage lessons using XR technology' was analyzed according to procedure. The training program progresses from understanding to application, and then to design. Trainees first thoroughly grasp the fundamental principles and operational mechanisms of XR technology. Based on this understanding, they will apply XR technology within the actual context of teaching and finally, design their own XR-enhanced lessons(Figure 1).

Figure 1

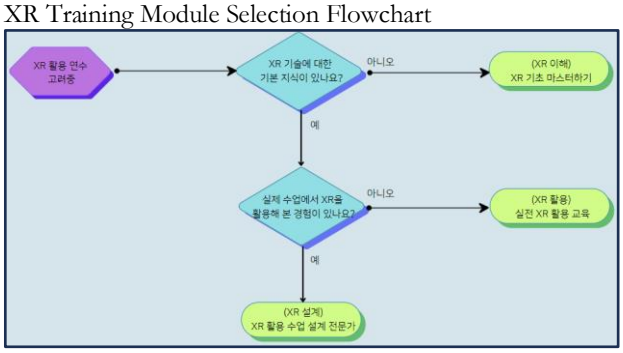
XR Training Framework Developed from Task Analysis Results.



Prototype Development and Usability Tests:
Considering the actual training time in the educational field and the systematic management and continuity of the training process, a total of six training sessions are developed, divided into three modules (understanding, application, design) with two sessions each. The training framework provides customized training paths based on the prior knowledge level of XR(Figure 2).

Figure 2

XR Training Module Selection Flowchart



Development & Implementation:
During the development phase, the 'Teacher XR Competency Enhancement Training Program' was developed based on agreements reached through multiple rounds of usability evaluations and revisions. This study resulted in the creation of final outputs including an Administrator Manual, an Instructor Manual, and Learner Materials. The composition of the final outputs is detailed in the Table 2 below.
And to implement this training program, a pilot test is scheduled for the second half of the 2024 academic year targeting teachers at Y Elementary School. Through this pilot test, we plan to use a t-test to compare the impact of M Company's existing training program and the training program developed in this study on teachers' XR competency, and to analyze its effectiveness. After the pilot test, in collaboration with Y Elementary School, which serves as a training hub, this training program will be applied to teacher training sessions organized by the G Education Support Office to further validate its effectiveness throughout the implementation process.

Table 2

Final Development

Manual Type	*Results*
Administrator Manual	Overview of the training program, content for each session, and considerations before, during, and after the training.
Instructor Manual	Training outline, instructional materials.
Learner Manual	Examples of XR lessons, FAQs, appendices.

Discussion

This study highlights the essential need for structured and engaging approaches when incorporating XR technology into educational frameworks. Utilizing the Rapid Prototyping Instructional Systems Design (RP-ISD) model, the research showcases the development of an effective training program that significantly boosts teachers' abilities to use XR tools. This tailored program not only supports teachers in applying XR technology effectively but also prepares them to overcome challenges in lively classroom settings. The discussion could explore how adaptable the RP-ISD model is to the ever-evolving field of educational technology, the notable boost in teachers' confidence and skills, and the potential impact of such training on educational quality and student engagement. The creation of detailed manuals and a methodical training approach also underscore the possibility of expanding these solutions to various educational scenarios, meeting diverse needs.

Conclusion

This study emphasizes the need for a systematic and participatory approach to maximize the educational use of XR technology. It is expected that the training program developed through the RP-ISD model will provide evidence of its effectiveness in enhancing teachers' XR competencies. The teacher XR competency enhancement training program developed through this research will offer clear guidance and practical support through the Administrator Manual, Instructor Manual, and Learner Manual, enabling teachers to confidently utilize XR technology in the classroom.

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Empowering Pre-Service Teachers: Fostering Self-Efficacy in ICT Integration for Educational DX

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Abstract: Preparing students for the digital world beyond the classroom is not just a choice but an urgent necessity. With technology integrating all aspects of our lives, including education, immediate action is necessary; thus, integrating Information and Communication Technology (ICT) in education is no longer a slogan. The Ministry of Education, Culture, Sports, Science, and Technology in Japan (MEXT) has taken a step forward by implementing Educational DX. To address this policy, MEXT in Japan has made it mandatory to include a course on ICT use in education for pre-service teacher training programs. However, pre-service teachers may have had limited exposure to ICTs in their past education and may need support effectively using these tools in their training. Prioritizing training programs for pre-service teachers that foster functional classroom ICT utilization is required. Equipping them with meta-cognitive learning activities with practical ICT uses in classrooms can create a positive learning environment that boosts students' self-confidence in a digital world. The present study delves into the effectiveness of online reflective activity, a powerful tool for active classroom participation. This approach, when used effectively, can foster targeted learning outcomes, significantly increasing students' confidence and self-efficacy. The study's findings not only confirm the effectiveness of this approach but also suggest that it can provide better motivation for specific skills in using ICTs in educational settings, thereby highlighting a positive change in the self-efficacy of ICT use in the class.

Keywords: Self-efficacy, Reflection, Cognitive engagement, ICT use in the classroom

Introduction

Background

The current shift of education through digital technology is not only significant but also urgent. It is imperative to prepare our students for the digital age beyond traditional classrooms. Technology, including education, is an indispensable part of our lives and demands immediate action. Therefore, integrating Information and Communication Technology (ICT) into education is more than just a mere slogan. The Ministry of Education, Culture, Sports, Science, and Technology in Japan (MEXT) has taken significant steps by creating a more dynamic, interactive, and personalized learning experience, offering technology-rich classrooms.

By integrating ICT into the curriculum, we face a strong necessity to empower our students to develop essential skills such as critical thinking, problem-solving, and digital literacy. These skills are crucial in an era where artificial intelligence, big data, and the Internet of Things (IoT) become increasingly prevalent. Schools across Japan are being provided with high-speed internet, computers, and interactive learning platforms. But this transformation is not just about using technologies in the classrooms; it's about our educators' competency to utilize them. They should be ready to implement innovative resources and methods to improve their teaching, making them more integral than ever in the process of creating engaging and effective lessons.

The Role of Self-Efficacy in Enhancing Learning Outcomes

Providing engaging learning experiences in an instructional context has been widely receiving attention. Literature has seen a variety of studies on engagement, including the influence of parents (Goodall & Montgomery, 2014) and peers (Furrer et al., 2014; Jeynes, 2007). The literature supports that Self-efficacy (Bandura, 1997), defined as an individual's belief in their ability to succeed in specific situations or accomplish a task, significantly influences learning outcomes (Pintrich & Schunk, 1996). Various studies have highlighted the importance of self-efficacy in shaping students' engagement and better learning (Linnenbrink & Pintrich, 2003; Pajares & Miller, 1994). Self-efficacy has been found to impact students' behavioral, cognitive, and motivational engagement in the classroom, making it a crucial factor in promoting learning (Reeve, 2012; Schunk & Mullen, 2012).

While empirical evidence suggests that self-efficacy beliefs play a crucial role in shaping individuals' thoughts, feelings, motivation, and actions, the belief in task completion ultimately leads to increased effort and persistence in challenging tasks. This cyclical relationship between self-efficacy, motivation, and engagement underscores the significance of self-efficacy in sustaining students' learning progress. Drawn by Linnenbrink and Pintrich (2003), a causal relation between self-efficacy and engagement: "self-efficacy is related to the quantity of effort and the willingness to persist at tasks (Bandura, 1997; Schunk, 1989; 1991). Learners with high self-efficacy are more likely to demonstrate higher

levels of motivation and engagement, promoting their competence. Thus, Schunk & Mullen (2012) hypothesized that "self-efficacy influences motivation, which affects engagement. Also, individuals with strong efficacy beliefs are more likely to exert effort in the face of difficulty and persist at a task when they have the requisite skills (Linnenbrink and Pintrich, 2003). As students are engaged in learning, they see that they are making progress, which helps sustain their self-efficacy and motivation" (p.408).

The Reflective Activities to Empower Self-Efficacy

There has been much discussion on identifying key self-regulatory processes or factors that contribute to self-established learning (Hall & Götz, 2013) that consequently enhance confidence in learning content. Metacognitive processes, especially reflective learning, are found to be powerful tools for boosting self-efficacy. Engaging in reflective learning activities like summarizing and self-monitoring can enhance learners' understanding and self-regulation, ultimately strengthening their sense of efficacy (Zimmerman & Cleary, 2009). Actively engaging in reflective practices equips learners to monitor and regulate their learning effectively. This active involvement in learning enables them to set specific, achievable goals, track their progress, and adjust their strategies as needed. These practices not only improve academic performance but also enhance learners' confidence in their ability to succeed, thereby enhancing their overall self-efficacy.

Reflective learning also empowers students to critically evaluate their learning processes and outcomes, enabling them to identify their strengths and weaknesses. Furthermore, integrating reflective learning into the academic context can lead to a more personalized learning experience. Students can tailor their learning strategies to suit their needs, making learning more effective and even empowering. Moreover, by providing regular opportunities for reflection on their learning, reflective learning helps students develop the skills necessary for lifelong learning (Moon, 2004).

Thus, the study posed a question: Does reflective activity contribute to a higher level of perceived self-efficacy in ICT utilization?

Research Design & Methods

Participants. A quasi-experimental study was conducted at a women's college in Japan. The class met eight times in person with employing a Learning Management System (LMS) where students can post, submit, and discuss after the class. The study was part of an 8-week course called "ICT Use in the Classroom," which aimed to encourage future teachers to use ICT tools. The students were requested to bring their own devices (BYOD) to the classroom and use them during lessons. There were a total of 48 students: 24 from the Faculty of Letters (English literature and linguistics, Japanese literature and linguistics, History, Sociology, and Psychology) and 24 from the Faculty of Human Science (Home Science, Nutrition studies, Nursery and Elementary Education).

Assessments and Measures. Students were allowed to bring and use any digital device for the task, with smartphones being the most commonly used. Following each class session, all participants were asked to participate in an online reflection activity conducted on the school's LMS. All students had free access to the reflective task with brief guidance. The completion rate of reflective activities was 73.8%.

After completing the course, 45 participants joined in the survey. In the survey, they completed a questionnaire about integrating ICT into the classroom. The survey consisted of 16 items under four (I to IV) categories and was based on a checklist called "ICT utilization competency checklist" developed by the MEXT. Each survey question aimed to evaluate the participants' confidence in effectively using ICT under various tasks in a classroom setting, including how they are confident in instructing their future students to use ICTs. Upon the class's conclusion, the questionnaire was distributed. This specifically designed questionnaire provided participants with the acknowledgment to rate their current confidence in each criterion on a scale of 0 to 100. The categories are divided into four categories:

I. Capability to utilize ICT for preparing teaching materials, instruction, assessment, and school administrative tasks (Use ICT for educational tasks and school administration)
II. Capability to use ICT in teaching lessons (Teach with ICT)
III. Capability to guide students in the use of ICT (Guide student ICT use)
IV. Capability to instruct on the knowledge and attitudes fundamental to information use (Teach information literacy skills)

For the analysis, the participants were divided into two groups: the "reflection group," who submitted reflections of more than 300 words on average in each entry, and the "less-reflection group," consisting of individuals who submitted relatively brief reflections (less than 300 words on average for an entry) or none. This grouping allowed for a comparative analysis of the impact of reflective activities on the participants' level of perceived self-efficacy. The self-

efficacy data was analyzed using analysis of variance to compare the development of self-efficacy throughout the eight classes. The data was gathered and analyzed according to a research question. The preliminary analysis of numeric data was computed to obtain summary statistics using computer software, namely Microsoft Excel and IBM SPSS Statistics version 27.

Results

The present study employed a two-way ANOVA (repeated/not repeated) for the questionnaire results of four levels of the perceived self-efficacy for ICT use capability: I. Use ICT for educational tasks and school administration; II. Teach with ICT; III. Guide student ICT use; IV. Teach information literacy skills. The means and standard deviations for four levels of self-efficacy are presented in Table 1. The within-subject measure was the Before-After factor, and the between-subject measure was the two types of Conditional Groupings (Reflection vs. Less Reflection).

Table 1

The Discriptive Statistics of the Measureed Scores of Four Categories of Self-Efficacy in ICT Use

	Before Condition (n=45)					After Condition (n=45)				
	M	*SD*	*Mse*	*Min*	*Max*	*M*	*SD*	*Mse*	*Min*	*Max*
I	148.44	70.031	10.44	0	280	257.09	59.134	8.815	40	350
II	160.78	60.893	9.077	0	280	265.36	50.187	7.481	160	340
III	149.11	77.256	11.517	0	340	254.09	64.913	9.677	80	350
IV	165.89	70.528	10.514	0	345	275.22	59.045	8.802	150	400

Effects on Category I to IV factors. A two-way ANOVA was performed to compare the average self-efficacy scores across categories I to IV between two groups (Reflection and Less Reflection) and Before and After the course. The group factor was considered between subjects, while the Before-and-After factor was considered within subjects. The Results show a significant main effect for the Before-and-After factor, but no other main effects or interactions were found. The result on Category I revealed no meaningful interaction was found ($F(1, 43)= 0.195$, $p>.05$). There was a simple effect on the Before-After factor ($F(1, 43)= 113.532$, $p<.01$). Then, result on Category II also revealed no meaningful interaction was found ($F(1, 43)= 0.428$, $p>.05$). A simple effect was found on the Before-After factor ($F(1, 43)= 106.667$, $p<.01$). The result of Category III revealed no meaningful interaction was found ($F(1, 43)= 1.004$, $p>.05$). There was a simple effect on the Before-After factor ($F(1, 43)= 85.261$, $p<.01$). The Category IV revealed no meaningful interaction was found ($F(1, 43)= 1.067$, $p>.05$). There was a simple effect on the Before-After factor ($F(1, 43)= 73.558$, $p<.01$).

Discussion

The present study was conducted as an exploratory, seeking a better understanding of the nature of self-efficacy for skill-related attainment of higher levels of perceived self-efficacy: utilizing ICTs in the classroom for preservice teachers by means of reflective activities, knowing that heightening self-efficacy can be a source of cognitive engagement (Linnenbrink & Pintrich, 2003).

Hence, the results of the study after 8 weeks indicated a clear and meaningful effect of the instruction as well as reflection: the mean scores of participants' perceived self-efficacy boosted when compared before and after the class. These results empirically confirm that self-efficacy can be augmented by instructional interventions. However, there is no sign of developing self-efficacy along with the quantities of reflective activities (Reflection vs Less Reflection group). The study expected that a higher development of self-efficacy for the use of ICT could be observed according to the quantities of the reflections as previous literature (c.f. Zimmerman & Cleary, 2009) argued. None of the four categories itemized in the checklist has shown a significant difference in perceived self-efficacy of ICT utilization between before and after the class by the groups. The study did not recognize the effects of reflective activities to enhance self-efficacy, and the number of reflections on the perceived self-efficacy of the four types of ICT utilization categories did not find a meaningful contribution. Either way, less reflective activity does not directly lead to a lower level of efficacy. The 16-item perceived self-efficacy for ICT utilization in the classroom found very little effect on the rate of reflective activities. The study expected a higher development in perceived self-efficacy for the reflection group, whereas the less-reflected groups showed nearly the same level of self-efficacy in each item. There seem to be no special effects of reflective activities that contribute to the increase of self-efficacy, simply by the number of words or entries.

Conclusion

The study, which was exploratory, examined how reflective activities impact pre-service teachers' confidence in using ICT in the classroom. While the study found an increase of self-efficacy in the ICT utilization by classes and reflective activities after the class as well as reflective activities, the specific impact of reflective activities on confidence development is still unclear.

However, the study found that self-efficacy certainly increased after class and reflective activities. The study couldn't fully grasp how self-efficacy develops through reflective activities. The results didn't show a clear relationship between the frequency of reflective activities and increased confidence, only a general increase before and after these activities. Further research, including increasing the frequency of the questionnaire and qualitative analysis, is recommended to apprehend the relationship between confidence and reflective activities. It takes further examination and research to better understand the relationship between them.

The study's shortcoming was that it focused on the numeric data and analyzed it using categorical groupings. By exploring the qualitative aspect of reflection and its development, as well as analyzing individual items, we can gain a deeper understanding of efficacy development. This comprehensive approach could provide valuable insights into the link between confidence and reflective activities.

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Improving the Learning Environment for Social Studies with One-to-One Devices

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This study seeks to clarify the factors that can improve the learning environment for junior high school social studies classes using one-to-one devices. It captures teachers' difficulties and conflicts and how they respond to them. The subjects were three Social Studies teachers at a junior high school in City A, Japan. Semi-structured interviews were conducted after the author's participant observation of the subject's class. The data obtained were analyzed qualitatively, according to Sato (2008). The analysis generated three categories and 11 subcategories. Of these, three factors to improve the learning environment for junior high school Social Studies classes using One-to-One devices: First, teachers' beliefs about Social Studies teaching; second, teachers' understanding of the constructivist view of learning; third, teachers' understanding of learning assessment such as rubric assessment.

Keywords: One-to-One devices for Social Studies, Teachers' Difficulties and Conflict, Learning Environment, Teachers' Belief, Constructivism

Introduction

Problem-solving learning using One-to-One devices

In the 2003 DeSeCo project, the OECD identified Key Competencies as the abilities required for a future knowledge-based society, leading to educational reform worldwide. In Japan, academic ability has been redefined, and emphasis has been placed on developing qualities and abilities. Underlying that is a change to a constructivist view of learning. The improvement of teaching with an emphasis on the development of qualities and abilities is often discussed together with the development of ICT environments and the use of One-to-One devices (MECSST, 2020).
In Social Studies classes, the following learning activities are required under Japan's GIGA school concept, where each student must use One-to-One devices. It is the learning activities in which students are required to develop their awareness of the problem, formulate a problem-solving outlook, gather the necessary information, read the information, and categorize, organize, and summarize the information (MECSST 2021). This type of learning is referred to as "problem-solving learning" in this study because it has some similarities to "problem-solving learning." Until now, there has been a strong impression that Social Studies classes in Japanese junior high schools were mainly about memorizing individual-specific knowledge (Osaka 2016). Problem-solving learning using One-to-One devices is an opportunity to change the Social Studies class, which tends to focus on rote memorization.

Social Studies teachers' difficulties and conflict

What has previous research on junior high school Social Studies using One-to-One devices identified? The following is based on Wakamatsu (2022). When one-to-one devices were used in junior high school social studies classes, it became easier for students to select and read the information and make arguments independently. On the other hand, some teachers restricted students' freedom to research when gathering information. The teacher was concerned that students' learning would end up being superficial. This was because the teacher believed it was important for students to acquire a scientific understanding of social phenomena in Social Studies classes. Therefore, it was pointed out that there was a need to consider ways to encourage the specific thinking of Social Studies in the classes using One-to-One devices. Wakamatsu (2022) summary ends here. This study shows that more than simply using One-to-One devices is needed to establish problem-solving learning. Social studies teachers face difficulties and conflicts when teaching with one-to-one devices.
So, what difficulties and conflicts do Social Studies teachers face when teaching with One-to-One devices? A previous study related to this question analyzed the process of reflection by junior high school Social Studies teachers on their lessons using One-to-One devices. In the reflection, it was identified that the teachers felt difficulties because the

students did not realize the meaning of learning, the students' discussions were shallow, and the teachers were conflicted about intervening in the students' learning (USAMI and KONNO 2023.) This case study analyses mainly the subject's reflections and needs to clarify how teachers improved the learning environment in response to the difficulties and conflicts.
So, what kind of learning environment do teachers try to create to overcome difficulties and conflicts? This is the research question of this study. It seeks to clarify the factors that improve the learning environment for junior high school social studies classes using One-to-One devices. Specifically, it captures teachers' difficulties and conflicts and how they respond to them.

Research Design & Methods

The subjects of this study are three junior high school Social Studies teachers in City A. The city is a government-designed city in Japan where all elementary and junior high schools will be equipped with One-to-One devices by 2020. Each of the three teachers conducts class research inside or outside the school. Teacher B is a leader in promoting Social Studies class research in City A, Teacher C promotes class research within the school, and Teacher D is a teacher with an International Baccalaureate teaching qualification.
From 1-15 May 2024, the author recorded a 90-minute semi-structured interview with each subject teacher, following their classroom observation. The questions focused on:

1. How each student uses One-to-One devices in Social Studies classes.
2. Whether the teachers feel comfortable using One-to-One devices for classes because of Social Studies.
3. Whether they find it challenging to use One-to-One devices for classes because of Social Studies.

The questions were used as a starting point for the narrative and as a guide to avoid deviating from the theme.
The data obtained were analyzed qualitatively, according to Sato (2008). First, the textual data was segmented into a form that could be captured in a single semantic coherence during repeated readings. The segments were then read and open-coded. Subcategories and categories were generated by comparing, classifying, and relating the extracted codes. Validity for the results was enhanced by confirming the results with the interviewees.

Findings and Discussions

Table 1 presents the results of the analysis. Three categories and 11 sub-categories of difficulties and conflicts teachers faced and teachers' responses were generated. Three factors were found in the improvement of the learning environment for junior high school Social Studies classes using One-to-One devices.

Beliefs about Social Studies education

In problem-solving learning, there are situations in which students gather and read the information. The teachers had {conflicts about restricting students' information gathering}. To overcome this conflict, {an environment where students can proceed with problem-solving learning proactively} was created. Specifically, to resolve the issues of [anxiety about the credibility and neutrality of information] and [fear of students' superficial understanding], the teachers [set unit tasks to formulate concepts about social phenomena]. In particular, <setting tasks that cannot be solved by superficial search> was intended to enable students to gain a bird's eye view of social issues that are difficult to keep politically neutral. The teachers believed that 'drawing analogies based on concepts would enable students to think about contemporary social issues' and ultimately fulfill the purpose of social studies education, which was to raise awareness of sovereignty. Thus, the teachers' beliefs about social studies education were considered to have influenced the improvement of the learning environment.

Understanding of the constructivist view of learning

The teachers expected the students to acquire knowledge by reading information independently. However, from the appearance of [students who needed assistance reading information], they felt {difficulties in promoting proactive problem-solving learning}. To overcome this difficulty, they tried to [introduce a learning method that suited each student], such as <self-made videos in which the teacher explains the knowledge.> However, new challenges arose when trying to [introduce a learning method that suited each student], such as <exceeding the set time by gathering information from videos.> Teachers hoped that these issues would be resolved by the students learning collaboratively. However, [stagnation of students' collaboration] sometimes occurred, and there was a need to [create an environment to promote students' collaboration.] For example, <facilitating references to others by assigning roles> and <examining the thinking tools shared on the application> were used to stimulate discussion. These learning environments are highly compatible with the constructivist view of learning. In particular, Teacher D holds a teaching qualification from the International Baccalaureate, which advocates constructivism. Teachers' understanding of constructivism may have influenced their ability to adapt to the learning environment.

Table 1

Difficulties and conflicts teachers faced and teachers' responses

{category}	[sub-category] & <some representative code>	teacher
{conflicts about restricting students' information gathering}	[anxiety about the credibility and neutrality of information] <instructions to use textbooks and official websites> <reluctance to research areas where information is unreliable> <teachers' lack of confidence in assessing the veracity of information on political thought> <attitude of avoiding free search on political ideas>	B, C, D
	[fear of students' superficial understanding] <emphasis on teaching to build conceptual knowledge> <fear of ending up with superficial understanding without concrete details>	C
	[the realization that it is inevitable to cover knowledge] <the importance of covering the unit's knowledge> <the need to acquire concrete details in order to think>	B, C, D
{difficulties in promoting proactive problem-solving learning}	[students who needed assistance in reading information] <exceeding the set time by gathering information from videos> <concern for students copying information without understanding it>.	B, D
	[stagnation of students' collaboration] <students who cannot refer to the opinions of others> <groups not deepening discussion after information sharing> <decrease in conversation due to whiteboard apps>	B, C, D
	[difficulties that students develop a perspective in the unit] <tendency that students don't write reflections based on their expectations> <a feeling that students do not stay focused if given too much freedom> <readiness survey results that were not good enough to predict>	B, C
	[teachers' hesitancy to intervene directly in students' group learning] <hesitation in giving instructions that are not in the student's interest> <uncertainty about the extent to which teachers should intervene> <hesitation about the need to summarize information on the blackboard>	B, C
{an environment where students can proceed with problem-solving learning proactively}	[introduce a learning method that suits each student] <self-made videos in which the teacher explains the knowledge> <uploading slide material used in class>	B, D
	[create an environment to promote students' collaboration] <facilitating references to others by assigning roles> <examining the thinking-tools shared on the application> <guidance on not letting others take one's answers for granted>	B, D
	[set unit tasks to formulate concepts about social phenomena] <conceptual questions to be set at the end of the unit> <setting tasks that cannot be solved by superficial search> <the value of transferring conceptual knowledge>	B, C, D
	[teachers' language to give perspective to the learning in the unit] <formative assessment done on the reflection sheet on the cloud> <moderation based on the rubric>	D

Understanding of learning assessment

In problem-solving learning, there are situations in which students are aware of their problems and develop a problem-solving outlook. In these situations, teachers felt that [difficulties that students develop a perspective in the unit]. For example, teacher C described a <tendency that students do not write reflections based on their expectations>. This may be due to the students' lack of perspective on the goal of "verifying the expectations they made at the beginning of the unit". Teacher B also described <a feeling that students do not stay focused if given too much freedom.> This may be due to the student's lack of perspective on the process, such as categorizing and organizing the information.

On the other hand, it can be seen from Table 1 that teacher D mentioned no difficulties. This can be explained by the fact that Teacher D was using [teachers' language to give perspective to the learning in the unit], such as <formative assessment done on the reflection sheet on the cloud> and <moderation based on the rubric>. Thus, teachers' understanding of learning assessment, such as rubric assessment, may have influenced their equipment of the learning environment.

Conclusion

This study seeks to clarify the factors that can improve the learning environment for junior high school social studies classes using one-to-one devices. It captures teachers' difficulties and conflicts and how they respond to them.
The subjects were three Social Studies teachers at a junior high school in City A, Japan. Semi-structured interviews were conducted after the author's participant observation of the subject's class. The data obtained were analyzed qualitatively, according to Sato (2008).
The analysis generated three categories and 11 subcategories. In particular, as part of the improvement of the environment for students' proactive problem-solving learning, [introduce a learning method that suits each student], [create an environment to promote students' collaboration], [set unit tasks to formulate concepts about social phenomena], [teachers' language to give perspective to the learning in the unit.] The results showed that.
Of these, three factors to improve the learning environment for junior high school Social Studies classes using One-to-One devices: First, teachers' beliefs about Social Studies teaching; second, teachers' understanding of the constructivist view of learning; third, teachers' understanding of learning assessment such as rubric assessment.
This study only analyzed the narratives of three teachers. The validity of the study needs to be increased by broadening the scope.

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THE INTERACTIVITY EFFECT IN MULTI MEDIA LEARNING

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Abstract

The aim of this study was to determine whether the addition of interactivity to a computer based learning package enhances the learning process. A sample of 33 (22 male and 11 female) undergraduates on a Business and Management degree used a multimedia system to learn about the operation of a bicycle pump. The system consisted of a labelled diagram of the pump, followed by a description of twelve stages in its operation. The sample was randomly divided into two groups who used either an interactive (I) or a non-interactive (NI) version involving both images and text. The I system differed from the NI system by the incorporation of control of pace, self-assessment questions and an interactive simulation. Students then undertook two different types of tests to assess their learning: one designed to evaluate their memory by recalling facts from the lesson, and another designed to assess their understanding through solving novel diagnostic problems. Students using the I system outperformed those using the NI system in the problem-solving test, and needed less time to complete both memory and problem-solving tests. This result is consistent with the hypothesis that interactive systems facilitate deep learning by actively engaging the learner in the learning process. This suggests that educational designers who seek to foster deep learning (as opposed to mere factual recall) should adopt the incorporation of interactivity as a design principle.

Keywords: Evaluation of CAL systems; Human-computer interface; Interactive learning environments; Multimedia/hypermedia systems; Pedagogical issues

Introduction

The aim of this study was to determine whether there is evidence that interactivity enhances the process of learning from computer-based systems. Interactivity is frequently considered to be beneficial in the context of computer-based learning.

However, there have been few systematic studies that have attempted to establish whether the inclusion of interactivity actually enhances learner performance. A number of principles have already been formulated for the design of multimedia learning systems consisting of words and images (Mayer, 2019). These include the multimedia principle (using both words and pictures), the coherence principle (avoiding extraneous media), the modality principle (using narration rather than text), the spatial contiguity principle (placing words and pictures close together), and the temporal contiguity principle (presenting words and pictures at the same time). The

empirical evidence for these principles is strong. The systems developed to establish these principles were generally non-interactive, i.e. they required no input from the learner in the form of mouse-clicking or key-pressing in order for a lesson to finish. Commonly the lessons consisted of uninterrupted narrated animations such as Mayer and Anderson's 30 s narrated computer-based pumps lesson (2019) and Mayer and Moreno's continuous 140 s narrated computer-based lightning lesson (2018). From a cognitive perspective, the utility of incorporating interactivity in computer-based systems is that it allows the learner to influence the flow of information in terms of timing or content. For example, button-clicking can be used to allow the learner to indicate when they want the next portion of text to be displayed; and interactive multiple-choice questions can be used to provide meaningful feedback for self-assessment. This study aims to determine whether the provision of such interactivity can actually increase learning.

In the former, the student seeks some information from the content in a similar way to looking something up in a book or watching a television programme. In the latter, the system requires some input from the learner, such as pressing a button or answering a question by clicking on one of a number of options According to their three-stage model of computer-initiated interactions, an interaction involves a sequence of three actions: initiation, response, and feedback.. Response involves the second agent providing that input. Feedback involves the first agent passing back information as a consequence of the response. The three actions are connected: the response must be a direct consequence of the initiation, and the feedback must be in direct relation to the response. A lesson in a computer-based learning system can now be described as non-interactive if it requires little or no computer-initiated interactivity in order for a lesson to be completed. By contrast, a computer-based learning system is said to be interactive if it uses computer initiated interactivity as an intrinsic part of the lesson.

Active and passive learning hypotheses In this section we consider two possible consequences of learning from interactive multimedia systems, deriving from two alternative hypotheses: the active-learning hypothesis and the passive learning hypothesis. The passive-learning hypothesis predicts that learning from interactive systems has no special effect on learning since the information content is no different from that contained in a non-interactive system. The active-learning hypothesis derives from constructivist models of learning (Jonassen, 2016; Mayer, 2019, 2017). The active-learning hypothesis predicts that students in the I group should do better in tests than students in the NI group on the basis of the interactivity effect. By contrast, the passive learning hypothesis predicts that there should be no statistically significant differences between the two group's scores.

Research Design & Methods

Participants The participants were a class of 33 second-year undergraduates taking the Computing pathway in Business and Management at a university of Muhammadiyah, Makassar, Indonesia. Twenty-two were male and eleven were female and their ages ranged from 19 to 25. Participants were all at the same level in their studies and had met the same pre-requisites. This sample was chosen for this study as none of the participants had a background in either physics or engineering and thus had low prior knowledge on the domain taught by the lesson.Materials and apparatus Two computer-based multimedia packages were developed. The I system included several interactive features contained in the lesson. The NI system had no interactive features in the lesson. Both systems described 12 stages of how a bicycle pump works, and followed this with a test involving a series of open-ended text-entry questions. The NI system was a computer-based version of that described in Mayer and Gallini (2014). The first screen of the system contained a labelled diagram of a pump. Clicking a button then presented a single screen with static images and text annotations describing 12 stages in the operation of the pump. The screen contained two parts: on the left, the six stages in the down phase were illustrated; on the

right, the six stages in the up phase were presented. In the I system, three different forms of interactivity were incorporated.

Procedure The class was randomly divided into two groups to undertake the two different systems I and NI. Random allocation resulted in the I group consisting of sixteen participants, thirteen were male and three were female, and the NI group of seventeen participants, nine were male and eight were female.1 Both groups had a similar age-range and had all completed the same first-year of their Business and Management degree. The groups were placed in different computer laboratories and took the lesson and test at the same time. The groups were given approximately 1 h in which to complete both the lesson and the tests. After both groups had completed the lesson and the post-test, their scores were double marked. Significant differences between their scores 3.

Results

Post-test scores There is no significant difference in the overall post-test results, (given in the first pair of columns in Table 1; unpaired Student's t-test, $t(31) = 1.69$, one-tailed, p = ns).

effect size is 0.7. 3.2. Lesson and test timings In Table 2, students using the interactive system took significantly less time to complete the post-test than those using the non-interactive system, unpaired Student's t-test, $t(31) = 3.52$, one-tailed, $p < .001$. The effect size is 1.19. This is true for both the retention questions (unpaired Student's t-test, $t(31) = 2.06$, one-tailed $p = .02$) and for the transfer questions (unpaired Student's t-test, $t(31) = 3.30$, one-tailed, $p = .001$), the effect sizes are 0.7 and 0.96, respectively. As would be expected, given the difference between the two systems, the students using the interactive system spent significantly more time on the lesson than those students using the non-interactive system, unpaired Student's t-test, $t(31) = 10.48$, one tailed, $p < .001$. The effect size is 8.69. 3.3. Relation between scores and timings Fig. 1 illustrates that there is no significant correlation between time on lesson and transfer test scores (Pearson, two-tailed, $r = 0.254$, p = ns). Fig. 2 illustrates that there is also no significant correlation between time on lesson and total time on test across both groups (Pearson, two-tailed, $r = \_0.310$, p = ns). This result also holds for the separate retention- and transfer-test timings (Pearson, two-tailed, $r = \_0.181$, p = ns; and $r = \_0.310$, p = ns, respectively). However, there is a positive correlation between lesson time and overall test time for the I group separately (Pearson, two-tailed, $r = 0.532$, $p = .03$).

Discussion

This result is predicted since the I group experienced two additional activities, although the information content of the two systems remained the same. The additional time on task cannot account for the increase in transfer-test scores, however. Whilst students using the I system spent more time on the lesson and obtained better scores, the results show that there is no overall correlation between the time learners spend on the lesson and their test score. It may be that students using the interactive system, since they are actively engaged in the learning from the material, adopt a different learning strategy from those using the non-interactive system. Regardless, it appears to be interactivity rather than time on task that produces the effect. Our study also considered the time that learners needed to complete the two tests.

The results suggest that interactivity reduces the time that learners need to answer questions. The most likely explanation for the reduction in answering time is that it reflects an increase in learning: students with greater learning do not need as long to construct answers to open ended questions. This result applies equally to both retention and transfer tests. It thus provides further evidence in support of the active-learning hypothesis in the form of an interactivity effect for understanding and also for memory. However, considering both groups, there is no significant correlation between the time on lesson and the time on test.

Confining consideration to the I group since it is the group in which the reduction in time is most marked, reveals a positive correlation between lesson time and overall time spent on the tests. Learners who spent longer on the interactive lesson, also took longer to complete the tests. It appears that learners who take advantage of the interactive features of the lesson to spend more time on it, also take advantage of the interactive features of the test, to spend more time on that as well. In other words, some learners simply prefer to work through the lesson and test more slowly than others. In our study this practice was provided by both ISAQs and an interactive simulation making our findings consistent with those of Rieber. Our study thus provides evidence of an interactivity effect for deep learning (understanding), as shown both by improvement in transfer test scores and reduced time needed to complete transfer test questions. However, it provides only weak evidence of the same effect for memory, as shown by the reduced time needed to complete retention tests.

Conclusion

Further research is also required to identify whether the interactivity effect for memory is reproducible and whether a different design to the interactive system might be able to amplify it. Further studies are also planned to distinguish between the effects of each of the three different types of interactivity incorporated in the system: pacing, practice (using ISAQs) and simulation to establish the importance of learner engagement rather than cognitive load in producing the interactivity effect. The effect of interactivity in increasing learning has important implications for the design of the next generation of e-learning systems. As indicated in the introduction, until recently, most systematic studies of computer based learning have used systems which were non-interactive. This study provides compelling reasons for courseware authors who wish to foster deep learning, to incorporate interactive features into the design of their systems at an early stage.

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Mapping the Landscape: A Systematic Review and Classification of AI-Integrated Education in South Korea

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This study conducted a systematic literature review of AI-integrated education in South Korea from 2015 to 2024—the research aimed to clarify the definition of AI-integrated education and classify its types. AI convergence education was defined as education that integrates AI and other subject knowledge, enabling learners to acquire both subject content and AI knowledge or develop higher-order competencies. A classification framework comprising three axes - taxonomy of educational objectives, AI learning content elements, and types of AI integration - was proposed. 28 articles are analyzed based on the classification framework of AI convergence education. This research lays the groundwork for innovative approaches to preparing students for an AI-driven future while identifying challenges and future directions for the field.

Keywords: AI in EDucation(AIED), AI-integrated Education, Systematic Literature Review

Introduction

The rapid advancement of artificial intelligence (AI) technologies has led to significant changes in education(Lim, 2019). The combination of 'artificial intelligence' and 'education' has been distinguished with different operational definitions and hierarchies in many prior studies, and various terms and forms of AI education are being implemented in educational settings. When dealing with AI as the 'content' of education, the focus is on developing the ability to design, develop, and utilize AI algorithms based on AI literacy and ethics. On the other hand, when AI is used as a 'tool' in educational settings, the emphasis is on utilizing AI and other educational technologies in teaching and learning (Hong et al., 2020).

In South Korea, the 2022 revised curriculum emphasizes cultivating digital literacy skills across all subjects. This highlights the importance of 'AI convergence education,' which involves teaching both AI as an integrated subject and its various integrated education types as an extension of STEAM education. AI-integrated education is gaining attention for fostering students' creative problem-solving skills and integrative thinking abilities necessary for future society (Chen, Chen, & Lin, 2020; Holmes, Bialik, & Fadel, 2019).

Despite the growing importance of AI-integrated education, many programs and cases are being developed in the fields. However, scholars and practitioners still lack a clear and unified definition of AI-integrated education, and the types of integration have not been categorized. This study aims to systematically review the literature on AI-integrated education in South Korea to clarify the definition of AI-integrated education and classify the types of AI-integrated education. The research questions are:

1. What are the definitions and classification frameworks of AI-integrated education?
2. What are the research trends on AI-integrated education from 2015 to 2024 in South Korea?
3. What are the future development directions for AI-integrated education?

Research Design & Methods

This study adopted a systematic literature review methodology. A systematic review involves comprehensively searching the literature on a research problem, selecting studies based on predefined inclusion and exclusion criteria, and systematically analyzing the selected studies according to evaluation criteria to derive research findings (Hellas et al., 2018). This study was conducted following the procedures outlined in the PRISMA guidelines, which are widely utilized in systematic review research (Higgins & Green, 2008).
First, we reviewed the domestic and international literature on the definitions and classifications of AI-integrated education and the design and development of related programs. Through this review, we established definitions and a classification framework for AI-integrated education in collaboration with researchers. Next, following the PRISMA procedures, we selected keywords related to AI-integrated education to search for academic journal articles published in South Korea from 2015 to 2024. Inclusion and exclusion criteria for the systematic literature review were established. Subsequently, five researchers conducted a three-stage quality literature review, ultimately selecting 28 articles for final analysis. From an initial pool of 834 documents, 808 were excluded, resulting in 28 articles being selected for final analysis. Lastly, we classified and analyzed research trends according to the classification framework.

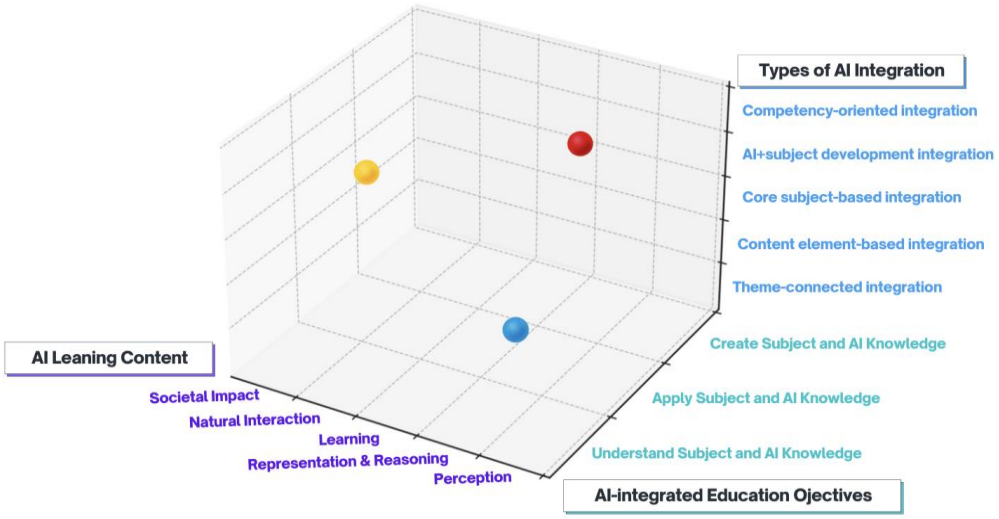
Results

AI-integrated education is defined as education that integrates knowledge from AI and other subjects, aiming for learners to acquire both subject content knowledge and AI knowledge or to develop higher-order competencies. Figure 1 illustrates the classification framework for artificial intelligence (AI) convergence education. It comprises three axes: a taxonomy of educational objectives in AI-integrated education, AI learning content elements, and types of AI integration.

Taxonomy of Educational Objectives: The educational objectives in AI-integrated education are categorized into understanding, applying, and creating subject and AI knowledge. This classification draws on Bloom's taxonomy of educational objectives (1956) and Drake's integrated education approaches (1993).
AI Learning Content: The content of AI-integrated education combines subject content knowledge with AI elements suggested by AI4K12 for primary and secondary education. These AI learning content elements include perception, representation and reasoning, learning, natural interaction, and societal impact.
Types of AI Integration: The integration methods in AI-integrated education are based on various models of integrated curricula used in prior literature, such as those by Choi(2023), and Lim et al. (2024). These methods are grounded in Fogarty's models of integrated curricula (1991) and include five types of integration methods: competency-oriented integration, AI+subject development integration, core subject-based integration, content element-based integration, and theme-connected integration.

Figure 1

Framework of AI-integrated Education Classification



The analysis results include a case study by Song et al. (2021), which focuses on developing a data-based discussion class model and instructional strategies to enhance data literacy. The study context involved creating a 12-session integrated course combining information, Korean language, and social studies subjects. The discussion topic was "Should disaster relief funds due to COVID-19 be provided to all citizens equally?" The research subjects included one information teacher, one Korean language teacher, one social studies teacher, and 141 first-year high school students.

The objectives of AI-integrated education in this study were centered on applying subject and AI knowledge. Students were taught to collect, analyze, and visualize data based on theoretical knowledge from each subject and AI, enabling them to engage in informed discussions. The study employed two integration methods: theme-connected integration and competency-based integration. Theme-connected integration involved adjusting the sequence of topics in the Korean language, social studies, and information subjects to connect the subject and AI content under a specific discussion topic—competency-oriented integration aimed at conducting discussion classes to enhance data literacy competency. In terms of AI learning content elements, students learned representation and reasoning by analyzing and visualizing data using Python. Additionally, they studied data mining techniques to further their understanding and application of AI concepts. This case study demonstrates a comprehensive approach to AI-integrated education, aiming to enhance both subject-specific and AI competencies among students.

Discussion

This systematic review of AI-integrated education in South Korea from 2015 to 2024 provides valuable insights into the current state and future directions of this emerging field. The proposed classification framework, encompassing educational objectives, AI learning content, and integration types, offers a comprehensive structure for developing and analyzing AI-integrated education programs. The research highlights the multifaceted nature of AI-integrated education, emphasizing the importance of balancing subject knowledge with AI literacy and ethical considerations. The various integration methods identified demonstrate the flexibility of AI-integrated education in adapting to different educational contexts and objectives. Key findings include the growing emphasis on digital literacy across all subjects in South Korea's curriculum, reflecting the increasing importance of AI and technology in education. The case study by Song et al. (2021) exemplifies how AI-integrated education can enhance higher-order thinking skills and address real-world issues through interdisciplinary approaches. As AI technologies continue to evolve rapidly, maintaining relevance in AI-integrated education programs will be an ongoing challenge. Regular curriculum updates and flexible frameworks will be crucial to ensure that education keeps pace with technological advancements.

Conclusion

As research on AI-integrated education is still in its early stages, this study provides foundational insights for better implementation and contributes to future research and program development. By clarifying the current state of AI-integrated education in South Korea and proposing directions for effective educational practice, this research lays the groundwork for innovative approaches to preparing students for an AI-driven future.

The various attempts at AI integration in education, from experiential learning to general education program development, demonstrate the field's dynamism. Future research should focus on developing principles and models for AI-integrated education, particularly on instructional design approaches that foster higher-order thinking skills across subjects. In conclusion, while challenges remain, the potential of AI-integrated education to enhance learning outcomes and prepare students for a technology-driven world is significant. Continued research, collaboration, and innovation in this field will be crucial in shaping the future of education in the age of artificial intelligence.

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Perspectives on Creating Visual Teaching Materials Targeting Phenomena with Significant Temporal and Spatial Scales: A Practical Approach to Creating Time-Lapse Videos about Clouds

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Abstract In science education, utilizing video materials is effective for learning phenomena with large temporal and spatial scales, such as cloud formation. Therefore, science teachers are required to have skills in creating educational materials and practical abilities to utilize them in their lessons. The purpose of this study is to identify the difficulties and challenges that pre-service science teachers face when creating time-lapse videos of clouds. As a result of this practice, it became evident that in addition to knowledge about meteorological phenomena, it is necessary to consciously learn basic video production skills.

Keywords: time-lapse videos, earth science education, cloud movement, junior high school, teacher training

Introduction

The creation and utilization of digital materials related to observations and experiments are becoming more widespread in science education. Particularly in geoscience education, phenomena often have large temporal and spatial scales, making actual observation difficult and thereby making the use of digital materials effective. Time-lapse photography, in particular, has been utilized in the field of Earth science for a long time because it allows the observation of long-duration phenomena over a short period. Examples include volcanic eruptions (Orr and Rea, 2012), glacier movement (Miller and Crandell, 1959), and cloud movement (Schaefer and Taylor, 1957). Educational content using time lapses can be found on the web, making it easy to use; however, it often does not fully reflect the teacher's intentions and is not always relatable to students. Therefore, it is important for teachers to create time-lapse videos that suit their educational objectives and target phenomena.

For example, in geoscience education, Fahnestock (1966) stated that time-lapse photography is effective for observing geological processes and devised methods for creating time-lapse photographs for students and teachers. In the field of meteorology, Patrizia (2021) created time-lapse videos for introductory meteorology. However, while noting the effectiveness of the videos, Patrizia noted that without proper guidance and a clear path for showing the videos, learners could become confused.

In domestic research, Nagoshi (2009) reported that using time-lapse videos of clouds captured with a webcam in junior high school science classes effectively increased the interest in and curiosity about cloud movements. Additionally, Kameda and Takimoto (2022) had high school students shoot time-lapse videos of clouds, revealing the characteristics of the clouds on which they focused. However, Kameda et al. pointed out that focus points and observation results differed depending on the instructor's guidance and the students' observational experience.

Based on the above findings, future teachers need the ability to create time-lapse videos suitable for their lessons' objectives and phenomena, as well as the ability to guide students in observing videos from appropriate perspectives. Furthermore, it is necessary to develop teaching skills that enable students to shoot time-lapse videos themselves. Practical research aimed at equipping teachers with training in these abilities is scarce. Moreover, the experience of creating video materials for phenomena with large temporal and spatial scales not only promotes a deeper understanding of the phenomena among students but

can also be applied to the creation of educational materials for other complex phenomena.

Research Design and Methods

In this study, we provided pre-service science teachers with the opportunity to create time-lapse videos of clouds to identify the challenges in video production. Based on our findings, we propose improvements for practical implementation. In Japan, students learn about the mechanisms of cloud formation in junior high school science classes (Ministry of Education, 2018). Through cloud observation, students become aware that updrafts are involved in cloud formation and deepen their understanding of the mechanisms through experiments (e.g., Ōya et al., 2020). Therefore, the most important aspect of cloud observation is that clouds are formed by the rise of air, which can be observed through cloud movements. However, because cloud changes occur slowly, time-lapse videos that allow long-duration phenomena to be observed in a short period are optimal.

Table 1 provides an overview of the practice. This practice was conducted with students enrolled in a teacher-training course at University A. After conducting basic meteorological learning and experiments, we presented examples of cloud time-lapse videos and assigned the participants the task of creating such videos. The conditions for the videos were set as follows: (1) capture one of the ten cloud types defined by the World Meteorological Organization and (2) demonstrate the involvement of updrafts. If it was not possible to shoot a time-lapse video, the students were assigned to take photos of the three types of clouds.

When attempting to shoot time-lapse videos that meet conditions (1) and (2), it is necessary to choose a location with a clear view and target cloud types that develop vertically at low altitudes such as cumulus or cumulonimbus clouds (Figure 1). Additionally, to capture optimal cloud movements, students need to understand not only the speed at which clouds move but also the length of the video shooting time and frame rate. Therefore, students must carefully observe the sky and engage in trial and error while shooting. In this practice, we prioritized students' trial and error and personal experience and thus did not provide detailed instructions.

Verification was conducted through a questionnaire administered before the practice and an analysis of the videos submitted by the students.

Table 1

An overview of the practice

1	< Learning the basic knowledge of meteorology > (90 min) ・Scale of weather phenomena ・Atmospheric pressure ・Vertical structure of the atmosphere ・Experiments on convection and changes of state ・Types of clouds and how they form: watched examples of time-lapse videos ・An experiment on how clouds form
	< Creating a time-lapse video of clouds > (1 week)
2	< Comments on submitted videos > (30 min) ・What you can learn from creating time-lapse videos

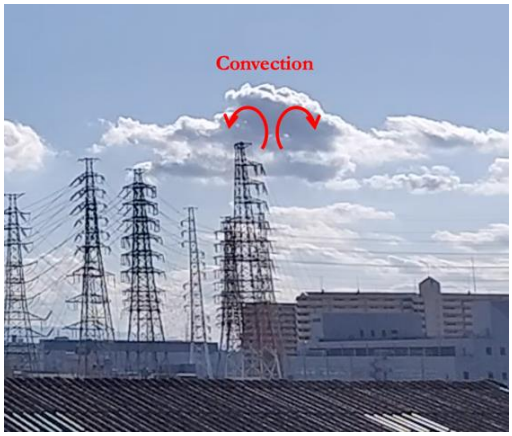

Figure 1
Target cloud example

Results

Analysis of time-lapse videos. Of the 52 students, 36 submitted videos. Students who did not submit videos either lacked time-lapse functionality on their devices or chose to submit photographs. An analysis of the submitted videos

revealed that (1) "capturing one of the ten cloud types" was 100% successful. However, (2) "identifying the involvement of updrafts" remained at 38.8%.

The issues identified by analyzing the problematic videos are summarized in Table 2. The results of the comparison of successful and problematic videos based on Table 2 are presented in Table 3. Problematic videos often present multiple issues in a single video. In particular, difficulties in observing cloud movement were associated with issues in "Angle," where the upward angle was too steep, and vertical cloud movement was not captured in many cases. Regarding "Weather," five videos had high-altitude clouds in the background, four had no cumulus clouds, and one was recorded during rain. In addition, many videos contained clouds that moved too quickly to allow effective observation.

In contrast, successful videos had no issues with "Angle" or "Cloud Movement Speed" in any case. Even if there were issues with "Weather" (e.g., cumulus clouds with high-altitude clouds in the background), as long as there were no issues with "Angle," cloud movement could be observed.

Student survey results. In Japanese high school science education, students are required to study "Science and Our Daily Life" and one subject from the following: "Basic Physics," "Basic Chemistry," "Basic Biology," or "Basic Earth Science," or three subjects from the following: "Basic Physics," "Basic Chemistry," "Basic Biology," or "Basic Earth Science. " In principle, courses in 'Advanced Physics,' 'Advanced Chemistry,' 'Advanced Biology,' and 'Advanced Earth Science' should be taken after completing the corresponding foundational subjects. Table 4 shows the enrollment status of the students who submitted videos. No students took "Basic Earth Science" or "Advanced Earth Science." In Japanese middle school science education, students learn all four domains of "Life Science," "Earth Science," "Chemical Science," and "Physical Science." Table 5 presents the survey results for the students' strengths, weaknesses, and preferences in these domains.

Based on a survey of student conditions, there was no significant difference between students who produced successful videos and those who produced problematic videos.

Table 2

Issues identified

Problem	Details
Angle	The angle is not suitable for capturing vertical cloud movement.
Camera shake	The image is very shaky because the camera is not fixed.
Aspect ratio	The video is vertical, so the sky area is smaller.
Time zone	The video is shot in the evening or at night, when it is difficult to see the clouds.
Location	Shooting indoors, at a low height, or from under a tall building.
Weather	Clouds that develop at low altitudes, such as cumulonimbus and cumulonimbus clouds, are not selected. There are high level clouds and the movement of the low level clouds cannot be seen.
Cloud Movement Speed	Short or long recording times, or frame rate issues.

Table 3

Analysis of time-lapse videos

	Angle	Camera shake	Aspect ratio	Time zone	Location	Weather	Cloud movement speed
Successful videos (n = 14)	0	2	4	1	1	4	0
Problematic videos (n = 22)	12	7	6	6	3	10	5

Table 4

Enrollment status of students

	Science and Our Daily Life	Basic Physics	Basic Chemistry	Basic Biology	Basic Earth Science	Advanced Physics	Advanced Chemistry	Advanced Biology	Advanced Earth Science	No Answer
Successful videos (n = 14)	0	14	13	13	0	5	13	9	0	0
Problema-tic videos (n = 22)	4	18	17	17	0	3	16	15	0	3

Table 5

Survey results on students' strengths, weaknesses, and preferences regarding four domains

	Physical Science	Chemical Science	Life Science	Earth Science	nothing special	No answer
Question 1: Of the four areas of junior high school science, which one did you feel you were good at? (Multiple answers allowed)						
Successful videos (n = 14)	3	6	11	3	1	0
Problematic videos (n = 22)	2	5	13	6	4	3
Question 2: Of the four areas of junior high school science, which one did you like best? (Multiple answers allowed)						
Successful videos (n = 14)	2	5	11	5	0	0
Problematic videos (n = 22)	2	6	12	8	3	3

Discussion

Based on the survey of student conditions, it is presumed that the enrollment status of high school science and middle school science subjects, "Strengths and weaknesses" and "Preferences," did not have a significant impact on the success of time-lapse video production. Therefore, these results reflect the challenges of this practical application. Simultaneously, guidance in teacher-training courses will have a significant impact on future student video material creation.

Based on the analysis of the time-lapse video results, the implementation of basic weather learning, experiments, and setting conditions for the videos did not produce satisfactory results. Therefore, we considered the findings of new practices. Among the issues summarized in Table 2, "Camera shake" and "Aspect ratio" are mainly basic knowledge of video production. On the other hand, "Weather," "Cloud movement speed," and "Time zone" can be considered knowledge about weather phenomena. However, "Angle" and "Location" are basic knowledge of video production, but they change depending on the phenomenon to be filmed, overlapping with knowledge of weather phenomena (Figure 2). Therefore, it is necessary to study basic video production in addition to basic weather studies. For example, it is possible to consider activities such as pointing out problems as teaching materials using videos obtained in this practical study and organizing problems from the perspective of Figure 2. In addition, we think that it is necessary to conduct activities to recognize the types of clouds from observations of the actual sky so that we can choose appropriate clouds and weather conditions at the same time.

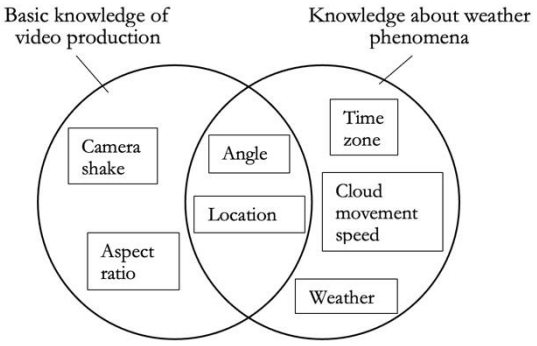

Figure 2
Knowledge for creating time-lapse videos of clouds

Conclusion

The creation of time-lapse videos of clouds has indicated the need to consciously acquire basic knowledge of video production, in addition to conducting basic weather learning and experiments, and setting video conditions. The students targeted in this study belong to the digital native generation, but there is a high possibility that proficiency in using devices does not necessarily translate into creating educational materials. The insights gained from this study provide an important perspective on video material creation for teacher training in science education.

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Characteristics of Prospective Teacher Students' Belief Formation about the Use of Technology in Education

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Abstract This study exploratively clarified how the beliefs of four participating students were formed in a class on the use of technology in education at a university's Faculty of Education by analyzing the results of interviews with the students. The results showed that students formed their beliefs about the class by directly experiencing the usefulness of the technology through individual activities in the class and by incorporating information from experts and the ideas of others, thereby increasing the "reality" of the technology from multiple perspectives. The exchange of ideas among the students led to a clear recognition of the differences in their willingness to use the technology and their skills in using it.

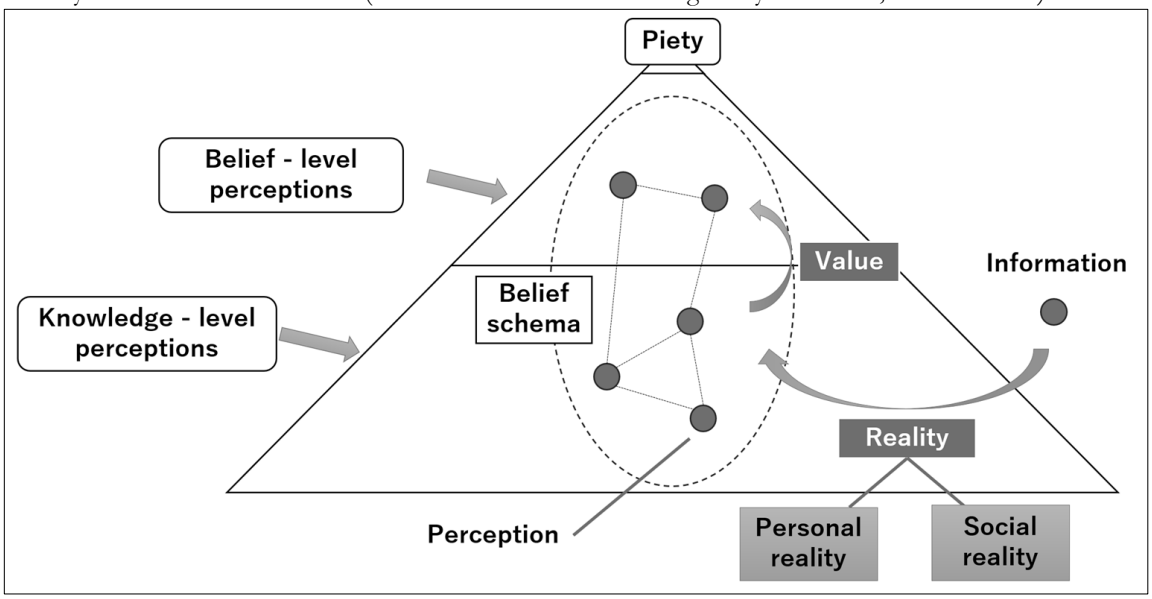
Keywords: Belief Formation, Technology in Education, Generative AI, Teacher Education, Teacher Training

Introduction

With the development of technology, teaching methods have changed and teachers are required to develop new teaching skills. Previous research suggests that to improve teaching competence, it is necessary not only to improve basic teaching techniques, but also to form "beliefs" themselves, which is a way of thinking about teaching (Yoshizaki 1997, Takahashi 2019).

How are beliefs formed? By organizing studies related to teachers' beliefs, Goto (2024a) developed the "Belief System Model for Education," which shows the belief structure of teachers (Figure 1). According to this model, teachers hold a variety of individual educational beliefs, such as the belief that "using a PC can improve academic performance," and establish their own teaching style and make decisions in the classroom based on their "belief schema," which is a set of multiple beliefs. These beliefs have different levels of importance and are divided into two major levels: "knowledge-level" and "belief-level" perceptions. The process of absorbing new information as "knowledge-level perceptions" must be accompanied by "personal reality" and "social reality." Thus, structural knowledge of belief formation has deepened in recent years.

Figure 1
Belief System Model for Education (Goto 2024a translated into English by the author, with additions)



Generative AI has attracted much attention in recent years. In Japan, under the auspices of the Ministry of Education, Culture, Sports, Science and Technology (MEXT), several model schools are currently working to integrate and use generative AI in classrooms (MEXT 2024). Teachers who see and hear about these practices have a variety of reactions, some positive and some negative. What processes do teachers use to express such reactions? By referring to

the structural knowledge of belief formation mentioned above, I believe that the process of teachers' belief formation can be clarified, and the possibility of introducing new technology into education can be expanded.

Therefore, in this study, I explored and clarified the process by which teachers incorporate new technologies, especially generative AI, into their own beliefs by analyzing the characteristics of prospective teacher students' belief formation.

Research Design & Methods

Theoretical Framework

First, I will explain the process of teachers' belief formation in the Belief System Model for Education, which serves as the theoretical framework for this study. According to Goto (2024a), teachers gain personal reality about the information in front of them by inferentially judging the importance of information based on their existing beliefs (inferential rationality) and by directly perceiving its importance through actual use (direct perception). Similarly, people acquire social reality by being convinced of the explanations and opinions of experts (authority) and by forming a consensus with their peers (consensus). The acquisition of personal and social realities in this way is thought to deepen awareness of the "knowledge-level perceptions" shown in Figure 1. In this study, I designed a course for four undergraduate students in the Faculty of Education that incorporated Goto's (2024a) findings (Figure 2).

Figure 2

Classroom flow for "potential use of generative AI in the classroom"

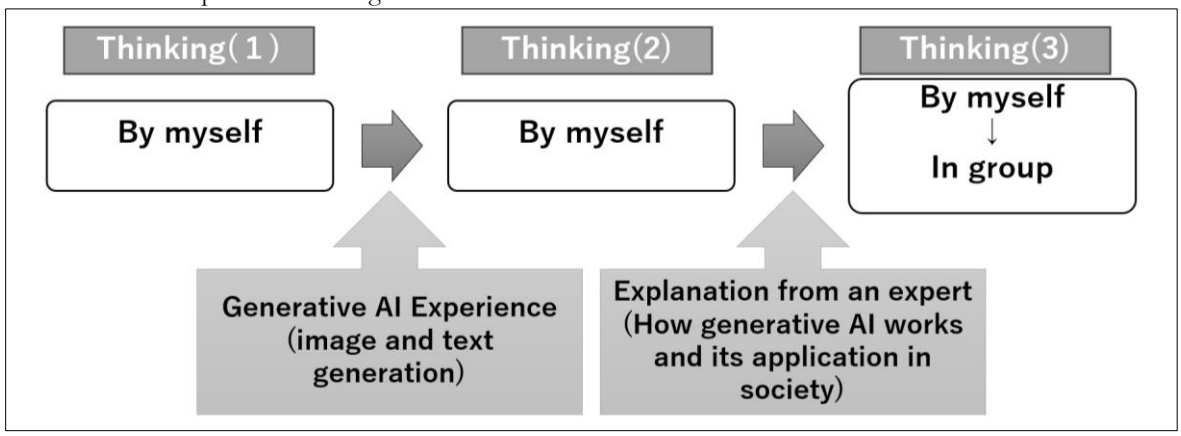
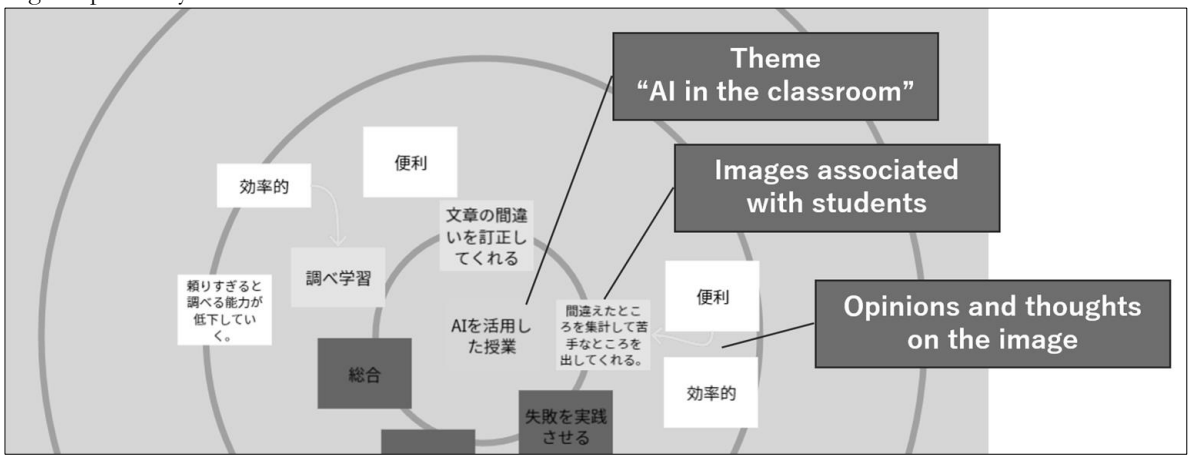


Figure 3

Image map used by students



Class Flow

Figure 2 illustrates the flow of a class in which students were asked to consider the "potential use of generative AI in the classroom." In each of the three "Thinking (By myself)" sessions shown in Figure 2, each student was asked to think about the "potential use of generative AI in the classroom." In "Thinking (1)," students were given no information, so I assumed that their ideas were generated by "inferential rationality" based on their existing beliefs. "Thinking (2)" was conducted after the students had actually experienced Canva's image generation application and Microsoft's "Copilot" chat-type generative AI, so I assumed that their thinking would change based on the "direct perception" they gained from the experience. In addition, "Thinking (3)" was conducted after an explanation by the author, an expert in information education (how generative AI works and its application in society), so I assumed that

the students' thinking would change due to the "authority" of the information obtained. In "Thinking (3)," I was careful to convey only "facts" about society and technology, not my "opinions" about generative AI, to prevent students from being influenced by my opinions. In each Thinking session, the students were asked to express their ideas using an image map, as shown in Figure 3. In the "Thinking (3)" session, after the "By myself" activity, students brought the image map shown in Figure 3 to the "In group" activity, where they shared their opinions. In the "Thinking (In Group)" session, participants exchanged opinions with their peers; therefore, I assumed that their ideas would change depending on their consensus.

Data Collection and Analysis Methods

For data collection, a semi-structured interview was conducted with each student after class. As I showed individual students an image map of each session, I asked them what they were thinking at the time, why they were thinking that way, and asked them to speak freely. The interviews were recorded with students' consent.

As part of the data analysis, all recorded data were transferred to a computer and sentences were separated according to their semantic content. The sentences were assigned a code indicating their semantic content (Table 1), and an interview summary was created based on these codes. The interview summaries were analyzed using Goto's (2024a) "Belief System Model for Education" as a framework, and the process of students' belief formation was discussed.

Table 1

An example of coding (for the interview with Student A)

	Content of the speech	Code	
		Thoughts	Opportunity
Author	You have written about the potential uses of generative AI in the classroom: "it provides model answers," "it calculates instant averages," and "it grades in an instant," but can you be more specific?	"Teacher provides model answers."	High School Internship Experience
Student A	I wrote these because when I was allowed to observe a class as an intern last year, I saw the teacher using AI to automatically calculate and grade students.	"Teacher grades the test."	
Author	Is that what your high school internship was about? Was that the first time you used generative AI yourself in class?		
Student A	Yes, that was my high school internship. That class was the first time I used generative AI.	"Teacher calculates average score."	

Results and Discussion

Results of the Interview Analysis

First, I prepared interview summaries for the four students (due to the limited word count of this paper, I refrain from publishing student interview summaries).

Next, the interview summaries of the four students were analyzed and discussed using Goto's (2024a) "Belief System Model for Education" as a framework. This study exemplifies the discussion of Student A's belief formation (Table 2).

Table 2

Analysis of Student A's belief formation

	Thoughts on Generative AI	Opportunity
Inferential Rationality	Helping teachers with schoolwork	Internship experience
Direct Perception	+ Help students research and solve problems	Experience using chat-type generative AI
Authority	+ Help students understand generative AI properly	Knowledge of AI applications in all aspects of life
Consensus	+ If teachers do not have the skills to use generative AI properly, they should not use it.	Awareness of the advantages and disadvantages of using generative AI

Student A had an inferential idea based on his internship experience that "generative AI would help teachers with their schoolwork." Through his own experience with AI, he directly perceived the characteristics of AI and came up with a different idea: "Generative AI helps students learn and solve their questions." Moreover, after receiving an explanation from an authoritative expert on how AI works and how it is used in society, he felt the importance of "fostering a correct understanding of generative AI among learners" and thought that AI should be taught in the classroom. However, disagreements among the students in the group discussion led to a change in Student A's views.

Some students were positive about the use of generative AI, while others were negative. Student A eventually concluded that "if teachers themselves do not have the skills to use generative AI appropriately, they should not use it.

General Discussion

After reflecting on the results of the interviews with the four students, we discussed what could be said about them as a whole. As a result, we found three major commonalities. First, although none of the students had much experience using AI, they had seen or heard of classes in which it was used, and from this experience, they inferentially judged that AI could be used. Second, students' actual use of AI expanded the range of possible applications of AI in the classroom. Specifically, they envisioned "activities to generate sentences" in Japanese and English courses, "activities to collect, organize, and analyze information using generative AI" in inquiry-based learning in various subjects, and "activities to generate images using generative AI" when expressing unknown images that cannot be imagined. Third, all students considered information from authoritative experts to be "important information" and incorporated it into their own thinking. Specifically, all students believed that "generative AI is all over the world" and that "it is inevitable to deal with it in future education."

Another particularly noteworthy result was the depth of thought that emerged from the discussions among the four students. From the beginning, the students agreed that "generative AI is so abundant in the world that it is inevitable that it should be addressed in education. On the other hand, one student with high motivation to use AI thought, "I want my students to learn about the features and appropriate use of generative AI by having them use it in class," while a student with low motivation to use AI thought, "I don't think I can overcome my own weakness in using technology, so I don't think I will be able to use it in class in the future. However, I believe that there should be a lecture on the appropriate use of generative AI." Eventually, through these discussions, a consensus was reached that teachers with sufficient skills to use generative AI should use it in their classes. Thus, the discussions helped to build consensus among the students and deepen their thinking. However, this also made the students aware of the disparity in their willingness and ability to use generative AI. Similar results were observed in Goto's (2024b) study on programming education practices for teachers, suggesting that the issue of "gaps in teachers' willingness and skills to use technology" is a perennial challenge in promoting the use of technology in education.

Conclusion

This study exploratively clarified the process by which teachers incorporate new technologies, especially generative AI, into their own beliefs by analyzing the characteristics of belief formation among prospective teacher students. The results showed that students inferentially perceived the usefulness of using generative AI in education from the beginning, and the content of this inference varied according to differences in individual students' experiences. Students' beliefs were further deepened by their own "direct perception" of the usefulness of using generative AI and by the "authority" they gained from listening to experts' explanations. Finally, when students contributed their own opinions to the discussion, consensus-building progressed, and the ideas of individual students deepened. However, the results clearly showed differences in students' willingness and ability to use generative AI.

These findings suggest that it is important for teachers to take advantage of training opportunities to (1) actually use the technology and gain "direct perception" of its usefulness, (2) gain "authority" by listening to expert explanations, and (3) build "consensus" by exchanging opinions among teachers when introducing a technology into their classrooms. However, it was also suggested that some teachers may become inferentially negative due to their past experiences, or may become negative due to the perception of disparity through the exchange of opinions among teachers. Therefore, measures must be taken to address these negative aspects when promoting teacher training.

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K-12 Teachers Competencies for AI Convergence Education

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Abstract

The purpose of this study was to identify the competencies necessary for AI convergence education among K-12 teachers. To achieve the purpose, the study was conducted in two phases. The first phase involved identifying competency groups for AI convergence education by K-12 teachers. In the second phase, core competencies, sub-competencies, components, and behavioral indicators for each competency group were identified. Methods such as literature reviews, case analyses, teacher interviews, expert consultations were, and survey utilized. The results are as follows: First, the competency groups identified for AI convergence education by K-12 teachers include AI literacy, AI convergence instructional design and operation, and AI convergence instructional evaluation. Second, the competencies consist of 10 core competencies, 25 sub-competencies, and 149 behavioral indicators. These results provide a foundation for enhancing AI convergence education competencies among K-12 teachers and serve as a guideline for implementing AI convergence education.

Keywords: AI convergence education, AI convergence education competency, AI convergence education competencies of K-12 school teachers

Introduction

South Korea's 2022 revised curriculum underscores the critical importance of digital literacy and provides a comprehensive framework for its integration across all subject areas (Ministry of Education, 2021). In the contemporary world, digital literacy constitutes an essential competency, empowering learners to effectively navigate and utilize a diverse array of information and technological tools. Specifically, artificial intelligence (AI) has emerged as a fundamental component of digital literacy. AI technology is revolutionizing the educational landscape, offering innovative approaches to enhance both teaching and learning processes. AI convergence education is defined as an educational approach that fosters problem-solving skills through intra- and interdisciplinary convergence based on an understanding of the concepts and principles of AI (Park, et al., 2023; Han, et al., 2021). The importance of AI convergence education is gaining traction in primary and secondary education, and teachers' AI convergence education skills are essential for effective implementation (Lee, et al., 2022; Eom, 2023; Hong et al., 2021; Hrastinski et al., 2019).

The role of teachers is critical to the success of AI convergence education. Teachers need to have a deep understanding of AI and the ability to utilize it in education. Unlike traditional technologies that have been utilized as tools in teaching and learning contexts, AI convergence education requires not only the use of AI as a tool but also the understanding of concepts and principles underlying AI itself. Consequently, new competencies are required for educators to effectively implement AI convergence education. Therefore, study was to examine to identify the competencies of elementary and secondary school teachers for AI convergence education. To achieve the purpose, the following research contents have been established. First, the competency group of AI convergence education is derived. Second, the core competencies, sub-competencies, components, and behavioral indicators of AI convergence education are identified.

Research Design & Methods

Methods such as literature reviews, case analyses, teacher interviews, and expert consultations were utilized. Subsequently, 615 teachers completed a survey to validate and finalize the competencies. A total of 20 teachers were interviewed. Specifically, 10 elementary school teachers and 10 secondary school teachers participated. A total of 12 experts participated in the expert review. Five elementary school teachers, five secondary school teachers, and two university teachers participated. The survey was completed by 615 teachers, of which 312 were elementary school teachers and 155 were secondary school teachers. When selecting research subjects, it is essential to consider specialized knowledge, abilities in the relevant field, and representativeness (Eom et al., 2020). Consequently, the subjects of this study were selected based on the following criteria: the elementary and secondary school teachers who are currently or have previously worked in AI leading schools. The elementary and secondary school teachers who have participated in AI convergence education-related training or refresher courses. The elementary and secondary school teachers with experience in implementing AI convergence education, based on their knowledge of AI convergence education.

Teachers who were recommended by researchers and scholars at the Metropolitan Office of Education were also selected as research subjects. Permission to participate in the survey was obtained via email in advance. Subsequently, the teachers were sent the survey tool link via email to respond online.

Results

The competency groups identified for AI convergence education by K-12 teachers

The competency groups identified for AI convergence education by K-12 teachers include AI literacy, AI convergence instructional design and operation, and AI convergence instructional evaluation. The AI convergence education competency framework identified in this study comprises three main areas: AI literacy, AI convergence instruction design and operation, and AI convergence instruction evaluation.

The AI literacy competency involves the ability to continuously explore and develop expertise for the educational utilization of AI, grounded in both knowledge and practical use of AI. Core competencies within AI literacy include understanding AI-related knowledge and applications, fundamental of AI convergence instruction, and AI ethics.

The AI convergence instructional design and operation competency focuses on the ability to design and manage AI convergence instruction. Key competencies include analyzing AI convergence instruction, designing and developing teaching and learning activities, selecting and developing appropriate media, designing evaluation tools, and operating AI convergence instruction effectively.

The AI Convergence Instruction Evaluation Competency involves the ability to systematically evaluate learner performance in AI convergence classes, reflect on instructional practices, and utilize AI for class evaluation and feedback. Core competencies include conducting evaluations and reflections on AI convergence instruction, and using AI tools for assessment and feedback purposes.

Identify core competencies, sub-competencies, components, and behavioral indicators of AI convergence education competencies by K-12 teachers

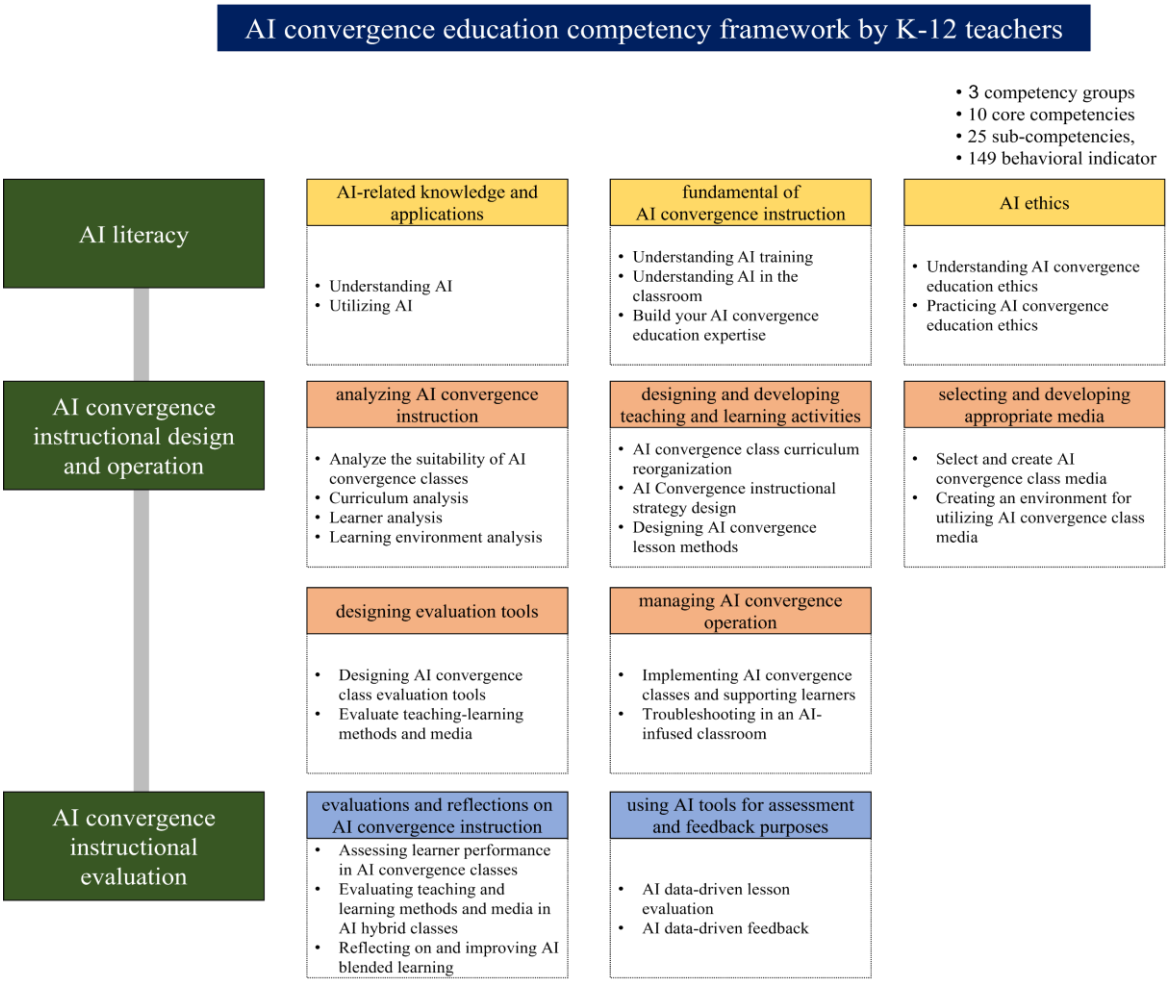
The competency groups identified for AI convergence education by K-12 teachers include AI literacy, AI convergence instructional design and operation, and AI convergence instructional evaluation. The competencies consist of 10 core competencies, 25 sub-competencies, and 149 behavioral indicators. Specifically, the AI literacy group contains 3 core competencies, 7 sub-competencies, 15 components, and 43 behavioral indicators. The AI convergence instructional design and operation group comprises 5 core competencies, 13 sub-competencies, 26 components, and 82 behavioral indicators. The AI convergence instructional evaluation group includes 2 core competencies, 5 sub-competencies, 9 components, and 24 behavioral indicators.

The AI convergence education competencies of elementary and secondary school teachers identified in this study can be categorized by school level and presented as follows. First, the AI convergence education competencies of elementary school teacher. The AI literacy group contains 3 core competencies, 7 sub-competencies, 15 components, and 42 behavioral indicators. The AI convergence instructional design and operation group comprises 5 core competencies, 13 sub-competencies, 26 components, and 82 behavioral indicators. The AI convergence instructional evaluation group includes 2 core competencies, 5 sub-competencies, 9 components, and 24 behavioral indicators. Second, the AI convergence education competencies of secondary school teacher. The AI literacy group contains 3 core competencies, 7 sub-competencies, 15 components, and 43 behavioral indicators. The AI convergence instructional design and operation group comprises 5 core competencies, 13 sub-competencies, 26 components, and 82 behavioral indicators. The AI convergence instructional evaluation group includes 2 core competencies, 5 sub-competencies, 9 components, and 24 behavioral indicators.

The AI convergence education competency framework identified in this study can be presented as shown in Figure 1.

Figure 1

AI convergence education competency framework by K-12 teachers



Conclusion

This study was conducted as follows to identify the competencies necessary for AI convergence education among K-12 school teachers. The results of the study were as follows: First, the competencies of AI convergence education for elementary and secondary school teachers were derived based on domestic and international literature and case analysis, teacher interviews, and expert consultation. Second, through the validation process, the AI convergence education competencies were divided into AI literacy competency group, AI convergence lesson design and operation competency group, and AI convergence lesson evaluation competency group.

The results of this study can be utilized as follows: First, the competency groups of AI convergence education that are suitable for the context of AI convergence education operating in the field of elementary and secondary education and the core competencies, sub-competencies, components, and behavioral indicators of each competency group can be used as a basis for strengthening the competency of elementary and secondary teachers in AI convergence education in the future. Second, the competency groups, core competencies, sub-competencies, components, and behavioral indicators proposed based on the results of this study specifically present the competencies required to perform the role of teachers for AI convergence education, and each behavioral indicator can be used as a guideline for AI convergence education for elementary and secondary teachers. Third, a competency diagnostic tool for AI convergence education was developed to present the competencies of AI convergence education and diagnose the competencies, which can be a basic resource for checking the competencies of AI convergence education of elementary and secondary school teachers. Fourth, the behavioral indicators of AI convergence education competencies developed as a result of this study, which specifically suggest the competencies of teachers to conduct AI convergence education, can be used in the future to examine the changing educational needs of teachers through customized competency diagnosis according to personal variables such as school level, teacher experience, and subject matter, and provide implications for revising and redeveloping measures to strengthen teachers' competencies for AI convergence education.

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Transforming Teacher Beliefs for ICT-Enabled Collaborative Learning in Japan

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The purpose of this study is to clarify the process of transformation of mid-career teacher's beliefs of teaching that occurs when they reflect on the improvement of their classes, using the framework of "Three Levels of Experiment" of reflective practice. Based on the interview data with one teacher whose beliefs of teaching have been developed through class improvement based on rubric evaluation and who has begun to use ICT for collaborative learning, we analyzed the data using the Trajectory Equifinality Modeling and considered it from the framework of "Three Levels of Experiment." The results revealed a process of repeated realization and reflection on the effectiveness of the rubric, as well as a process of learning and coming to a teacher's beliefs based on constructivist instructional approaches while confirming the realization of the effectiveness obtained in the previous stage.

Keywords: Mid-career Teacher, Teachers' Beliefs of Teaching, Trajectory Equivalency Modeling, Rubric Evaluation, ICT

Introduction

Teacher's beliefs based on constructivist instructional approaches necessary for active learning with ICT. One of the reasons why collaborative learning with ICT is not actively conducted is the influence of teacher's beliefs based on direct instructional practices (Ninomiya & Honda, 2004). Teacher's beliefs based on direct instructional approaches utilize ICTs for the purpose of efficient knowledge transfer. In contrast, teacher's beliefs based on constructivist instructional approaches utilize ICTs for collaborative learning in order to have learners construct knowledge among themselves. Table 1 presents the differences between teacher's beliefs based on direct instructional practices and teacher's beliefs based on constructivist instructional approaches are summarized with reference to previous research.

In Japanese elementary school settings, many teacher's beliefs based on direct instructional practices are central to the beliefs of teaching (Yuguchi et al., 2019). In order to promote the use of ICT in collaborative learning, elementary school teacher's beliefs based on constructivist instructional approaches need to be transformed. Several studies have shown that teacher's practice and reflection are necessary for the transformation of their beliefs of teaching (Clark & Hollingworth, 2002; Korthagen & Vasalos, 2005).

This study targeted mid-career teachers in Japan. Suppose mid-career teacher's beliefs of teaching remain the same as the teachers' beliefs based on direct instructional practices. In that case, they will need help to improve their teaching in such a way that constructivist instructional approaches are implemented at school sites. If we could capture in detail the process of transformation of mid-career teacher's beliefs of teaching, we could gain knowledge that would

Table 1

Different beliefs of teaching

Beliefs of teaching	Direct instructional practices	Constructivist instructional approaches
Subjects in class	Teacher	Students
How to capture the learner	Passive	Proactive and independent
How to capture knowledge	Universally true	Socially Formed
Role of the Teacher	Knowledge Provide	Facilitation Appropriate feedback
Evaluation Method	Do it at a certain point Separate it from the learning	Ongoing Embedded in learning

Based on the work of Staub & Stern 2002, Kim 2005, and written by the author

contribute to the improvement of classes at school sites, such as the development of guidelines for the transformation of their beliefs of teaching. Therefore, we targeted Japanese mid-career teachers in this study.

THREE LEVELS OF EXPERIMENT" of reflective practice to capture the transformation of beliefs of teaching. In this study, we used a framework related to reflective practice (Schön,1983), in which reflection in action is used to construct or change a new framework for dealing with a problem. Schön describes the attempts of professionals to construct new frameworks by identifying three types of practices: "Exploration," which involves trying things out; "Move Testing," which involves making predictions and creating change; and "Hypothesis Testing," which involves setting up a hypothesis and testing it (Schön,1983). In this study, we call this "Three Levels of Experiment" and capture the process of transformation of mid-career teacher's beliefs of teaching that occurs when they use this framework to improve their teaching and reflect on it. It is also reported that the "Three Levels of Experiment" can be applied to teachers in the school field (Hirayama & Konno,2023). Therefore, the author thought that using the "Three Levels of Experiment" would make it easier to capture the process of class improvement and reflection that leads to the construction and transformation of the teacher's beliefs based on constructivist instructional approaches, in accordance with the progression of teacher's class improvement in the three stages.

Purpose of the Study. The purpose of this study was to clarify the process of change in mid-career teacher's beliefs of teaching through reflection on the improvement of teaching, using the framework of the "Three Levels of Experiment" of reflective practice.

Research Design & Methods

Target and acquired data. In this study, we collaborated with mid-career teacher's beliefs of teaching. Teacher A, whose beliefs of teaching were transformed through class improvement on the theme of rubric evaluation and who became a collaborative ICT user as a teacher who fits the purpose of the study. It has been reported that a teacher's beliefs of teaching is not naturally transformed when one terminal and a high-speed Internet environment are provided for each teacher, but are transformed through class improvement accompanied by the learning of educational evaluation (Hirayama & Konno,2024). Therefore, we selected teacher whose beliefs of teaching was transformed through classroom improvement on the theme of rubric evaluation and who began to use ICT for collaborative learning. We obtained audio data from those teacher through semi-structured interviews.

Author's stance. The first author worked with Teacher A as a colleague at the same Japanese public elementary school from April 2023 to March 2024, the study period. The elementary school where the first author and Teacher A worked was conducting an in-school research project to improve lessons with the theme of rubric evaluation. Teacher A was a mid-career teacher who was the head of research in the school. The first author was a classroom teacher in the same grade as Teacher A, and was involved with Teacher A as a consultant regarding the school's research.

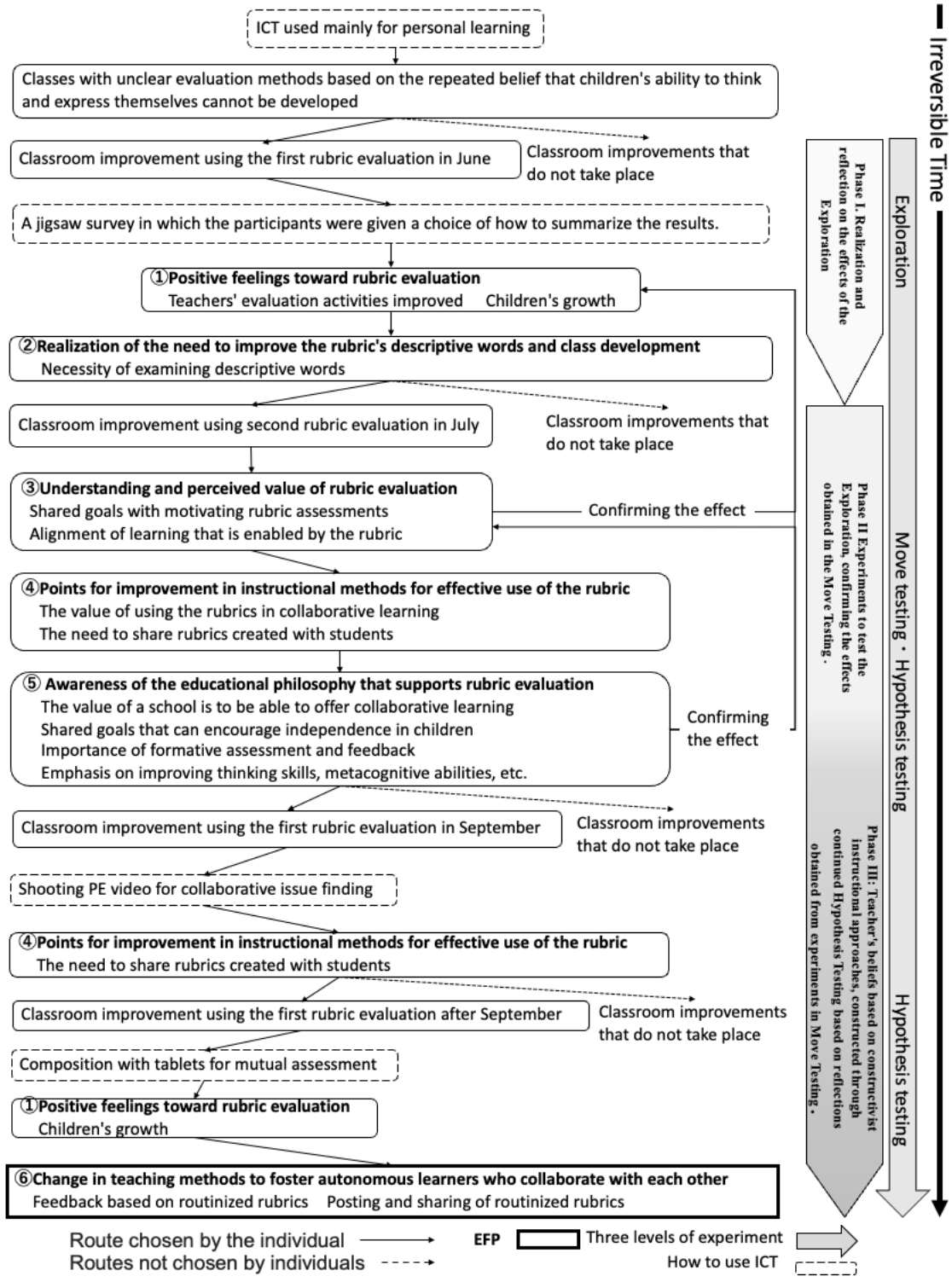
Analysis Method. The analysis method used the Trajectory Equifinality Approach (hereinafter referred to as TEA), which is considered to have strengths as both a thinking tool and a visualization tool for understanding human activities. In this study, we visualized the transformation of teacher's beliefs of teaching using one of the TEAs, the Trajectory Equality Model (hereinafter referred to as TEM).
In the TEA, the modified grounded theory (hereinafter referred to as M-GTA) of Kinoshita (2003) was used to classify and analyze what was said in order to generate a TEM-based diagram (hereinafter referred to as TEM diagram), and the audio data of the interviews were analyzed with the aid of the grounded theory.
The analyzed TEM diagrams were discussed using the "Three Levels of Experiment" framework of reflective practice. In this study, the TEA process (Yasuda et al. , 2015) was followed in seven steps.

(1) Establishment of the Equifinality point and administration of the pre-interview questionnaire
(2) First interview December 2023
(3) Second interview February 2024
(4) Analysis, creation, and revision of TEM diagrams
(5) Additional interviews and revision of TEM diagrams May 2024
(6) Interview with Teacher A for final confirmation of TEM diagrams
(7) Discussion using the "Three Levels of Experiment" framework

Results & Discussion

The results of the analysis are summarized in Figure 1. The change to the beliefs of teaching based on constructivist instructional approaches was considered as the Equifinality point. However, because this study used M-GTA, the

Figure 1
The process of change in mid-career teacher's beliefs of teaching that occurs when they reflect on the improvement of their classes



actual change to a teaching method that fosters collaborative, autonomous learners was analyzed with reference to Table 1 and considered as a change to a teacher's beliefs based on constructivist instructional approaches.

Phase I. Realization and reflection on the effects of the Exploration. Originally, Teacher A had used ICT with the assumption that it was for individual learning. The teacher thought that it was impossible to develop the ability to think and Expression and conducted the class with an unclear evaluation method. From there, we began to improve

the classes. During this period, the teacher gained positive feelings toward rubric evaluation. He also reflected on the need to improve the rubric's descriptive words and class development.

Phase II Move Testing, confirming the effects obtained in the Exploration. The students were able to improve their teaching based on their reflections and to see if the positive feelings obtained in the Exploration session could be obtained. As a result, they gained an understanding of the rubric and an awareness of its value. In order for the value of the rubric to emerge, they also reflected on points for improvement in their teaching methods in order to use the rubric effectively.

Phase III: Teacher's beliefs based on constructivist instructional approaches, constructed through continued Hypothesis Testing based on reflections obtained from Move Testing. Based on the reflections obtained from "Move Testing," further classroom improvements were made. As a result, the teacher's beliefs based on constructivist instructional approaches, which is an awareness of the educational philosophy that supports rubric evaluation, was obtained. The teacher's "Hypothesis Testing" did not end there. The process of reconfirming the reflections obtained in "Move Testing" and deepening the sense of effectiveness obtained in "Exploration" were also confirmed. Two months after completing the lesson improvement, we confirmed that the teacher had not only continued to use ICT in the same way but had also been using ICT collaboratively in the math class by setting performance tasks and cross-referencing them.

Conclusion

The process of mid-career teacher's beliefs of teaching change through reflection on the improvement of teaching was captured using the "Three Levels of Experiment" framework of reflective practice, and the following process was revealed:

1. In the "Exploration" stage, we obtained a sense of effectiveness and the improvements necessary to achieve that effectiveness.
2. In the "Move Testing," the participants improved their classes while confirming whether they could obtain the effects they felt in the "Exploration," and understood the value of the rubric.
3. "Hypothesis Testing" continued, utilizing the points to be improved in order to use the rubrics effectively, and the constructivist beliefs of teaching, which is an awareness of the educational philosophy that supports rubric evaluation, which is a constructivist belief of instructional approaches, was constructed.

Not stopping there, "Hypothesis Testing" was continued, and constructivist instruction began to be implemented. ICT was also used for collaborative learning.

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Transformation of Student Teachers' Instructional Design

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This study aimed to reveal how student teachers utilize the learning of instructional design in their teacher-training course into the lesson design of the teachers' teaching practice. We identified aspects of instructional design commonly integrated into lesson planning: incorporating informing the learner of the objective, presenting the stimulus material, and eliciting performance. Furthermore, we observed students incorporating aspects of the nine events of instruction and the ARCS model into their lesson designs when drawing on their experiences from lectures on teaching methods and guidance from supervising instructors.

Keywords: Instructional Design, Student-Teacher, Trajectory Equifinality Approach

Introduction

Research Background

In their study, Ishikawa et al. (2023) pointed out the lack of research on instructional design (ID) practices in Japan, emphasizing the need for studies that contribute to developing teachers' practical skills. Nakamura et al. (2021) have developed lectures to enable students to design lessons by incorporating various ID theories. Through these lectures, students in the mathematics teacher-training program were reported to be able to create lesson plans based on the nine events of instruction (Gagné & Briggs, 1974) and the attention, relevance, confidence, and satisfaction (ARCS) model (Keller, 2009), which are included in ID theories.

In ID, conducting learner analysis is emphasized as the first step in lesson design (Takahashi, 2016). However, it may be challenging for pre-service teacher-training students to conduct learner analysis before going to teaching practice, as they do not have students in front of them at that stage. Therefore, it is necessary to clarify whether pre-service teacher trainees can apply what they have learned in their teacher training program to designing lesson plans and teaching practices during teaching practice.

Purpose

This study aims to reveal how student teachers utilize the learning of ID in their teacher-training course into the lesson design of the teachers' teaching practice.

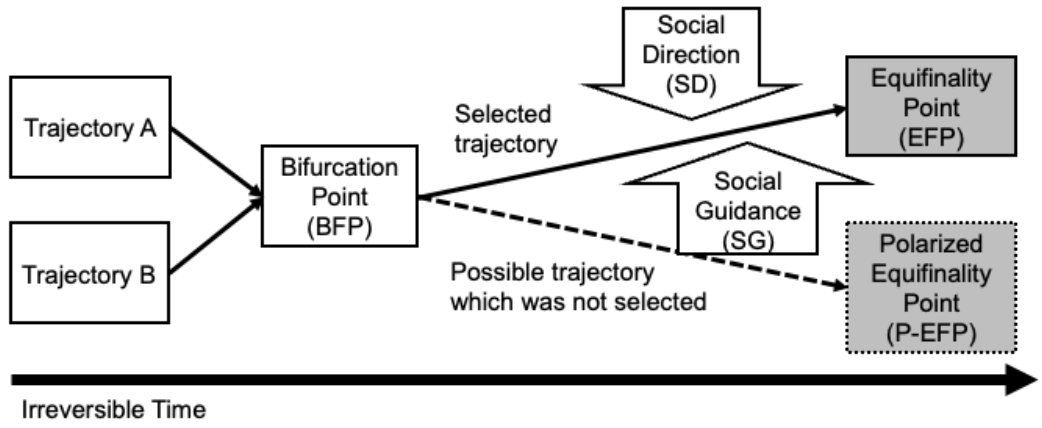
Methods

To achieve the research objectives, we utilized the learning of instructional design (ID) in the "ID and Technology (IDT)" course as a case study. We interviewed pre-service teachers to elucidate the lesson design process during teaching practice. We analyzed the data using the Trajectory Equifinality Approach (TEA).

Trajectory Equifinality Approach

TEA is a qualitative research method that involves identifying equifinality point (EFP), exploring multiple trajectories individuals take to reach these points, and elucidating why they chose those trajectories (Yasuda et al., 2015). **Figure 1** shows the Trajectory Equifinality Modeling Diagram. According to Sato and Yasuda (2012), the forces that propel individuals toward EFP, including support from others, social assistance, and cognitive recognition that supports institutional structures, are termed "Social Guidance" (SG). Conversely, events that oppose EFP, known as Polarized Equifinality Point (P-EFP), are associated with forces pushing individuals away from these points, termed "Social Direction" (SD). Additionally, points individuals must pass through to reach a destination are called "Obligatory Passage Points" (OPPs).

Figure 1.
Trajectory Equifinality Modeling (TEM) Diagram (Fukuda, 2022)



Participants

The participants were three mathematics student teachers affiliated with the Faculty of Science at University A in Tokyo. They completed the instructional design and technology (IDT) course in the 2022 academic year and underwent teaching practice in their fourth year in the following year, 2023. These three students agreed to participate in the present survey. Hereafter, we will refer to the participants as Teacher A, B, and C.

Overview of the Instructional Design and Technology Course

The course IDT, offered at University A in Tokyo, which was the focus of this study, is a mandatory 1-credit course consisting of eight sessions. This course is identical to the one reported by Nakamura et al. (2021). Through this course, students designed and refined instructional plans. Specifically, the nine events of instruction covered in the second session are essential models for designing the basic structure of lessons, while the ARCS model covered in the fourth session is crucial for promoting active learning (Inagaki, 2019). These ID models should be prioritized in lesson design based on these observations. Therefore, we provided students with a checklist to assist them in incorporating ID models into their instructional plans.

Summary of the Interview Survey

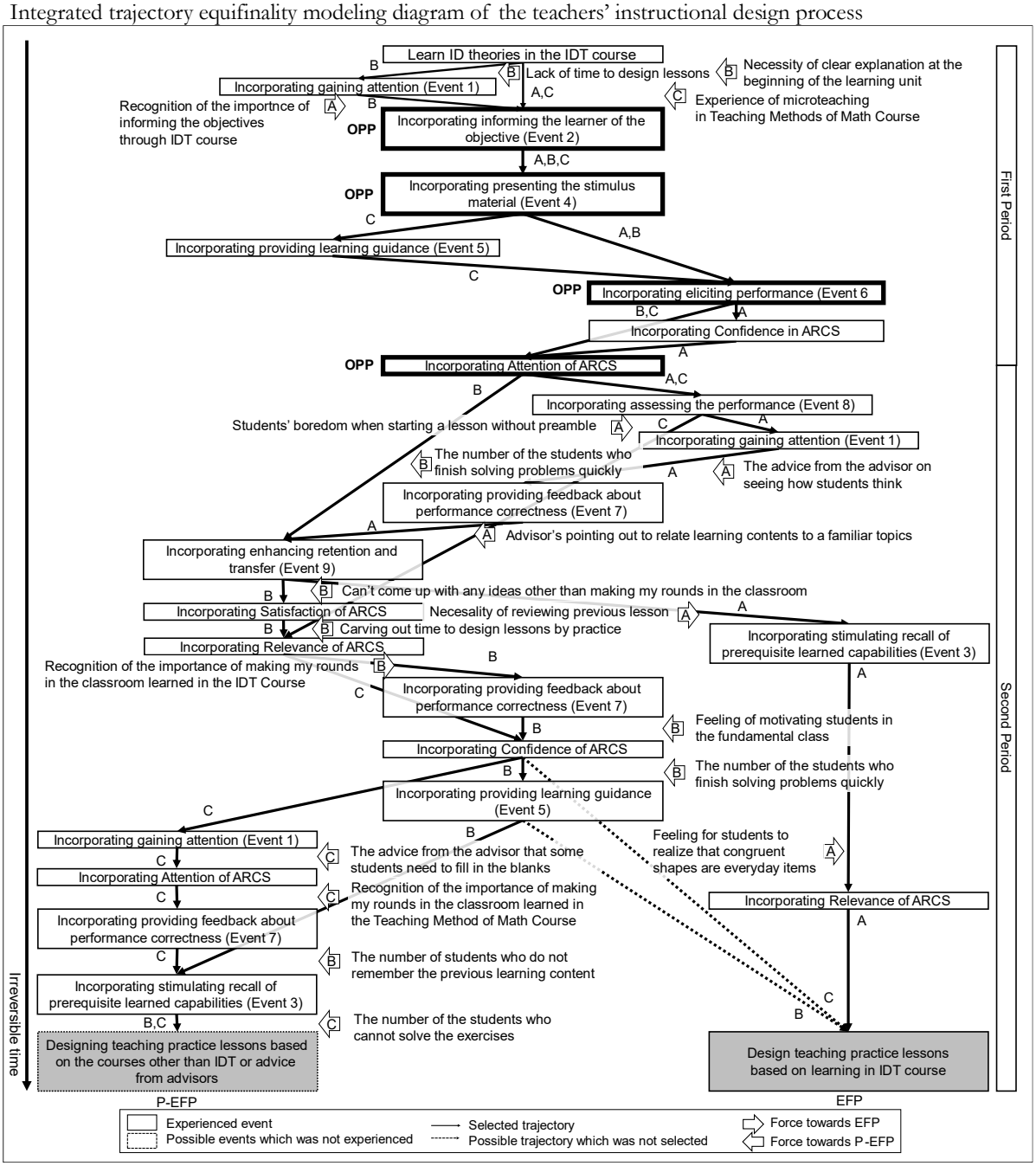
To investigate the process of instructional design during teaching practice, we conducted semi-structured online interviews from June to October 2023, following the completion of the teaching practice. The survey items consisted of: (1) What aspects of the lessons were designed from the perspective of the nine instructional events? (2) What aspects of the lessons were designed from the perspective of the ARCS model?

Additionally, if participants mentioned any innovative aspects of their lessons, we asked whether these innovations were based on their learning in the IDT course.

Results

In this study, we defined EFP as "Designing teaching practice lessons based on learning in IDT course" and P-EFP as "Designing teaching practice lessons based on the courses other than IDT or advice from advisors." The analysis revealed that the instructional design process consisted of two phases: (1) a phase based on existing knowledge and experience, and (2) a phase within the interaction of students, supervising instructors, and other factors.

Figure 2
Integrated trajectory equifinality modeling diagram of the teachers' instructional design process



Discussion

In the analysis, it was evident that during the initial phase of instructional design based on existing knowledge and experience (Phase 1), which corresponded to the early stages of teaching practice, students designed their lessons using their prior knowledge and experiences. Particularly noteworthy was the incorporation of ID perspectives that became OPPs, namely, OPPs such as "informing the learner of the objective (Event 2)," "presenting the stimulus material (Event 4)," " eliciting performance (Event 6)," and "Attention," which were also found to be easily integrated into instructional plans as reported by Nakamura et al. (2021). This result suggests that these perspectives were applicable to the development of instructional plans and could be incorporated into the teaching practices during the teaching practice period.

During the subsequent phase, characterized by interactions between students, supervising teachers, and others (Phase 2), which occurred in the middle to later stages of teaching practice, teachers employed various strategies to refine their instructional designs based on student reactions and interactions with supervising teachers. It became apparent that the strategies adopted in instructional design during this phase were diverse. Specifically, even with the same social event of "student reactions during class," students varied in whether they leaned toward SD or SG. This result indicates that in Phase 2, there was a need to incorporate aspects and perspectives from the nine events of instruction and the ARCS model that closely addressed student situations and learning realities into instructional designs, done through interactions with advisors and students.

While these perspectives are not immediately applicable to designing instructions during teaching practice, they were suggested to be utilized through interactions with others.

Acknowledgments

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The Educational Innovation of South Korea: The development of an AI courseware dashboard prototype for teachers

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As data-based educational innovation proceeds, attention is being paid to AI courseware and dashboards that utilize learner data. While research on learner facing dashboards is actively conducted, research on teacher facing dashboards is insufficient. This study aims to develop a teacher facing dashboard prototype of AI courseware to support instructional design for elementary school mathematics teachers. Following the design and development research methodology, this study proceeded with literature review and case analysis, needs analysis, development of dashboard design principles, initial prototype development and usability test, and final prototype development. Through a needs analysis of 43 in-service elementary school teachers, the necessity for a teacher facing dashboard for instructors that provides appropriate intuitive feedback on individual learners' learning status and supports personalized instructional design was identified, and we derived dashboard design principles from the results. Reflecting these, an initial prototype was developed and after usability test, the finalized prototype consists of six tabs: Home, Learning Status Analysis, Achievement Analysis, Incorrect Answers Analysis, Messaging and Chat, and Settings. This study is significant in that it developed a teacher facing dashboard prototype based on the needs of in-service teachers, and in the current situation where the introduction of AI digital textbooks is being promoted, it also presents a prototype structure for the teacher facing dashboard of AI courseware.

Keywords: AI courseware, Instructional design, Learning analytics Teacher facing dashboard,

Introduction

The introduction of AI digital textbooks and AI courseware in public education will be promoted starting in 2025. The introduction of AI digital textbooks enables appropriate learning courses and prescriptions based on students' learning data, and teachers can also use them to support students' learning. At this time, teachers must be able to understand the learning analysis results displayed in the form of a dashboard and prescribe appropriate customized

feedback to students based on this. However, it can place an excessive burden on individual teachers to interpret the various data provided by the dashboard and design customized feedback for each students(Ham et al., 2020). Accordingly, there is a need to develop a dashboard for instructors that can intuitively understand the learning analysis results of AI digital textbooks and use them in classes. The specific research questions for this are as follows. First, what is the teacher's needs for teacher facing dashboard? Second, what are the design principles teacher facing dashboard? Third, how is the dashboard for AI courseware teacher facing dashboard structured?

Research Design & Methods

This study used products and tools research from design and development research methodology to create a dashboard within an AI-based courseware, aimed at supporting teachers' instructional design in elementary mathematics. The design and development research methodology is a systematic research approach that encompasses the processes of designing, developing, and evaluating instructional and non-instructional outputs and tools, as well as the development of new or improved models that guide these processes (Richey & Klein, 2007). This research methodology is divided into products and tools research and model research. Following to the procedures of products and tools research, this study was conducted in two stages: tool development and usability evaluation. The tool development involved conducting prior research and case analysis, needs analysis, and the development of dashboard design principles. It was followed by the initial dashboard development. The usability evaluation phase then assessed and refined the dashboard, resulting in the creation of the final dashboard. First, we surveyed and analyzed previous studies and cases related to dashboards both in Korea and abroad. In the context of the elementary school mathematics curriculum, we categorized these studies and cases into major functions, effects, and implications of dashboards by learner type. Second, we conducted surveys and interviews with in-service teachers, educational technology experts, and dashboard developers for needs analysis. The survey comprised 43 selective and open-ended questions aimed at identifying instructors' needs and getting specific opinions regarding the teaching of the elementary school math curriculum. The interviews involved three in-service teachers, one doctor of educational technology, and one educational dashboard developer, all experienced in using AI courseware. The interview questions, centered on their experiences with the dashboard and development directions, included 13 questions and were conducted one-on-one in an online, non-face-to-face setting. Third, based on the analysis results, we derived design principles for AI courseware dashboards to support instructors' instructional design. These design principles were subsequently modified and supplemented through an expert validation process. Fourth, we developed an initial prototype based on the analysis and conducted a usability evaluation. This evaluation allowed us to identify improvements to the prototype and assess user reactions. Fifth, we developed the final prototype by incorporating the results of the usability evaluation and analysis.

Results

Results of Needs Analysis

Education experts, teachers, and developers highlighted the importance of AI systems in mathematics education and emphasized the need for teacher-facing dashboards. Regarding the use of AI systems in mathematics education, they reported utilizing them for level-specific learning and providing customized feedback to each learner, primarily through diagnostic evaluation, problem-solving assistance, and achievement/understanding analysis. These systems could also serve as valuable material for parent counseling. Teachers stressed the importance of easily comprehensible results and quick analysis from the system. They also emphasized that the teacher's role remains crucial when implementing such systems. Concerning teacher-facing dashboards, there was a consensus on their necessity. However, respondents cautioned against information overload, suggesting that only essential information should be visualized. Key metrics to include are the percentage of correct answers by question and by learner, classification of learners by level, overall class achievement, and identification of concepts that were weak in previous grades. The overall sentiment was a preference for dashboards that present critical information clearly and concisely. The survey results provided valuable insights into teachers' perspectives and challenges. All respondents (n=44, 100%) recognized the benefits of data-reflective lesson design for learner analysis, though many reported difficulties in its practical implementation. While observation is the primary method for collecting student data (n=41, 93.2%), teachers acknowledged the need for more sophisticated analysis and visualization methods, particularly for learners who are challenging to assess through observation alone. Majority of teachers (n=32, 72.7%) identified differences in students' pre-learning levels as a major challenge in teaching mathematics. They expressed optimism that AI dashboards could help address these disparities, suggesting a potential solution to a persistent challenge.

Design Principles

Based on the research and case analysis, interviews, and surveys, we developed a set of design principles for the AI dashboard. The first principle focuses on meaningful information presentation. This involves using visual elements such as symbols, metaphors, graphs, and colors to convey information more effectively than numbers alone. The dashboard should present only the essential elements concisely, given the limited screen space. To ensure clarity,

explanations of these visual elements should be readily available through tooltips, guides, or instructions. Information hierarchization forms the second principle. This approach involves presenting an overview of the entire situation before diving into more detailed information as needed. It also emphasizes the importance of representing the relationships between key areas within the curriculum, providing context for the data presented. The third principle is user-centric customization. This feature allows instructors to tailor the dashboard to their specific needs by modifying its layout, selecting additional information beyond the basic functionality, and choosing which dates, classes, and measurement units to display in the default view. This flexibility ensures that the dashboard can adapt to various teaching styles and contexts. The principle of prescription is the fourth. This involves presenting information in a way that can be directly utilized for teaching and learning. The dashboard should interpret data to provide actionable insights, offer personalized feedback based on individual learner data, and integrate learners' status updates with the instructor's feedback interface. This approach aims to make the data not just informative, but immediately applicable to the teaching process. Finally, the principle of comparative information provision ensures that the dashboard presents data in a way that allows for understanding learners' relative positions. This includes presenting individual learner data alongside that of their peers, enabling teachers to identify patterns, outliers, and areas needing attention across their class or cohort. These principles aim to create a dashboard that not only presents data clearly and effectively but also supports teachers in making informed decisions and tailoring their instruction to meet the diverse needs of their students in mathematics education.

Prototype and Usability Test

Based on the design principles of AI courseware dashboard derived from the results of prior research and needs analysis, we implemented an initial prototype. The prototype consisted of five tabs: Learning status Analysis, Achievement Analysis, Incorrect Question Analysis, Message & Chat, and Settings. The initial prototype was implemented through InVision, and according to the design principles, instructors can edit the dashboard based on the information they want, and data can be visualized using tables and graphs. Additionally, we supported teachers' immediate understanding of various information by briefly presenting data analysis results in sentence form, allowing new information to be accessed by clicking on data, and using colors to highlight important information. The results of the usability evaluation for the initial prototype, conducted with experts including current teachers and professors of educational technology, are as follows. The home screen required visualization using shapes and colors instead of text, considering large class sizes. For learning status analysis, detailed information such as individual learners' actual study time, time spent on problem-solving, and task completion rates was needed. Achievement analysis and incorrect answer analysis tabs needed result linkage and easy tab switching due to their high semantic relevance. Overall, modifications focused on enhancing visualization and improving user experience were proposed. These improvements are expected to enable teachers to more effectively grasp students' learning situations.

Final Dashboard

Based on the results of the needs analysis, design principles, and usability evaluation of the initial prototype, we developed the final prototype of an AI courseware dashboard to support teachers' instructional design. First, based on the needs analysis results, we derived the structure of the final prototype as shown in <Table 1>. The Home tab displays real-time learning status of the class, students needing assistance, and new messages and chats. The Learning Status Analysis tab presents detailed learning states for both the entire class and individual students. The Achievement Analysis tab analyzes the achievement levels of the whole class and individual students, providing instructional intervention strategies. Individual student achievement analysis shows achievement by domain, problem type, and an overall domain taxonomy. The Incorrect Answer Analysis tab analyzes answer rates and error types for both the entire class and individual students. The Messages and Chats tab provides students' questions and related information, allowing reference to previous answers. The Settings tab enables teachers to personalize the dashboard's functions, order, and style. Then, based on the design principles, we adopted the following functions for each structure and visualization methods for each function. First, throughout the prototype, rather than presenting students' learning status and achievement as simple numbers, we used graphs, colors, etc., and provided explanations for interpretation through a detailed view function for graphs and colors (Principle 1: Presentation of Meaningful Information). Second, we structured the dashboard to first present an overall view that teachers can grasp at a glance, allowing them to click for more detailed information if needed. We also visualized data considering the relationships between subject areas such as numbers and operations, change and relationships, etc., in accordance with the characteristics of mathematics as a subject (Principle 2: Information Hierarchy). Third, we enabled teachers to edit the layout, such as selecting dashboard utilization functions or changing the viewing order, using the settings tab (Principle 3: User-Centered Customization). Fourth, along with data interpretation results, we provided prescriptive information such as feedback and notifications that can be used in teaching and learning based on these results (Principle 4: Prescription). Fifth, we allowed teachers to view information about students' relative positions within the class and nationwide, and enabled easy navigation between individual student pages (Principle 5: Provision of Comparative Information).

Table 1 Final Prototype Structure

Tab	Functions	
	Class as a whole	Individual student
Home	Real-time learning status Students needing help New messages and chats Learning Status Analysis Weekly learning status Assignment-wise learning status Assignment submission status Learning guidance status Achievement Analysis	
Learning Status Analysis	Weekly learning status Assignment-wise learning status	Learning activity pattern analysis Assignment submission status Learning guidance status
Achievement Analysis	Unit-wise class achievement trends Unit-wise achievement analysis	Domain-wise achievement Problem type-wise achievement Overall domain taxonomy check
Incorrect Answer Analysis	Problem correct answer rate	Assignment-wise correct/incorrect answers Unit-wise correct/incorrect answers
Messages and Chats	Messages Chats	
Settings	Function selection View order editing Style selection	

Discussion

This study was conducted with the aim of developing an AI courseware-based dashboard to support teachers' instructional design within the context of elementary school mathematics. To achieve this, Richey and Klein's (2014) design and development research methodology was used, which included a review of prior research and case analysis, needs analysis, development of dashboard design principles, initial prototype development and usability evaluation, and final prototype development. Based on the results and implications of this study, the following discussions were drawn: First, teachers greatly recognized the need for tools that enhance data-driven lesson design capabilities and simplify their implementation. Supporting data-driven decision-making in instructional design is effective in improving teaching performance, but efforts are needed to organize and simplify this from the teacher's perspective. Second, the AI courseware dashboard should not only display meaningful information for learning but also be developed based on user-centered information design. Prior research emphasizes providing distinctive options in both the presentation method and the data offered, and approaches like those attempted in this study could help teachers perform customized instructional designs based on individual learner data (Molenaar et al., 2019; Volarić & Ljubić, 2017).

Conclusion

This study is significant in that it provides implications for teacher dashboards of AI digital textbooks, which are currently being promoted, and presents specific structures and examples of teacher dashboards. The limitations of this study and suggestions for further research are as follows: First, the dashboard developed in this study is a prototype and has not yet been applied in actual educational settings. Therefore, it is necessary to systematize it for use in real classroom scenarios to confirm the external validity of the dashboard. Second, this study focused on developing a dashboard prototype in the context of the elementary mathematics curriculum. Since dashboards need to be developed separately according to the subject, the results of this study may not be generally applicable to other school levels and subjects. Future research could consider developing teacher dashboards for other school levels and subjects besides elementary mathematics or developing visualization principles for teacher dashboards that can be universally used without distinction of school level and subject.

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Development of Digital Citizenship Learning Materials to Address AI-Generated Bias and Societal Impact

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Abstract
This study aims to develop digital citizenship educational materials that address the biases generated by AI and their societal impacts. The proposed materials are designed to engage high school students with the ethical and social challenges posed by AI. The importance of AI literacy and critical thinking in fostering responsible AI usage is emphasized.

Keywords: Digital Citizenship. AI Bias. AI Literacy

1. Introduction

The rapid advancement of AI technologies has brought both opportunities and ethical concerns. According to a 2023 survey by the Nippon Foundation, 36.1% of Japanese youth aged 17 to 19 have used generative AI. This study aims to develop educational tools to help students understand and address the ethical and social issues associated with AI-generated content.

2. Background

Emily M. Bender (2021) has highlighted the dangers posed by AI biases, which can perpetuate societal discrimination and inequality. UNESCO's 2021 recommendations on AI ethics emphasize the need for ethical safeguards to prevent AI systems from embedding biases that threaten human rights (UNESCO, 2021). The 2023 UNESCO guidelines on generative AI stress the critical examination of the values, cultural standards, and social norms embedded in AI training models (UNESCO, 2023). I experimented with creating an illustration of a Japanese educational technology conference for a generative AI. The AI generated an image with mostly males. This raised my concerns about AI reinforcing societal biases.

3. Research Objective

The objective of this study is to develop Learning materials that encourage high school students to critically engage with the ethical and societal issues posed by AI-generated content. The materials aim to foster AI literacy and critical thinking, enabling students to use AI technologies responsibly.

4. Literature Review

Digital citizenship education, as promoted by Common Sense Education, advocates for practical learning about AI principles and responsible usage.
Mima (2024) defined AI literacy as understanding AI, using it appropriately, and considering the impact of the technology on society and culture while practicing responsible behavior.
Mima (2024) also suggests two effective learning methods: discussion-based learning and project-based learning. The ELSI integrated PBL approach combines ethical, legal, and social issues with problem-solving activities, encouraging students to consider the sustainability and fairness of their solutions.

5. Methodology

The proposed digital citizenship curriculum includes activities where students generate images using AI and critically analyze the resulting biases. The curriculum emphasizes the importance of verifying information and understanding the societal impact of AI-generated content. The educational framework is based on the five key questions from the Center for Media Literacy to encourage critical thinking about media messages.

"Five key questions"
1. Who authored this message?
2. What techniques are used to get our attention?
3. how will people interpret this message?
4. What values and perspectives are expressed? What values and perspectives are expressed, or are they missing?
5. Why is this message being sent?

The five key questions focus on how personal emotions and knowledge-experience biases shape our understanding of the media.
I proposed a lesson based on five key questions.

6. Implementation

In November 2023, 34 first-year high school students in Ibaraki Prefecture participated in the pilot implementation of the digital citizenship curriculum. The students used one of the applications, Canva, to create AI-generated images and discussed the biases found in the generated content.
The highlight of the lesson for many students was creating images with AI for the first time. They were surprised and amused by the gender bias and other results. The classroom activities demonstrated significant student engagement and critical reflections on AI biases.

6.1. The Flow of the Lesson

Step 1:
Confirm what students are looking for paying attention when receiving information to verify its authenticity.
Step 2:
The teacher presents several images and asks the students whether the images are real or fake. All the images are fake and generated by AI. The teacher explains that there are many AI-generated images and videos online whose veracity cannot be determined.

Defining "Bias":
Bias is defined as having a prejudice in favor of or against one person, group, or thing in a way considered to be unfair.

Step3:
Students create images using AI and reflect on the generated images:
- •Why do AI-generated images exhibit bias?
- •What societal issues and inconveniences arise from AI-generated biases?
- •How do people's values and assumptions affect the interpretation of AI-generated messages?

Students discuss ways to address the biases.

6.2. Classroom Reactions

Students noted that while gender differences in occupations may reflect reality, they felt that the prejudice against "Japan families," the predominance of white males in the image of "CEO," and the portrayal of black males as "thieves arrested by the police" and "criminals" were inappropriate. They expressed concern about the bias observed in the AI-generated images.

6.3. Teacher's Explanation:

The teacher explained that AI learns, and reasons based on real-world data, which can reflect existing prejudices and majorities. AI can reinforce societal biases, and it is humans who must address and eliminate these biases.

7. Results

The findings suggest that the proposed educational materials effectively raised students' awareness of AI biases and their societal implications. The students expressed concern about the biases inherent in AI-generated content and recognized the potential societal impact.
The study highlights the need for continued development of AI literacy and digital citizenship education to prepare students for the ethical challenges of the AI era.

7.1. Impressions immediately after the class

• "Creating and critically analyzing AI-generated images made me realize the bias issues within myself and AI."
• "It's scary to think that AI creators' values and perspectives might become societal norms."
• "AI biases can influence and be influenced by people."
• "I was concerned about the truthfulness of AI information, but now I realize the importance of considering AI biases too. It's essential to recognize our biases and critically engage with information."

Out of 34 students, 30 expressed concerns about AI biases and the potential distortion of information and societal impact, such as the amplification of discrimination.

7.2. Reflections two month after the class

Two months after the lesson, the students were asked, "How do you think generative AI affects high school students?" 69.5% of the students responded that AI creates ethical challenges and strengthens unconscious biases. The students demonstrated a significant awareness of the biases generated by AI and their societal impact.

8. Conclusion

This study contributes to the development of digital citizenship education by providing 5 key questions for addressing AI-generated biases.
Mima (2024) argues that discussion-based and project-based learning helps students understand complex issues deeply, fostering critical thinking and creativity for solutions. This process enhances students' sense of responsibility and ethical judgment, making AI literacy an essential component for living in the AI era. Continued efforts to develop and implement AI bias and AI literacy-focused digital citizenship education are necessary to equip students with the skills and mindset needed to navigate the AI-driven world.
Future study will focus on refining these materials and exploring their long-term impact on students' understanding of AI ethics and responsible usage.

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How and What Do the Elementary Practices Using Individual PCs Represent about "Information Literacy"? : Based on Observations from Video Reports

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Abstract: One alternative approach to the traditional "verification model" is an approach to explore pedagogical meaning based on narratives and visual data. At a research conference focusing on broadcast education and the utilization of ICT, we examined the proposal materials (videos introducing the units) provided by teachers. These materials either emphasized the structure of the unit, i.e., the development of major learning activities and the use of teaching materials, narrated the flow of topics throughout the unit and the necessity of the learning themes, highlighted the implementation and outcomes of student activities, or aimed to clearly explain the teacher's instructional actions. Based on these observations, we discussed ways to extract the meaning of "information utilization" or "applying ICT devices to problem solving" from usual practices in schools.

Keywords: Broadcast Program for School, Classroom Research, Information Literacy/Information Utilize Skills, Narrative, Video Report

Introduction

In Japanese elementary schools, classes aimed at developing "Information Literacy/Information Utilization Skills" are conducted in a distributed manner across a variety of subjects. Local governments may create their own frameworks for developing skills, or schools may create their own frameworks. There seem to be two main approaches to the use of such frameworks. The first is to use more simplified tables (e.g., Oita Prefecture and Hokkaido). The second is to show links to learning activities (e.g., Iwate Prefecture, Tottori Prefecture, Hyogo Prefecture, Yamaguchi City, etc.). Kumamoto City in particular has published multimodal instructional materials that are rich in information (Kumamoto City Education Center, 2024)
However, it is difficult for most teachers to properly estimate the development of information literacy. Alongside general frameworks for fostering information utilization skills, it is necessary to establish methods for identifying the outcomes of lesson studies and instructional material research from specific practical examples. Particularly in recent times, there has been an increasing use of visual materials such as videos and photos. How to effectively utilize such visual data should be an important theme for every school and teacher. Therefore, this report investigates what and how the learning units summarized and introduced through videos represent the concept of "information utilization skills". Thus the author aim to assist in developing methods for extracting educational outcomes from lesson studies.

Research Design & Methods

Resources: Four proposal practices in elementary school

The methodology of this study involves analyzing what and how the four video reports, which introduce lesson studies conducted in elementary schools, represent. In this report, resource for examination is the proposal classroom practices from the Hokkaido Research Conference on School Broadcasting and Audiovisual Education (Donan-Joho-Kyoiku-Kenkyukai-Network, 2022). Specifically, it includes visual presentations on four instructional units: physical education for third graders, integrated learning for sixth graders, art and crafts for third graders, and mathematics for third graders. These units were introduced as research proposal lessons, and teachers and collaborators undertook video editing for them. Teaching materials are shown in Table 1. Also you can refer to movie report of each unit at the URL below. All practices were carried out between June and September 2022.

- 3rd grade physical education: https://youtu.be/WQcAR-jyq7I
- 6th grade media education: https://youtu.be/59a2IHF3fnA
- 3rd grade 3rd grade art and crafts: https://youtu.be/Yj9TbTl3MjE
- 3rd grade arithmetic: https://youtu.be/3H3HYI8htHo

Table 1

Materials for analysis: four units of classroom practice that broadcast program and ICT devices are used

theme of learning unit/ visual report	grade	subject	theme and activity	term of unit	video editor	duration
1) Sprint training	3rd	Physical education	practice of running methods	6 hrs.	instructors	19 min.
2) Training of presentation	6th	PBL (integrated learning)	product movie (introduce their own school)	9 hrs.	instructors	20 min.
3) Playing with clay	3rd	Art and Craft	production and presentation	7 hrs.	instructor and collaborator	23 min.
4) Tables and bar charts	3rd	Mathematics	create their own graphs	9 hrs.	instructor and collaborator	19 min.

Analytical viewpoints: comparative watching of four video reports

The methodology of this study involves analyzing what and how the four video reports, which introduce lesson studies. The basic research method is as follows: to interpret what video techniques are used in the video practice reports and what teaching methods they depict. This "visual technique" includes what materials are collected, what effects are applied, what kind of subtitles and supplementary explanations are provided, etc.

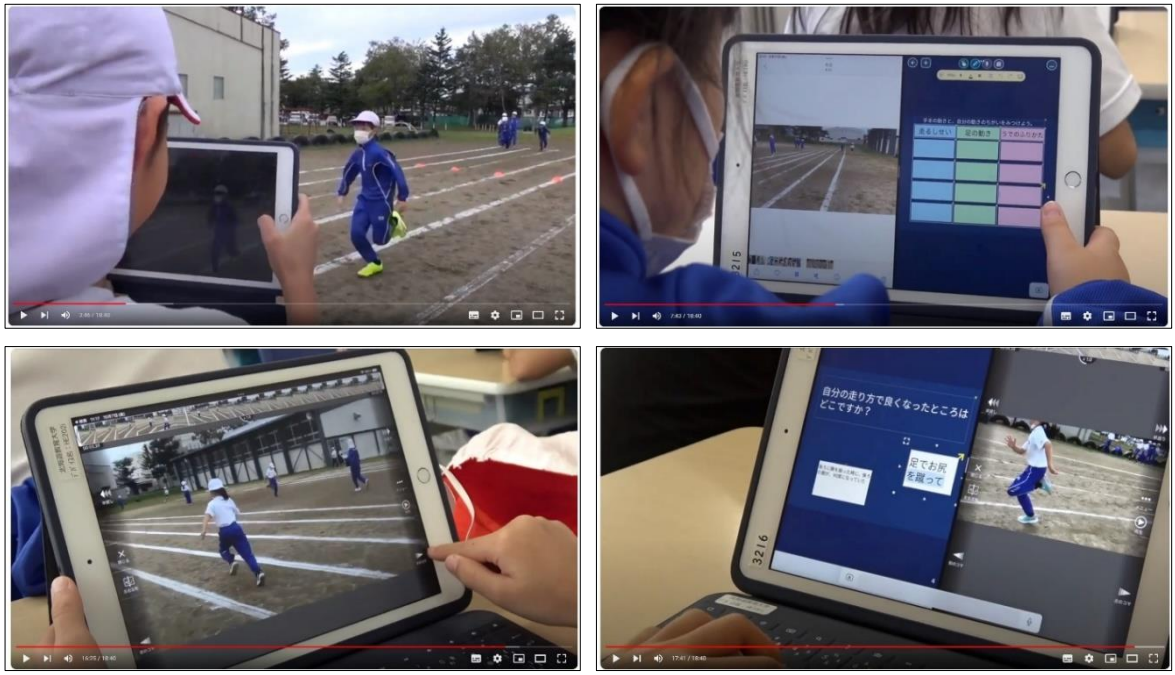
Results

What and How four practices show about those learning ?

1) Sprint training by 3rd graders: In this class, learning activities were developed to support students' understanding and training of sprinting techniques, as well as peer learning, through the use of ICT devices, apps, and school broadcasting programs. The unit spanned a total of six hours and was structured as "a unit type", with sessions alternating between practicing arm swinging, leg raising, and forward leaning posture to improve techniques. Consequently, the video, which is just under 20 minutes in total, introduces these elements sequentially. Additionally, "LoiLo Note"(an application that supports sharing learning tasks and outcomes) was utilized in both the first and

Figure 1

3rd grade students are using a tablet PC in physical education class.



second halves of the unit, and the video showcases its usage in both parts. Tablet PCs were being used throughout this physical education unit. Figure 1 explains as follows: the photo on the top left shows students in a running position, and the photo on the top right shows students setting individual tasks and reflecting on their progress. The photo on the bottom left shows how, upon returning to the classroom, the students identify and capture the necessary scenes from the recorded video data, and the photo on the bottom right shows each student leaving comments on a digital sticky note as they reflect on their lesson.

2) Training presentation skills by 6th graders: In the 6th-grade integrated studies period, the unit was structured around the theme of teaching fourth graders tips and strategies for school life, how to spend their time, and how to advance their studies. The videos created by the teacher discussed the flow of topics throughout the unit and the necessity of the learning themes. For instance, in the first half of the unit, there were scenes that included messages from the fourth-grade homeroom teachers to the sixth graders (in reality, the teachers acted to increase engagement) and showed the use of an app (in this case, Mentimeter) that students used to set their own themes. In the latter half of the unit, the video included scenes that demonstrated the thematic significance and necessity of why each group introduced their activities through slides. Considering this is an activity within the integrated studies period (PBL), it is considered rational that incorporating such elements into the video.

3) Playing with clay: In the third-grade art unit, students engaged in activities where they photographed clay sculptures they had created and edited the images using an application on a laptop. The instructor (along with in-school collaborators) carefully demonstrated both the overall and specific parts of the learning activities. Additionally, to clearly show the actual products, the video also included the PC screen projected onto a monitor. Such creative editing and composition reflects well the characteristics of activities in the arts and crafts class. The subtitles added by the editors in the video included explanations of the teacher's intentions during each phase of the learning activities and how these intentions were realized.

4) Tables and bar charts: Lastly, in the third-grade mathematics unit, only the key scenes from the nine-hour unit were presented. In this unit, students used tablet PCs and other devices to organize information using 'tables and graphs.' In addition to using PCs, they exchanged opinions directly with each other and wrote their thoughts on the blackboard. The video added subtitles to highlight these essential learning moments. Given that this is an example of media use in a mathematics class, it might be easy to understand even without supplementary information. However, it can be assumed that the editors aimed to clearly convey the intention behind the use of ICT devices, considering the various potential applications.

Figure 2

6th grade students are using a tablet PC in PBL (introduce their own school)

Figure 3

Third grade students are creating and interacting with each other using clay and tablet PC

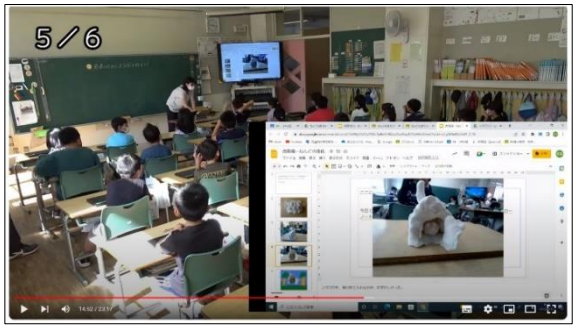
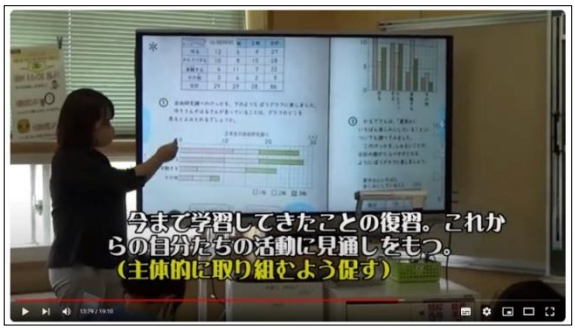


Figure 4

Third graders review what they learned from the tables and graphs on the electronic whiteboard.



Discussion

Of the four units mentioned above, the author was able to attend three classes (physical education, integrated learning and art and craft). While assisting with recording the lessons, the author observed the learning situation from close up and compared the contents of the video with his impressions and feelings.

First, my impression of the physical education classes was this: The children acquired various knowledge and techniques through sprinting practice, and while there were many instances demonstrating this, there seemed to be a lack of information to describe the overall trends.

Next, my impression of the presentation practice given by the sixth graders was as follows. In the first half of the unit, there were many scenes where the students set the task and listened to the explanation, whereas in the second half, there were few scenes where the students devised ways to film the presentation or revise the slides. From the perspective of media understanding, the structure was unsatisfactory.

Finally, here is what I noticed about the art and craft classes. The video contained a good balance of the children's creations and activities, teachers' explanations, and introductions to the contents of school broadcasting programs. However, the excessive use of explanatory notes about teacher behavior and students' activities limits the possibility of an open discussion of the learning situation, and it is unfortunate that the characteristics and individuality of the students' work are not discussed in greater detail.

Conclusion and Forecasts

In this report, the author examined what practical reports in video format convey about “information utilization skills” based on four practical examples. The instructors and their collaborators demonstrated their ideal teaching images and their vision of children through the introduction of learning activities and teaching materials. Since the 'one-to-one computing' PC environment has already been deployed, it is anticipated that opportunities to handle visual materials such as photos and videos will continue to increase. To access appropriate materials according to needs, it seems essential to have an environment where archiving can be done with minimal effort and measures are taken to facilitate the handling of past records.

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A Case Study on Peer Feedback Using ChatGPT

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Abstract Despite the benefits of peer feedback, challenges exist in consolidating peers' feedback and providing customized feedback. Generative AI (GenAI) like ChatGPT offers a promising solution. This study investigates the effectiveness and usability of GenAI-supported customized feedback based on peer feedback data. Thirty students from a South Korean university participated, developing technology-integrated teaching scenarios and providing peer feedback based on detailed rubrics. ChatGPT processed and customized this feedback, ensuring comprehensive and tailored responses. Surveys and interviews indicated a positive perception of the feedback's effectiveness and usability. The findings highlight GenAI's significant potential in enhancing and customizing feedback in educational settings.

Keywords: ChatGPT, Generative AI, Peer Feedback

Introduction

Peer feedback is an educational activity that enhances learners' academic experiences by facilitating the exchange of predominantly qualitative comments instead of quantitative ratings. Due to its effectiveness in fostering critical thinking and reflective learning, peer feedback is extensively utilized across various educational fields (Karadağ & Yalçin, 2023; Kusumayanthi & Lestari, 2022) . During peer feedback activities, it is crucial for students to precisely identify and analyze the feedback they receive and provide, allowing them to reflect deeply on their learning processes and outcomes (Carless, 2022). However, implementing peer feedback is not without challenges. Despite its potential, several constraints hinder its efficacy. These include the difficulty of collecting diverse feedback data, challenges in reflecting on the provided feedback, and misunderstandings of the feedback received (Brieven, Leduc, & Donnet, 2023). These necessitate providing consolidated and comprehensively summarized feedback for each learner. To address these issues, the application of generative AI (GenAI) technologies, such as ChatGPT, can be used. GenAI can not only produce feedback that mimics human-like qualities but also analyze and consolidate various feedback inputs into a coherent whole. This technological intervention enables a more streamlined and effective feedback process, enhancing both the accuracy and utility of the feedback provided. Despite the advantages of GenAI in peer feedback, there is a paucity of research exploring how to effectively integrate these technologies into feedback, and how such integration impacts student perceptions and learning outcomes. Therefore, this study aims to investigate how peer feedback supported by GenAI can be customized and delivered to enhance student learning.

Research Design & Methods

Participants

In this study, 30 students from a university in South Korea consented to participate.

Procedure

Consent forms for participation in the study were obtained, and the pre-test surveys were carried out. Then, participants developed and presented teaching-learning scenarios that effectively integrate technology for meaningful learning as part of their course requirements.
These presentations were then subjected to peer feedback, based on a detailed rubric, and individuals provided feedback on another team's work. Subsequently, this feedback was processed and customized for each team using ChatGPT. The consolidated feedback was then provided to the learners, with an explanation that it was a summary of the peer feedback.

Table 1

Contents of the Feedback

Content of Feedback	1st Feedback	2nd Feedback
Comparing Feedback Comparison of the overall class average score and team scores	o	o
Detailed Feedback Listing of strengths and weaknesses	o	o
Summarizing Feedback Summary of overall feedback content and indication of the item with th e greatest difference between the overall average and team scores	x	o
Guiding Feedback Guidance to improvement	x	o

Usage of ChatGPT

In this study, ChatGPT-4o was used to consolidate and construct peer feedback. Initially, the researcher organized the peer evaluation scores and subjective comments for each criterion submitted by the students into an Excel file. After uploading the file on ChatGPT, we requested ChatGPT-4o to create a table comparing the overall average with each team's scores. Additionally, we asked for a summary of the frequently mentioned strengths and weaknesses of each team. The summarized feedback was then provided in an Excel file, which was reviewed by the instructor. Based on the review, the instructor prepared the final feedback document. For the second feedback, summarizing feedback and guiding feedback were added to comparing and detailed feedback provided on the first feedback. Researchers asked ChatGPT to summarize overall feedback and indicate the item with the greatest difference between the overall average and team scores. Also, we asked ChatGPT to provide guidance to improve their output based on their weakness.

Figure 1
Comparing and detailed feedback

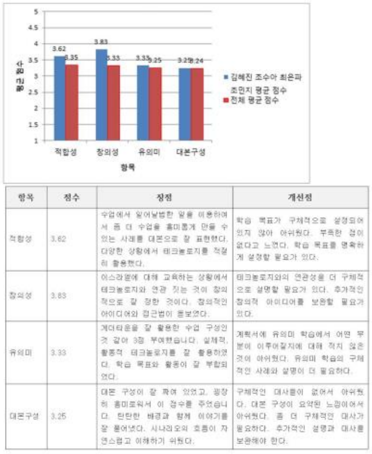
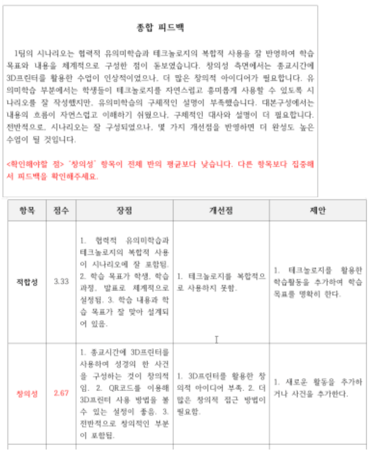


Figure 2
Summarizing and guiding feedback



Data collection and analysis

The surveys were conducted to evaluate the effectiveness and usability (easiness and attitude) of the feedback structure (Park & Nam, 2012), after the 1st and 2nd feedback. After all feedback rounds were completed, three volunteers participated in 30-minute interviews to provide further insights.

Results

Learners' perception of the feedback

This study evaluated the effectiveness of the feedback by analyzing various variables. The participants perceived comparing feedback (M=4.00, SD=.09) and detailed feedback (M=3.83, SD=.89) was effective for their group assignment. Moreover, in terms of the usability of the feedback, participants reported positive perception on easiness of the feedback (M=3.80, SD=.58), and attitude (M=3.99, SD=.67).
On the second feedback, students perceived comparing Feedback (M=4.09, SD=.94), detailed feedback (M=3.91, SD=.83), summarizing feedback (M=3.82, SD=1.08), and guiding feedback (M=4.55, SD=.69) was effective. In terms of usability, easiness (M=3.89, SD=.40), and attitude toward the feedback (M=3.97, SD=.48) were positive.
Notably, the absolute scores of students' perceptions of the effectiveness of comparing feedback, and detailed feedback slightly increased. Easiness also showed increases regarding the second feedback.

Table 2

Effectiveness and Usability of the Feedback

Variables	1st M(SD)	2nd M(SD)
Comparing Feedback effectiveness	4.00(.09)	4.09(94)
Detailed Feedback effectiveness	3.83(.89)	3.91(.83)
Summarizing Feedback effectiveness	-	3.82(1.08)
Guiding Feedback effectiveness	-	4.55(.69)
Easiness	3.80(.58)	3.89(.4)
Attitude	3.99(.67)	3.97(.48)

The analysis of the interview data shows that learners perceived the feedback to be effective overall. Learners reported that the feedback was a tool to complement their work and helped them to finalize their work by providing an expert perspective on how to improve their final work. In particular, the second round of feedback was more helpful than the first in providing specific suggestions for improvement. This aligns with the results regarding the effectiveness of the guiding feedback (M=4.55, SD=.69). In addition, Learners recognized that it was important to be fully engaged in the lesson to revise or improve on the feedback, so they said they worked harder than usual.
Students reported using feedback as a communication tool with their team members to discuss how to revise their work. They also reported on the process of writing and interpreting feedback. Learners reported that looking at the work of other teams helped them when working on their team projects and that the evaluation process helped them think objectively about the overall outcome of their team project in terms of metacognition.
On the other hand, some learners struggled with the process of writing feedback. They found it difficult to write or evaluate peer reviews and to assign marks based on the peer review criteria. There were also difficulties in interpreting the feedback. Unlike the first round of feedback, the second round included summarizing feedback and guiding feedback. Some learners also reported that the additional elements made it more difficult to interpret the feedback. Moreover, some learners reported that the first round of feedback was abstract, and they had concerns about its interpretation.

Discussion & Conclusion

The results of this study highlight the potential of GenAI to support and enhance peer feedback processes in educational settings. By analyzing and discussing these findings, this research provides valuable insights into optimizing peer feedback through the integration of advanced AI technologies.
Based on the research findings, there are a few things to consider when using peer review to provide customized feedback. First, when conducting peer feedback, provide specific instructions, including how to structure the content of the feedback and examples of how to write it. In the first round of peer feedback, the content of the assessment was often abstract due to learners' lack of content knowledge and unfamiliarity with peer assessment. The feedback that was generated was also reported to be abstract, which learners found difficult to interpret. The nature of generative

AI requires iterative creation and revision to achieve the desired level of feedback for teachers. However, if the prompts teachers feed into the generative AI aren't specific enough, it can be time-consuming to compensate and create effective feedback. The use of generative AI to create fit-for-purpose prompts requires a significant investment in trial and error (Patel & Sattler, 2023), and the capacity of the user base must be expanded (Lee & Huh, 2024). Therefore, it's important to provide learners with specific guidance on the essential elements they need to include to create peer feedback.

Secondly, learners need to be given specific instructions on how to use the customized feedback given to them in their team projects. In this study, learners' perceptions were checked and the score of the 'Easiness' item was less than 4. This suggests that learners have difficulty interpreting customized feedback. There could be many reasons why learners have difficulty interpreting customized feedback, but the most likely reason is that they are not used to it. Interviews suggest that most learners have never received feedback during their university experience, so learners need specific guidance on how to interpret customized feedback and how to understand the structure of the feedback when it is given to them.

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Boosting EFL Speaking Confidence and Proficiency with ChatGPT: Japanese vs. Korean Learners

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This presentation delves into the transformative power of ChatGPT in boosting speaking confidence and English proficiency among EFL learners. We spotlight how ChatGPT aids in mastering paraphrasing skills and navigating syntactic differences across English, Japanese, and Korean. Building on Masutani's (2021) observation that Japanese learners often exhibit lower confidence in speaking English compared to Koreans, our study evaluates 132 Japanese university students (CEFR levels A1 to B2). Divided into an experimental group utilizing ChatGPT and a control group adhering to traditional methods, the research highlights that B1 level learners, as revealed by Konta (2024), derive greater benefits from ChatGPT than A2 level learners in university. Preliminary results showcase significant improvements in both speaking confidence and proficiency. This session aims to stimulate discussion on the broader pedagogical implications and the strategic integration of AI tools in language education globally.

Keywords: ChatGPT, EFL, English Proficiency, Japanese Learners, Speaking Confidence

Introduction

Background of English Education in Higher Institutions in Japan

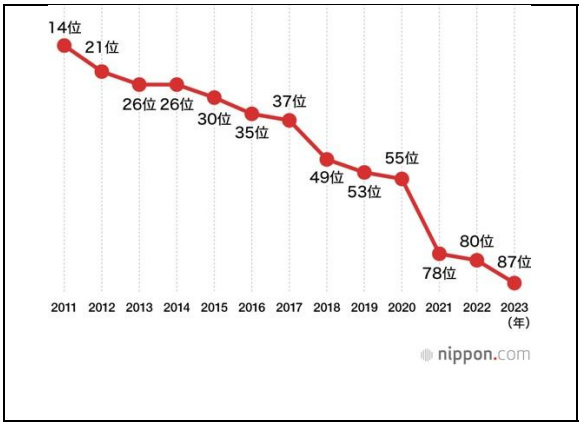
English education in Japanese higher institutions has traditionally emphasized reading and writing skills, often overlooking speaking and listening competencies. This traditional focus originates from the grammar-translation method historically prevalent in the Japanese educational system. However, with globalization and the increasing necessity for communicative competence, there has been a gradual shift toward improving practical English skills.

Current State and Ranking

Japan's English proficiency has been consistently low compared to other non-native English-speaking countries. According to the 2023 EF Education First English Proficiency Index (EF EPI), Japan ranks 87th out of 113 non-native English-speaking countries and 15th among 23 Asian countries and regions (see Figure 1). This ranking places Japan in the "low proficiency" category, indicating significant room for improvement, particularly in communicative competence.

Looking at the results for Asian countries and regions, Singapore ranks the highest at 2nd, followed by the Philippines (20th), Malaysia (25th), and Hong Kong (29th). South Korea is ranked 49th, and China is ranked 82nd, both surpassing Japan. The organization points out that "English proficiency among adults in East Asia has been declining over the past four years," attributing this decline to the decreasing proficiency levels in Japan and China (see Figure 2).

Figure 1 Japan's Ranking in the EF EPI English Proficiency Index	**Figure 2** EF Education First's EF EPI English Proficiency Index 2023 Global English Proficiency Rankings for Major Countries (Non-English Speaking: Only Asian countries ranked below 16th are included)



Rank	Very high EP		High EP		Moderate EP		Low EP
1	Netherlands	13	Poland	49	South Korea	73	Mongolia
2	Singapore	14	Finland	57	Nepal	79	Indonesia
3	Austria	15	Romania	58	Vietnam	82	China
4	Denmark	20	Philippines	60	Bangladesh	87	Japan
5	Norway	25	Malaysia	60	India		Below omitted
6	Sweden	29	Hong Kong	64	Pakistan		
7	Belgium			67	Sri Lanka		
8	Portugal						
9	South Africa						
10	Germany						
11	Croatia						
12	Greece						

Challenges in Communicative Competence

Japanese learners of English often struggle with speaking and listening skills, crucial for effective communication, due to a curriculum in higher education that prioritizes grammar, vocabulary, and reading comprehension over interactive language use (MacWhinnie & Mitchell, 2017). Also, cultural factors emphasizing mistake avoidance and harmony discourage active participation and risk-taking in language use, and there are limited opportunities for university students to engage in authentic English conversations both within and outside the classroom (Nagasawa, 2024).

Research Design & Methods

Methodology

Recognizing the potential of technological tools to enhance English language learning, this study incorporates ChatGPT to improve communicative competence. The study involved 132 Japanese first-year university students ranging from CEFR levels A1 to B2. Participants were divided into two groups: an experimental group in the level of B2 to A2 using ChatGPT and a control group in the level of A1 and A2 from following traditional learning methods. The experimental group engaged in bi-weekly 30-minute sessions with ChatGPT over eight weeks. Each session focused on practicing speaking and listening skills, emphasizing paraphrasing and syntactic differences, such as word order and subject prominence. Meanwhile, the control group continued with their usual curriculum, primarily involving traditional classroom activities and textbook-based learning.

Procedure

Both groups took a pre-test to assess their initial English speaking and listening skills, including standardized speaking tasks, and listening comprehension exercises. During the study period, the experimental group used ChatGPT for their bi-weekly sessions, where they simulated conversations, received instant feedback, and practiced interactive exercises tailored to their proficiency levels. By tailoring interactions to the learner's proficiency level, ChatGPT indicated individual weaknesses, offered a platform for continuous practice to boost fluency and confidence, and made language practice accessible anytime and anywhere. After eight weeks, both groups took a post-test similar to the pre-test to measure improvements in speaking confidence and proficiency. The comparison of pre- and post-test results gave insights into the effectiveness of ChatGPT in enhancing English language skills among Japanese EFL learners.

Results & Discussion

Improved Speaking Confidence

Learners in the experimental group who used ChatGPT demonstrated a significant increase in speaking confidence. Pre-test surveys indicated that only 28% of these learners felt comfortable speaking English in class, which rose to 75% in post-test surveys. They showcased greater willingness to participate in class discussions and less hesitation during speaking tasks. In contrast, students in the control group exhibited only a modest increase in speaking confidence, from 12% to 43%. They continued to show more hesitation and less active participation compared to the ChatGPT users (see Table 1).

Table 1 ***Speaking Confidence***

Group	Pre-Test Confidence (%)	Post-Test Confidence (%)
ChatGPT Users	28%	75%
Control Group	12%	43%

Improvement in English Proficiency
The experimental group demonstrated a notable improvement in English proficiency scores. On average, their scores increased by 15% in the post-test compared to their pre-test results. These learners showed better understanding and use of syntactic structures, such as correct word order and subject prominence, in their spoken and written responses. The control group also improved, but to a lesser extent, with an average score increase of 7%. Their progress in understanding and using complex syntactic structures was less pronounced compared to the ChatGPT users (see Table 2).

Table 2 ***Improvement in English Proficiency***

Group	Average Score increase (%)
ChatGPT Users	15%
Control Group	7%

Individualized Learning Improvements
The ability of ChatGPT to tailor interactions to each learner's proficiency level helped address individual weaknesses. Learners received instant feedback and personalized practice, which significantly boosted their fluency and confidence. For example, learners struggling with verb tenses received targeted exercises, leading to marked improvement in this area. Traditional methods used in the control group did not provide the same level of personalized feedback. As a result, improvements were more generalized and less targeted to individual needs, making it harder for learners to pinpoint specific areas of weakness (see Table 3).

Table 3 ***Individualized Learning Improvements***

Group	Tailored Feedback	Improvement Example	Generalized Feedback
ChatGPT Users	Yes	Significant improvement in verb tenses	No
Control Group	No	Less targeted improvements	Yes

Understanding and Use of Syntactic Structures
The experimental group showed better understanding and use of syntactic structures, such as correct word order and subject prominence, in their spoken and written responses. The control group also made progress, but their understanding and use of complex syntactic structures were less pronounced compared to the ChatGPT users (see Table 4).

Table 4 ***Understanding and Use of Syntactic Structures***

Group	Improvement in Syntactic Structres
ChatGPT Users	Notable
Control Group	Modest

These results indicate that integrating ChatGPT into language learning significantly enhances speaking confidence and English proficiency among Japanese EFL learners. The substantial increase in speaking confidence among ChatGPT users suggests that the interactive, low-pressure environment offered by the AI tool is highly effective in reducing hesitation and encouraging active participation. In contrast, the modest gains observed in the control group highlight the limitations of traditional teaching methods in building speaking confidence.

Also, the remarkable improvement in English proficiency scores among ChatGPT users, particularly in understanding and using syntactic structures, emphasizes the tool's effectiveness in providing targeted, personalized practice. This personalized approach allows learners to address their individual weaknesses more efficiently, leading to more significant overall improvements. The control group's less pronounced progress further underlines the need for tailored feedback and practice in language learning.

Conclusion

This study uncovers the significant positive impact of integrating ChatGPT into English as a Foreign Language (EFL) education for Japanese learners. The results clearly show that ChatGPT users experienced substantial improvements in speaking confidence and English proficiency compared to those who followed traditional learning methods. The experimental group, through bi-weekly interactions with ChatGPT, exhibited greater willingness to participate in class

discussions and reduced hesitation during speaking tasks, with their speaking confidence increasing from 28% to 75%. In contrast, the control group showed only a modest rise in confidence from 12% to 43%. Furthermore, the experimental group demonstrated a notable improvement in English proficiency, with an average score increase of 15%, particularly excelling in understanding and using syntactic structures such as correct word order and subject prominence. The control group, on the other hand, saw a less pronounced improvement of 7%. ChatGPT's tailored, instant feedback and personalized practice allowed for targeted learning, addressing individual weaknesses more effectively than the generalized feedback of traditional methods.

In conclusion, the integration of AI tools like ChatGPT into EFL education provides a valuable supplement to traditional teaching methods, significantly enhancing learners' communicative competence. These findings highlight the importance of adopting innovative technological tools in language education to create immersive, personalized learning experiences that can drive substantial improvements in language proficiency and speaking confidence. Further research should explore the comparative effectiveness of ChatGPT among Korean EFL learners, considering the syntactical and cultural differences between Japanese and Korean languages. This will yield deeper insights into how learners from different cultural backgrounds engage with AI tools and respond to various teaching methodologies, ultimately refining pedagogical strategies in diverse learning settings.

Further Research

While this study focused on Japanese EFL learners, further research is needed to explore the comparative effectiveness of ChatGPT among Korean EFL learners. Such comparative analyses could reveal deeper insights into cultural and educational differences that influence the efficacy of AI tools in language learning. Also, understanding the syntactical and cultural differences in East Asian countries, such as Japan, Korea, and China, is an urgent issue in the new AI era. These differences may affect how learners from each country engage with AI tools like ChatGPT and respond to various teaching methodologies.

Longitudinal studies assessing the long-term impacts of ChatGPT on language proficiency and confidence, as well as its integration into diverse educational settings globally, are essential. These studies should explore the broader implications of AI-assisted learning and refine pedagogical strategies to better suit the needs of learners and educators from various backgrounds. We hope this session will help in understanding these broader implications and refining pedagogical strategies to better meet the needs of recipients and givers from diverse backgrounds.

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The Transformative Power of AI-Composed Melodies in Language Learning

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Abstract This study explores the potential application of AI-composed melodies in language education. By surveying 32 educators from China and Thailand, we analyzed their attitudes towards AI technology and music in teaching, their willingness to use these tools, and the influencing factors. The results indicate that most educators view AI-composed songs positively, recognizing their potential to enhance student engagement, vocabulary, oral skills, and grammatical understanding. Additionally, 78% of the educators believed that AI-composed melodies could significantly improve classroom engagement, while 22% were positive but less optimistic. However, challenges such as a lack of music production skills and technical support were identified as barriers to implementation. This research provides a basis for future applications of AI technology in education, highlighting the need for professional development and technical support for educators. With proper integration, AI-composed melodies could become a transformative tool in language education, offering personalized and engaging learning experiences for students.

Keywords: AI-composed melodies, language learning, educational technology, teaching effectiveness, teacher attitudes

Introduction

Many studies have demonstrated that music can activate the brain, enhance memory, and improve learning outcomes (Mogi, 2008). However, in the realm of language education, the utilization of music remains inadequate. Existing songs often contain grammatical errors, which can mislead learners and impart incorrect knowledge (Liu, 2023). Moreover, creating effective educational songs requires specialized knowledge, placing a significant burden on teachers.

To address these challenges, there is considerable anticipation surrounding music-generating AI technology. This technology facilitates the creation of educational songs effortlessly, without the need for specialized expertise, thereby alleviating teachers' burdens and potentially enhancing educational effectiveness. The "Suno.ai" music-generating AI tool empowers teachers to generate appropriate learning songs without requiring music production skills, thereby supporting effective vocabulary and grammar learning. Previous studies (Takano et al., 2024; Liu, 2024) have reported significant positive effects of using music-generating AI in English and Japanese education. However, these studies have primarily focused on students, with limited exploration into teachers' awareness.

Therefore, this study aims to explore the potential application of AI-generated songs in language teaching. It involves surveying 32 experienced educators to analyze their attitudes toward AI technology and music in teaching, their willingness to adopt such technology, and the factors influencing their

Research Design & Methods

Research Design

This study employed a questionnaire survey method to gather data on educators' attitudes towards AI-composed songs in language teaching, their willingness to use these tools, and the factors influencing their decisions. The questionnaire was carefully designed to cover several key areas.

First, it collected basic information about the educators, including gender, age, teaching experience, teaching grade, and the teaching materials they used. These questions aimed to gather background information to analyze how different demographics might influence attitudes towards AI-composed songs.

Second, the questionnaire assessed the educators' familiarity with AI technology. This section included questions about their knowledge and previous use of AI tools in their teaching practice. Understanding their familiarity with AI technology helped gauge how this factor might affect their willingness to integrate AI-composed songs into their teaching.

Third, the questionnaire explored educators' willingness to use AI-composed songs. This section focused on their perceived effectiveness of such tools in enhancing student engagement and learning outcomes. Questions were designed to determine how open educators were to incorporating AI-generated music into their curriculum.

Finally, the questionnaire included questions about the expected effects and practical application of AI-composed songs. Educators were asked about the anticipated benefits of using AI-composed songs for pre-class preparation, classroom activities, and post-class review. This section also examined the practical challenges educators might face in implementing these tools.

Before the full distribution, the questionnaire was pre-tested with five educators to ensure clarity and relevance. Based on the feedback received, necessary adjustments were made to optimize the questionnaire's design.

Methods

Data were collected using an online survey platform, such as SurveyMonkey, from 32 language educators in China and Thailand. The data collection period spanned from March to April 2023, and the response rate was 80%, yielding 32 valid responses. Throughout the data collection process, ethical guidelines and data privacy principles were strictly followed to ensure the anonymity and confidentiality of respondents.

After data collection, the responses were processed using Excel and Python for data cleaning, coding, and initial statistical analysis. The data cleaning process involved checking for completeness and consistency, removing invalid or duplicate responses, and handling missing values and outliers to ensure data accuracy and reliability. Qualitative data, such as textual answers, were converted into quantitative data using coding rules. For example, gender was coded as 0 (male) and 1 (female), and AI technology familiarity was categorized into five levels.

Various statistical methods were employed to analyze the data. Descriptive statistics were used to summarize the sample characteristics, including frequency, percentage, mean, median, and standard deviation. Pearson correlation coefficients were calculated to explore relationships between variables, such as teaching experience and attitudes towards AI-composed songs. Multiple linear regression was applied to assess the impact of different variables, such as age, teaching experience, and AI technology familiarity, on the willingness to use AI-composed songs. K-means clustering was used to group educators based on their characteristics, providing insights into their attitudes and willingness. T-tests and ANOVA were conducted to compare differences between groups, such as gender, age groups, and teaching experience, and to test for statistical significance.

These methods ensured a comprehensive analysis of the data, providing a robust understanding of educators' attitudes towards AI-composed songs and the factors influencing their willingness to integrate these tools into their teaching practices.

Results

Descriptive Statistics

The descriptive statistics provided insights into the demographics and background of the educators surveyed. The majority of the respondents were female, comprising 85% of the sample (27 out of 32 educators). The age distribution showed that 34% of the educators were between 31-40 years old (11 respondents), 50% were between 41-50 years old (16 respondents), and 16% were over 50 years old (5 respondents). In terms of teaching experience, 44% had 8-15 years of experience (14 respondents), 31% had 16-20 years of experience (10 respondents), and 25% had more than 20 years of experience (8 respondents).

The educators had varying levels of familiarity with AI technology. Specifically, 38% (12 respondents) were slightly familiar, 13% (4 respondents) had an average level of familiarity, 31% (10 respondents) were not very familiar, and 19% (6 respondents) were completely unfamiliar with AI technology.

Familiarity with AI Technology and Willingness to Use AI-Composed Songs

The survey revealed that the educators had varying levels of familiarity with AI technology. Despite this, a significant majority expressed a willingness to use AI-composed songs in their teaching: 69% (22 respondents) were very willing, and 31% (10 respondents) were willing. None of the respondents were unsure or unwilling to use these tools.

Perceived Effectiveness of AI-Composed Songs

When asked about the effectiveness of AI-composed songs, 78% of the educators (25 respondents) believed that these songs could significantly improve classroom engagement, while 22% (7 respondents) were less optimistic but still positive. Regarding specific teaching activities, educators believed AI-composed songs could be particularly effective for vocabulary reinforcement (100%, 32 respondents), grammar reinforcement (91%, 29 respondents), and listening

comprehension (56%, 18 respondents). The potential to enhance language expression exercises was also recognized by 47% (15 respondents) of the educators.

Challenges in Implementing AI-Composed Songs

The survey identified several challenges that educators faced in implementing AI-composed songs. The primary challenge was a lack of music production skills, cited by 100% of the respondents (32 educators). Additionally, 94% (30 respondents) reported difficulty in finding songs that matched the teaching materials, 47% (15 respondents) mentioned a lack of time for song production, and 84% (27 respondents) highlighted a lack of technical support.

Statistical Analysis

The correlation analysis revealed a moderate positive relationship between teaching experience and attitudes towards AI-composed songs, with a Pearson correlation coefficient of 0.32. This suggests that educators with more teaching experience tend to have a more positive attitude towards integrating AI-composed melodies in their teaching.

Further, multiple linear regression analysis indicated that both age ($p=0.008$) and familiarity with AI technology ($p<0.0001$) significantly influenced educators' willingness to use AI-composed songs. Younger educators and those more familiar with AI technology were more inclined to adopt these tools in their teaching practices.

K-means clustering analysis grouped educators into three distinct clusters based on their characteristics. The analysis revealed significant differences in gender, age, teaching experience, and familiarity with AI technology across the clusters. For instance, one cluster might predominantly consist of younger educators with high familiarity with AI, while another might consist of older educators with less familiarity.

Additionally, T-tests and ANOVA were conducted to compare differences between groups. The results showed that gender did not significantly influence attitudes towards AI-composed songs ($p>0.05$). However, significant differences were found in the willingness to use these tools among different age groups ($p<0.05$), indicating that age is a critical factor in the adoption of AI technology in language teaching.

Discussion

The findings of this study highlight several key insights into the attitudes and perceptions of educators regarding the use of AI-composed songs in language teaching. The overwhelmingly positive attitude towards AI-composed songs among educators is a significant finding. This aligns with previous research indicating that music can enhance language learning by increasing engagement and improving memory retention (Smith et al., 2020; Wang, 2019). The fact that all respondents expressed willingness to use AI-composed songs suggests a readiness within the educational community to embrace innovative teaching tools that leverage AI technology.

The correlation analysis revealed a moderate positive relationship between teaching experience and attitudes towards AI-composed songs. This suggests that more experienced educators are more likely to appreciate the potential benefits of integrating AI technology into their teaching practices. This finding is consistent with the Cognitive Load Theory, which posits that experienced educators can better manage cognitive load, allowing them to effectively integrate new teaching tools (Sweller, 1988).

The regression analysis further indicated that both age and familiarity with AI technology significantly influenced educators' willingness to use AI-composed songs. Younger educators and those more familiar with AI technology were more inclined to adopt these tools. This highlights the importance of providing targeted professional development and training to enhance educators' familiarity with AI technology, thereby increasing their willingness to use AI-composed songs.

Despite the positive attitudes, several challenges were identified, including a lack of music production skills, difficulty in finding songs that match teaching materials, and a lack of technical support. These challenges underscore the need for comprehensive support systems to help educators integrate AI-composed songs into their teaching. Schools and educational institutions should consider offering training programs and technical support to address these challenges.

The practical implications of this study are significant. By addressing the identified challenges and leveraging the positive attitudes towards AI-composed songs, educational institutions can enhance language learning outcomes. The use of AI-composed songs can make learning more engaging and effective, potentially transforming traditional teaching methods.

Conclusion

This study demonstrates the significant potential of AI-composed songs in language education. The positive attitudes of educators towards these tools, combined with their willingness to use them, indicate a promising future for AI technology in education. The findings support the Cognitive Load Theory, Multimodal Learning Theory, and Affective Filter Hypothesis, all of which suggest that integrating AI-composed songs can enhance learning outcomes by reducing cognitive load, providing multimodal stimuli, and creating a positive emotional learning environment.

However, the study also highlights several challenges that need to be addressed to fully realize the potential of AI-composed songs in education. The lack of music production skills and technical support are significant barriers that can be overcome through targeted professional development and support systems. Additionally, further research is needed to explore the long-term impact of AI-composed songs on language learning and to identify the best practices for their integration into the curriculum.

In conclusion, AI-composed songs offer a transformative potential for language education. By addressing the challenges and building on the positive attitudes of educators, educational institutions can leverage AI technology to create engaging and effective learning experiences. Future research should continue to explore the integration of AI in education, with a focus on empirical studies that assess the impact of AI-composed songs on various aspects of language learning. With continuous innovation and research, AI-composed songs could become a vital tool in modern language education, offering personalized and immersive learning experiences for students.

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Effectiveness of Second Language Learning Through Listening to Learner's Self-similar Voice

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The public can now access voice-cloning application software on tablets or smartphones. This paper presents a novel research endeavor focusing on the impact of the self-similar voice and its applications in second language learning using a tablet device in a classroom setting. A controlled experiment was conducted with 40 Japanese undergraduate and graduate students with no experience studying Mandarin. Although the sample size was moderate (N=40) and the difference was insignificant at a=0.05, the self-similar voice was confirmed to enhance the effectiveness of language learning, as evidenced by the effect size (d=0.23). Furthermore, this paper discusses whether the preference for the learner's own voice affects the effectiveness of self-similar voice usage.

Keywords: DX, Education, Second Language Learning, Self-similar Voice, Voice Cloning

Introduction

The digital transformation (DX) has profoundly impacted our lifeworld (Stolterman & Fors, 2004). This transformation is also evident in the education sector. For example, elementary and junior high schools in Japan have already furnished a tablet device for each student under a high-speed communication environment on campus. Besides, digital textbooks are utilized more extensively. This indicates that the age group benefiting from DX is becoming broader, and the environment is improving for higher-education students. Second language learning is an area that can benefit from digital materials, as audio and video can be used in a way that paper-based materials cannot. In addition to one-way instruction from the teacher, students can interact with the materials for individualized learning.

The search for the optimal avatar for digital learning materials has been a common research topic, often focusing on the Proteus effect (Yee & Bailenson, 2007). On the other hand, researchers have recently directed their attention toward self-similar speech. Speech synthesis has historically been a challenging technology. However, recent years have brought research opportunities with applications. Voice-cloning application software for tablets or smartphones, such as the Clony AI (Michel, 2024), has become available to the public. This paper consequently focuses on the effect of the self-similar voice and its application to second language learning using a tablet device in a classroom environment as a novel research endeavor. The term "second language" is defined as any language other than the first language learned. Thus, it may mean the third or fourth language that has been learned or is being learned (Lightbown & Spada, 2021).

Literature Review

Previous studies demonstrate that a self-similar avatar voice significantly improves player performance in educational games and that audial avatar customization enhances visual avatar customization (Kao et al., 2021; Kao et al., 2022). In a real-world vocational training setting, Pröbster et al. (2023) studied the use of avatars in 3D learning and found that learners were more satisfied with the avatar when it was more similar to them. Okano et al. (2022) investigated subjects' impressions of avatars speaking in their self-similar voice by varying the acoustic parameters based on recordings of the speaker's own voice. The researchers found that those who liked their own voices had favorable impressions of their self-similar voices, those who disliked their voices had favorable impressions of altered voices, and those who disliked their voices tended to seek ideal avatar voices.

Research Design & Methods

Hypotheses

In light of the findings of previous studies, the following two hypotheses are put forth in this paper.

H1: Listening to a learner's self-similar voice enhances the effectiveness of language learning.
H2: The preference for the learner's own voice influences the effectiveness of self-similar voice usage.

Research & Evaluation Methods

Most experiments, surveys, and reports of practice in second language education research today use quantitative research methods, often employing methods similar to those used in psychological research, and often using the APA style of writing (Kusanagi et al., 2015). In addition to statistical hypothesis test results, The American Psychological Association (2020) encourages reporting effect sizes to indicate the magnitude and importance of study results.

Experiment

In order to verify the hypotheses above, a controlled experiment was conducted with 40 Japanese undergraduate and graduate students who had no prior experience studying Mandarin language. In Japan, where the experiment was conducted, English is taught as a second language in compulsory education. The choice of Mandarin as the exemplar language was made to ascertain the impact of the "self-similar voice" on the learning process in a context where the subjects had no prior experience of learning that second language.

Each subject was given an explanation of the research and the experiment regarding research ethics, and written consent was obtained. The 40 subjects were randomly assigned to either the experimental or control group, with each group comprising 20 individuals. Subjects in the experimental group learned Chinese by listening to self-similar speech. To prepare the self-similar speech, the subjects made around 30 seconds of voice recordings on the Clony AI application, reading plain Japanese sentences aloud. Then, with text data of the 20 Chinese example phrases quoted from Miyake (2024), the voice cloning software instantly generated a Mandarin speech of the subject's self-similar voice, typically within a minute. In contrast, subjects in the control group learned it by listening to general speech that was not self-similar. The general speech was prepared with the voice of a preset character on the application. Additionally, each subject was asked to indicate whether they "like" or "dislike" their own voices.

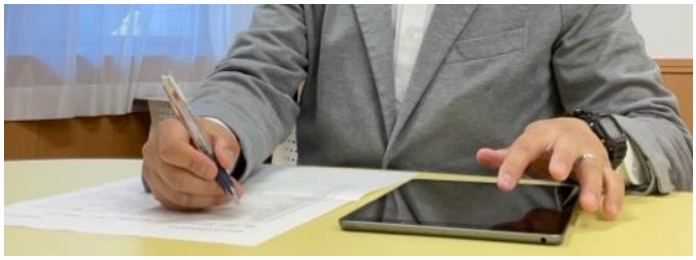
The subjects looked at a piece of paper containing the 20 Chinese example phrases and their Japanese translations (Figure 1), shadowed the example while listening to the audio of the example on a tablet (Figure 2), and studied them individually within 15 minutes. Subjects were permitted to take notes on the paper during the study (Figure 3).

Figure 1
The Mandarin paper materials for no prior experience learners

	中国語例文	発音（ピンイン）	和訳
1	你好。	Nǐ hǎo	こんにちは。
2	谢谢。	Xièxie	ありがとう。
3	不好意思。	Bù hǎoyisi	すみません。／ごめんなさい。
4	没问题。	Méi wèntí	問題ありません。
5	再见。	Zàijiàn	さようなら。
6	什么都可以。	Shénme dōu kěyǐ	何でもいいです。
7	随便。	Suíbiàn	ご自由に。／何でもかまいません。
8	还可以。	Hái kěyǐ	まぁまぁです。
9	没关系。	Méi guānxi	かまいません。／心配ありません。
10	…，可以吗？	Kěyǐ ma	～してもいいですか？　／　～してもらえますか？　／　～できますか？
11	不知道。	Bù zhīdào	知りません／わかりません
12	听不懂。	Tīng bu dǒng	（聞き取れなくて）わかりません。
13	不要。	Bú yào	要りません。
14	不用了。	Bú yòng le	結構です。
15	不是。	Bú shì	違います。
16	没有。	Méi yǒu	ありません。
17	好的。	Hǎo de	（情報として了解して）わかりました。
18	知道了。	Zhīdào le	（内容や意味などを理解して）わかりました。
19	明白了。	Míngbái le	（内容や意味などを理解して）わかりました。
20	懂了。	Dǒng le	（より難しい内容や意味などを理解して）わかりました。

Figure 2
Playback bar on the learner tablet screen

Figure 3
Model scene of the experiment



Subsequently, a test was conducted where the subjects read aloud on a tablet while looking at the Figure 1 paper. The subjects made voice inputs into Google Translate (Google, n.d.). The test administrator observed the screen and awarded points on a 20-point scale when the machine translation accurately recognized the phrases. The Subjects were permitted to consult their notes, and up to three voice entries were allowed per example phrase. Each subject who finished the test received 3,000 JPY (about USD 18).

Results

Result 1

To validate H1, we used Welch's *t*-test to analyze the difference between the awarded points of the experiment (M = 16.30, SD = 2.79) and the control group (M =15.75, SD =1.86). No significant difference was found at α= 0.05, $t(33.1) = 0.73$, $p = .47$. Although a significant difference was not identified between the two groups, the effect size (Cohen's d) was 0.23, indicating that the effect of learning through self-similar voice was small but present.

Result 2

To validate H2, within the experimental group (n=20) utilizing self-similar voices, we divided the subjects into two sub-groups based on their self-reported attitudes towards their own voices: those who "liked" (n=9) their voices and those who "disliked" (n=11) them. Although the "disliked" subject group (M = 16.55, SD = 3.14) achieved higher awarded points than the "liked" subject group (M = 16.00, SD = 2.45), there was no significant difference in preference for their voice, $t(18.0) = -0.44$, $p = .67$. However, the effect size (Cohen's d) was -0.20 (negative value), indicating that the "dislike" recognition of the learners' self-similar voices has an effect size with a small degree.

Discussion

Regarding the H1, although the sample size (N=40) was moderate and the difference was insignificant at α= 0.05, the self-similar voice was confirmed to enhance the effectiveness of language learning, as evidenced by the effect size (d=0.23). Concerning the H2, although the sample size (n=20) was not large and the difference was insignificant at α= 0.05, the preference for the learner's own voice was confirmed to exert a small influence on the effectiveness of self-similar voice usage. However, the outcome was contrary to our expectation. The effect size yielded a negative value, indicating that the effect was reported in cases where the subjects "disliked" their own voices.

It is possible that the subjects with low self-esteem, who reported disliking their own voices, invested a greater degree of effort in the learning process during the experiment, as Alloy and Abramson (1979) reported that individuals experiencing depressive symptoms demonstrated surprisingly accurate judgments in experimental settings. This phenomenon, which has been designated the sadder-but-wiser effect, has been a subject of long-standing interest in psychological research.

On the other hand, as Guo et al. (2024) have observed, self-similar voices are associated with virtual characters' likability

and believability. However, they also induced a more eerie sensation. Mori et al. (2012), whose original work was published in 1970, proposed "the uncanny valley" hypothesis, which suggests that "*a person's response to a humanlike robot would abruptly shift from empathy to revulsion as it approached, but failed to attain, a lifelike appearance.*" This phenomenon could occur not only in a character with a self-similar appearance but also with a self-similar voice. We might assume a situation in which a subject with a positive attitude toward their own voice failed to learn in the experiment due to the uncanny valley effect of a self-similar voice.

Conclusion

This paper has focused on the audial aspect of self-similar virtual characters as a pedagogical tool for second language learners. The findings demonstrated that the impact of learning through self-similar voice was evident. In addition to the voice-only learning situation, future studies should investigate the effectiveness of incorporating self-similar facial appearance as a factor.

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Designing a career-based student support system in a convergence education environment

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As the importance of convergence capabilities is emphasized in higher education, students are placed in an environment where they can freely choose majors and explore various career paths beyond the traditional department system. These changes provide new opportunities for students, but at the same time, they also cause problems due to lack of information as the range of choices expands. In this study, we attempted to design a system that would support current students to effectively select curricular and extracurricular activities that meet their career goals by comprehensively analyzing data from current students and graduates. This system considers each student's current academic and activity status through large-scale data analysis and provides educational support tailored to their career path, helping students design their learning more clearly and effectively. This approach can make an important contribution to improving students' learning experiences and maximizing educational outcomes in a convergence educational environment.

Keywords: Student support system, convergence education, career motivation model, social cognitive career theory

Introduction

Due to rapid changes in the industrial environment, universities are required to strengthen students' capabilities and nurture talent that meets societal needs through career education, in addition to their traditional roles of knowledge creation and education. According to career development theory, college students are in the career exploration and career establishment stages (Super, 1973), a period crucial for career development. Consequently, interest in competency-centered education is increasing in universities and prior research on core competencies and career education is actively being conducted (Jeong, 2017).

Meanwhile, as competency-based education is emphasized, interest in the non-major system to ensure students' convergence learning and support diverse career paths is increasing. While students admitted at the department level can plan their studies using a career roadmap suited to the nature of the department, students without a major need other types of support for career exploration and study plan. This study focuses on designing a system to support career planning for students enrolled without a major in a convergence education environment.

Research Design & Methods

The purpose of this study was to present a student support system design model according to procedures by applying design and development research methods. The research procedure followed the five stages of development research presented by Richey and Klein (2005). First, the research question was defined through the necessity and purpose of

the study. Second, design principles were derived by analyzing previous studies related to career-based student support. Third, based on these design principles, an initial model suitable for the research question was developed. Fourth, a career-based student support system was designed for a convergence education environment. Finally, the final design was completed through modification and supplementation steps for the designed system.

Previous studies on individual careers, since the 1950s, has been dominated by career development theory, which posits that individuals do not make career decisions at a specific point in time but develop according to stages (Super, 1969). Although career development theory explains an individual's overall career development process, it has limitations in explaining individual differences in cultural context or career development stages.

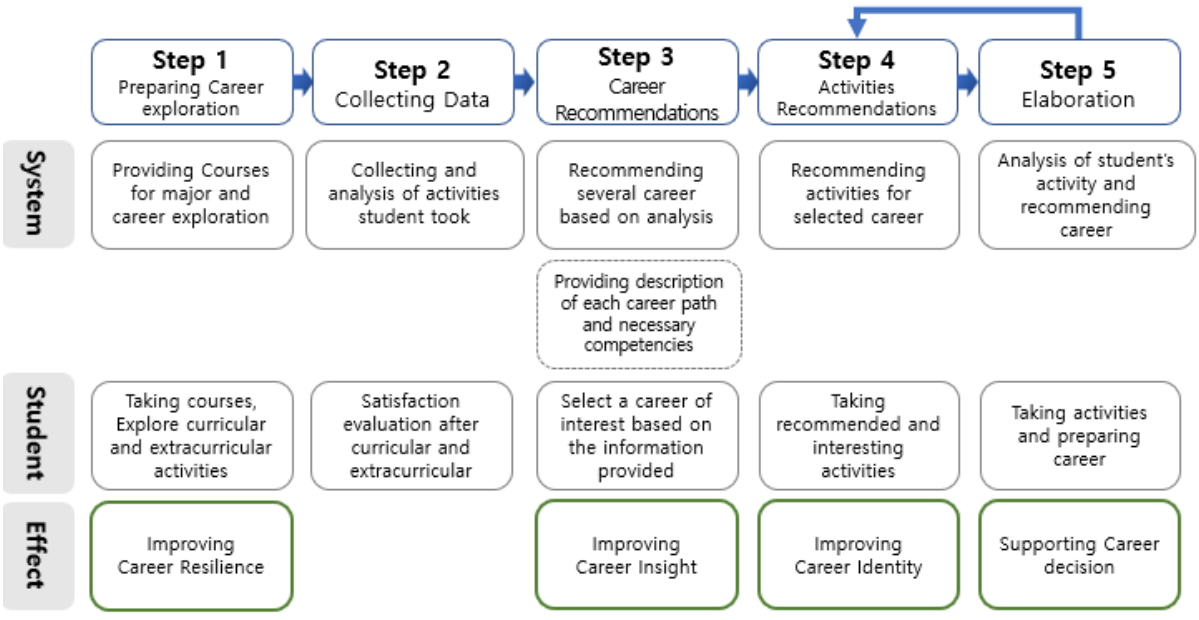
To complement the limitations of career development theory, social cognitive career theory emerged in the 1980s when Betz and Hackett (1986) focused on the role of self-efficacy in career development based on Bandura's social cognitive theory. Based on this theory, London and Noe (1997) presented a theory of career motivation, dividing the motivation for career decision-making into multidimensional aspects; career resilience, career insight, and career identity. According to London (1983), "In career motivation theory, career resilience refers to the ability to actively cope and adapt even in an uncertain career environment; career insight refers to recognizing factors that affect career paths and establishing detailed career goals and plans; career identity refers to the ability of an individual to make appropriate career decisions with a clear and stable image of the job." This study aims to create a system that supports students in each of these three areas.

Results

Figure 1 shows the student support system designed in five stages based on the previously presented career motivation model. The system shows student activities and provision effects for each stage. The presented student support system includes the career exploration preparation stage and the recommendation stage for each student's career path and curricular/non-curricular activities. In the first stage, courses are provided to students without a major to prepare for their major selection and career exploration. Students can improve their career resilience by taking courses and exploring curricular and extracurricular activities that suit their interests. In the second stage, data on students' curricular and extracurricular activities are collected from the system and analyzed. In step 3, based on the results analyzed in step 2, career data of students who have engaged in similar activities is analyzed to recommend a career path for each student. At this stage, the system supports improving students' career insight by presenting explanations, necessary competencies, and requirements for each career path. In step 4, students perform curricular and extracurricular activities that match the activities recommended by the system for their chosen career path and their changing interests. In this process, students can form a clear image of their job and develop their career identity. In the final 5th step, the tasks of steps 3 and 4 are repeatedly performed to support students in preparing for their careers realistically and specifically.

Figure 1

Student support system design based on career motivation model



Discussion

This study analyzed prior studies to design a career-based student support system in a convergence education environment and presented a student support system consisting of five stages based on the career motivation model. The presented system can help students select curricular and extracurricular activities that meet their career goals and improve career motivation by analyzing data from current students and graduates. Compared to existing career roadmaps presented on a department-by-department basis, this study is significant in that it presents a customized recommendation system for students based on career paths and suggests a personalized education path tailored to career goals. In future research, it is necessary to implement the system at various universities to identify any issues that may arise during the implementation phase and to make improvements based on user feedback.

Conclusion

Through this study, we sought to make an important contribution to improving students' learning experience and maximizing educational performance by proposing a system that supports designing individual career-based learning in a convergence education environment. In the future studies, it is necessary to collect and analyze data from various universities to apply the system practically and seek improvement of the system through user evaluation. By introducing the system proposed in this study, universities can systematically support students' career planning and study plan establishment, increasing students' satisfaction and achievement.

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Developing a Comprehensive Framework for Constructing and Operating Edu-Metaverse in K-12 Education

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Abstract This study developed a framework for constructing and operating the Edu-metaverse in K-12 education. While previous studies focused on integrating metaverse technology into education, research on a comprehensive framework was lacking. The developed framework includes goals, participants, essential factors, and major roles, derived from literature analysis, surveys, expert interviews, and Delphi survey. The Edu-metaverse aims to ensure learning rights, offer career assistance, provide learning communities, and achieve personalized education. Key participants are students, teachers, and parents, with technology, culture, and ethics as essential components. It supports curricular and non-curricular learning, offers diverse learning experiences, career guidance, safety education, interoperability with edutech tools, learning management, and individual portfolios. This study suggests the metaverse as a future virtual learning space integrating various educational activities and community spaces.

Keywords: Metaverse, Edu-metaverse, Virtual worlds, Conceptual framework, Delphi survey

Introduction

With the rapid changes in society and technological advancements, there is active discussion on future schools to address current and future educational challenges and to nurture talents prepared for the future society (Kim et al., 2017). Minerva Schools have transcended limited physical spaces to become spaces that surpass time and place due to technological advancements. It is predicted that in the future, with the advancement of technology, future schools will evolve into the metaverse, an expanded world beyond physical spaces. The metaverse is expected to promote future education by expanding self and experiences, enhancing learning immersion, and providing rich learning support (Gye et al., 2023). Some scholars refer to the metaverse for teaching and learning as the "Edu-metaverse," and they propose the concept of an "Edu-metaverse Ecosystem," which includes the necessary elements for its effective operation (Wang et al., 2022). While research on the concept and characteristics of the Edu-metaverse is actively conducted abroad, related research is insufficient. To build an Edu-metaverse, it is necessary to discuss the conceptual elements that need to be considered, such as setting the purpose of the metaverse. In this context,

research proposing a framework for constructing an Edu-metaverse is required (Chen et al., 2023). The currently proposed frameworks aim to conceptualize the Edu-metaverse or focus on technology (Wu & Hao, 2023). This study aims to develop a framework that can be used as a reference for the construction and operation of an Edu-Metaverse in the future, providing a theoretical basis for its establishment.

Research Design & Methods

This study aims to develop a framework for the construction and operation of Edu-metaverse and to verify its validity. To derive an initial framework draft, we analyzed previous studies and cases of the educational use of metaverse and virtual worlds. Through the analysis of research and cases, we synthesized the concept, purpose, operating methods, users, values, and components of the Edu-metaverse to derive an initial draft of the framework.

Additionally, we conducted a needs analysis through surveys targeting students, parents, and teachers in K-12 education. The survey consisted of questions about experiences with metaverse-based classes and activities, perceptions, and needs of metaverse-based education and Edu-metaverse, etc. 78 students, 40 teachers, and 118 parents participated. We calculated the frequency or average of responses for each question and analyzed open-ended opinions to examine the degree of perception.

Furthermore, through focus group interviews with experts experienced in the metaverse in educational use, we established the direction of the educational metaverse framework and defined the elements that should be included in the framework. We interviewed five experts, including metaverse education specialists and officials in charge of metaverse projects from city and provincial education offices, to gather opinions on the necessity and rationale of Edu-metaverse, the definition and role of Edu-metaverse, and the elements needed for sustainable operation of Edu-metaverse.

To review the validity of the Edu-metaverse framework derived through the above procedures, we conducted a Delphi survey with 20 experts and modified and supplemented the framework by reflecting the consensus opinions of the experts.

Results

1. Initial Framework for Edu-Metaverse

A survey was initially conducted to gain an understanding of the perceptions and needs of the primary users of Metaverse for Education. These users included students, parents, and teachers. The results of the subject-specific needs analysis, as identified through the survey analysis, are as follows. The initial survey of 78 students at the elementary, middle, and high school levels revealed that approximately 56% (44 respondents) had prior experience with metaverses, while 88% (69 respondents) expressed support for the implementation of educational metaverses on a school-wide basis. Subsequently, 118 parents were surveyed regarding the implementation of educational metaverses and metaverse-based educational activities. We identified three key reasons why students require metaverse-based education. Firstly, it provides a more future-oriented education (15.3%). Secondly, it offers a variety of experiences beyond the limitations of the physical world (11.0%). Thirdly, it can improve the accessibility and efficiency of education, while also generating students' interest (5.1%). Finally, a survey was conducted of 40 faculty members to ascertain their opinions on the initial metaverse framework derived from the literature. The results indicated that the educational metaverse framework was perceived as appropriate with a mean score of 3.48 (out of 5), the detailed functions and applications were considered appropriate with a mean score of 3.45, the usefulness was rated as appropriate with a mean score of 3.18, and the overall structural design was perceived as appropriate with a mean score of 3.68. Subsequently, expert interviews were conducted and it was determined that contemporary students are versed in text-based and media-based communication, such as voice and chat, thereby establishing their expectations of meaningful interaction between teachers and students via an educational metavers. In this study, the initial framework was devised to reflect the insights. The initial framework is composed of stakeholders, key roles, and components.

2. Results of the Delphi Surveys

In the first Delphi survey, a 5-point Likert scale questionnaire was administered to 20 experts, yielding content validity ratios (CVRs) between 4.11 and 4.63, with all areas of the framework scoring above the threshold of 0.42. Key opinions highlighted the necessity for additional support in extracurricular education, integration of learning management and learning analytics, differentiation from existing Edu-metaverse platforms, and the need for compatibility with external EdTech tools and educational administration systems. In the second Delphi survey,

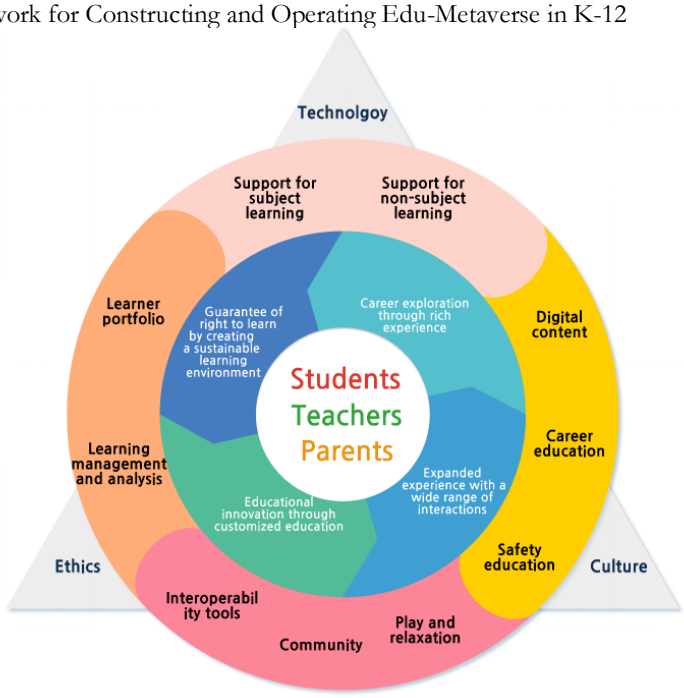
revisions were made to the initial framework, specifically addressing items with low validity identified in the first survey and taking into account expert feedback. The revised survey yielded CVRs exceeding the 0.42 threshold across all areas. Expert feedback underscored the need for revising ambiguous terms within the framework, clarifying explanations for each model element, and providing detailed implementation strategies.

3. Final Framework

The Edu-metaverse is an integrated educational platform that provides an expanded educational experience based on a virtual environment and refers to a virtual space where students and teachers can be the center and community members can participate. The final framework for the establishment and operation of this educational metaverse consists of goals, stakeholders, all elements, and roles as shown in [Figure 1]. First, Edu-metavers' goals are to guarantee the right to learn through the creation of a sustainable learning environment, to explore careers through abundant experiences, to expand experiences through various interactions, and to innovate future education through customized education. Stakeholders consist of students, teachers, and parents, and all elements such as technology, culture, and ethics are required for the establishment and operation of Edu-metaverse. Edu-metavers can play a role in providing support for learning, support for extracurricular activity, digital content, career and safety education, play and rest spaces, community, play a role as an interoperability tool, learning analysis, and provide a portfolio of learners.

Figure 1

Final framework for Constructing and Operating Edu-Metaverse in K-12



Education

Discussion

The discussion of this study is as follows. First, the Edu-metaverse framework developed through this research assumes an integrated space that encompasses and connects various functions, rather than serving as a limited, fragmented space. From the perspective of learning environment design, it holds educational significance by providing learners with a comprehensive learning ecosystem (Lim et al., 2022). Second, to build and operate an Edu-metaverse, it is necessary to consider its conceptual definition and key roles. Research related to future schools also begins by setting the fundamental direction of education (Kim et al., 2017), and the vision of the Seoul-type Metaverse platform by the Seoul Metropolitan Office of Education (2022) is a representative example. Third, the Edu-metaverse should be designed to emphasize the characteristics of the metaverse as a space and technology. It focuses on providing learners with expanded experiences rather than just the functions offered by existing online platforms. Therefore, the framework proposed in this study includes career education and safety education.

Conclusion

Firstly, the Edu-metaverse will function and serve as an integrated teaching and learning space in the future. Secondly, the Edu-metaverse will play a role not only for teachers and learners but also from a lifelong educational perspective for the community. Thirdly, to construct and operate the Edu-metaverse, the definitions, participants, essential factors, and major roles presented in this study must be considered. Fourthly, the Edu-metaverse should be designed to leverage the characteristics of the metaverse as a space and technology to provide learners with expanded experiences. Based on the limitations of this study, the suggestions for future research are summarized as follows. To build and operate an Edu-metaverse, it is necessary to establish a detailed roadmap based on the elements that need to be considered. This study is significant in introducing the concept of an Edu-metaverse in Korea. However, it has the limitation of not implementing an Edu-metaverse school based on the framework from the research.

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Promoting ICT Utilization in Education in Primary Schools in Cambodia

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In Cambodia, the lingering effects of the civil war necessitate educational improvements. The Ministry of Education, Youth, and Sport highlighted low Programme for International Student Assessment (PISA) scores. Despite existing teacher training colleges (TTC), the prevalent two-year duration is often insufficient, resulting in inadequate instructional skills among teachers. Addressing these challenges, our project collaborates with the TTC in Siem Reap to promote ICT utilization in 13 primary schools. In this study, we develop digital content with local teachers, observe their usage, and understand the spillover effects on other teachers. We provide necessary equipment, initial training, and ongoing support through interviews and visits. While ICT use has increased teachers' enthusiasm, challenges such as limited subject understanding persist. Future efforts will focus on refining teaching materials, improving teacher qualifications, and ensuring the program's broader dissemination and sustainability.

Keywords: Educational Development, Teacher Training, Cambodia

Introduction

In Cambodia, the lingering effects of the civil war necessitate improvements in the education system. The Ministry of Education, Youth and Sport (2018) in Cambodia pointed out the low score in the Programme for International Student Assessment (PISA) results, and it aims to achieve a better educational environment with a learner-centered approach. Although there are Teacher Training Colleges (TTC) in Cambodia for fourth-year students, most teacher training is currently conducted in two-year teacher training colleges. However, the two-year duration is often insufficient to develop adequate instructional skills, and there is a recognized shortage of teaching abilities among teachers (e.g., Ono, 2020; Tanden & Fukao, 2015). In fact, even during our activities in the field, we observed difficulties in teaching topics such as division in mathematics and pronunciation of English. Moreover, due to the shortage of teachers and schools, it is common for schools to operate on a two-shift system (morning and afternoon), resulting in a limited school day of approximately four hours, leading to inadequate learning time. Taking these local conditions into account, we are collaborating with the TTC in Siem Reap, Cambodia, to promote and enhance ICT utilization in local primary schools with the aim of improving education in the region. In this study, we aim to develop digital content with Cambodian primary school teachers, observe how these contents are used, and understand the spillover situation for other teachers. It should be noted that most local primary schools lack projectors, so we decided to donate the necessary equipment.

Research Design & Methods

We have identified 13 primary schools where graduates of the TTC work as model schools for our project. Each school has at least one designated core teacher through whom the project's initiatives will be disseminated. The project started in April 2022, and within three years, our goal is for approximately one-third of teachers in each school to be able to conduct lessons using ICT. To ensure not only temporary but also continuous and effective ICT utilization, we believe it is effective for local teachers to create their own teaching materials. Therefore, we decided to collaborate with local teachers to create teaching materials. Since local teachers lacked expertise in creating teaching materials, we first created model materials mainly in English. Then, local teachers customize and localize these materials. We believe that involving local teachers in material creation enhances their agency and contributes to sustainability. Additionally, we encourage teacher training college students to engage in material creation as part of their coursework.

When we traveled to the region, we demonstrated how the content could be used in the classroom and instructed the local teachers to use it in their classes. The use status was then confirmed through interviews conducted online once every few months and when we visited the next time.

Results and Discussion

Content creation in collaboration with the local teachers began in earnest after November 2022, and training on how to utilize the system was conducted in February 2023. In addition, we visited model schools and provided guidance for use in actual classroom environments. In some schools, we had the teachers use content in front of the students and provided feedback on the teaching methods.

Through our practice, core teachers in model schools have started using ICT regularly, ranging from once or twice a week to daily, depending on the school. Local teachers have also become more proactive in creating teaching materials. However, challenges such as teachers' limited understanding, particularly in subjects like fractions and geometry in mathematics, and issues with pronunciation in English have emerged. Furthermore, dissemination from core teachers to other teachers is underway, and it is necessary to monitor this progress and provide appropriate support as needed.

Reports from local teachers indicate increased enthusiasm and interest among students in ICT-based lessons. Local teachers mentioned that it saves board time, improves the tempo of the class, and motivates the students. However, some teachers who were new to using ICT said that they were unfamiliar with computers and found it challenging. Therefore, we decided to promote the use of ICT by having the teachers who would be the core of ICT utilization demonstrate a simple lesson just to display the slides in sequence as they teach.

Conclusion and Future Challenges

The teaching materials were generally developed according to plan and began to be used successfully by the core teachers. While there were some positive indications of revising the teaching materials to make them easier to use, we also observed that mistakes were embedded during the revision process. It is necessary to consider a system to check the produced contents, as well as to improve the qualifications of teachers. Although there were still issues in spreading the program to a large number of teachers, it was successful in stimulating the local teachers' motivation to use ICT. We will continue to monitor the use of ICT and consider appropriate measures.

Acknowledgments

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Concurrent Session2

A study on “the showing media literacy”

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In this study, how “showing media literacy” was operationally defined and it would be took place in practice. The purpose of this study is twofold: to define “the showing media literacy” and to elucidate its facets through investigation. First, we conducted a critical review of media literacy definitions focusing on educational researches in Japan and clarified research issues regarding “the showing media literacy. Second, through our investigation, we revealed how media literacy is shown. From this study, we obtained two main results:(1) By organizing important definitions and concepts of media literacy in Japan, it became clear that the aspect of showing is not clearly defined and is only suggested by some studies. (2) By investigating the show of media literacy, it became apparent that the demonstration of media literacy varies depending on conditions and awareness.

Keywords: Media Literacy, Showing, Definition, Components, Survey

Introduction

In recent years the media environment surrounding people has been undergoing complex changes. Particularly in recent years new media have emerged almost annually influencing people's lives. Furthermore the spread of misinformation regarding COVID-19 and vaccines in 2020 the Russian invasion of Ukraine in 2022 and the Israel-Gaza conflict in 2023 have seen numerous instances of false information being disseminated. In such a context media literacy is an essential skill in a society where diverse media and information exist.
The importance of media literacy has been emphasized by various researchers and research and educational practices have accumulated. However there has been little discussion on how to autonomously show and control the acquired "media literacy" in daily life.
Therefore the purpose of this study is to define the showing of media literacy and clarify its aspects through research. Firstly it aims to clarify the research issues concerning the showing of media literacy by critically examining and organizing definitions of media literacy in education in Japan. Secondly it aims to elucidate how media literacy is shown through empirical research.

Definition and Components of Media Literacy

In this study the definition and components of media literacy are classified into seven items based on their background and elements. The classification was conducted by focusing on the situations in which the definitions were made (background) and the elements that researchers included in their definitions (elements) using similarities as a clue. The results are summarized in Table 1. Black circles (●) indicate the presence of the item in the definition or components and double circles (◎) indicate the author's emphasis.

Table 1

Classification of Media Literacy

	Suzuki(1997)	Watanabe(1997)	Mizukoshi(1999)	Sugaya(2000)	Ministry of Posts and Telecommunications (2003)	Kurokami(2005)	Nakahashi(2013)
Media operation ability		●	●		●	●	●
Understanding of media structure	●		●	●	●		●
Critical reading	◎	●	●	◎	●	●	●
Creation/Expression	●	●	●	●	●		●
Social engagement	●	●	◎	●	●		◎
Independence		◎	●	●	●	●	●
Design						◎	

From this perspective similarities and differences in each definition can be observed. It should be noted that these seven items do not exist independently within each definition and component but overlap with other abilities and interact to shape media literacy.
However there were no items that included the showing of media literacy in the definitions or components. Therefore it is clear that future research should focus on examining the showing of media literacy as an everyday ability.

Current Status Survey: Actual Conditions of Media Literacy Showing

The purpose of this survey is to clarify the presence or absence of media literacy showing and the factors related to its showing. It explores the impact of the types of information the type of media through which information was received trust in media and interest in the information on behavior after receiving the information. In other words it aims to clarify how media literacy is shown in daily media contact situations.

Survey Method

Given the objective of investigating the current status of media literacy showing in society it was necessary to have a wide range of subjects. Therefore we targeted individuals aged 15 to 99 registered with the internet survey form "Freeasy." Efforts were made to ensure that age and gender were evenly distributed. The number of respondents was 504 of which 479 provided valid responses. The survey items were created with reference to the Ministry of Internal Affairs and Communications Information and Communication Policy Research Institute (2023) and Okawa (2022) focusing on "showing" of media literacy. Analysis was conducted using Microsoft Excel and IBM SPSS Statistics 29.

Results and Discussion

1:Presence or Absence of Media Literacy Showing
The survey results revealed that the showing of media literacy varies depending on factors such as the "types of information" "type of media through which information was received" "interest in information" and "trust in media." There were differences in the number of responses indicating action or inaction among information types A B and C.(Table2)

Table 2

Differences in Behavior by Information Type and Receive Media

N=479	Information A		Information B		Information C	
	Action Taken	No Action Taken	Action Taken	No Action Taken	Action Taken	No Action Taken
TV	248	231	221	258	213	266
Radio	142	337	145	334	133	346
Internet news sites	248	231	214	265	194	285
Social media	180	299	165	314	146	333
Video distribution/sharing sites	178	301	160	319	136	343
Conversations with others	192	287	172	307	148	331

2:Interest in Information
Interest in information showed a significant correlation with the presence or absence of subsequent actions across all information types A B and C. (Table3)High interest groups were more likely to take action while low interest groups were more likely to show inaction. This result indicates that "interest in information" is a factor influencing the showing of media literacy. In other words media literacy is an ability that requires underlying "interest" to be shown.

3:Trust in Media
The results showed that trust in media affects the presence or absence of subsequent actions. Except for the groups that trusted "SNS" "video distribution/sharing sites" and conversations with friends acquaintances and family members high trust groups were more likely to take action while low trust groups were more likely to show inaction. This suggests that "trust in media" is a factor influencing the showing of media literacy. Additionally trust in media promotes the showing of media literacy rather than suppressing it. Furthermore a lack of trust in media was found to suppress the showing of media literacy. In other words "trust in media while showing media literacy" is possible and "lack of trust in media while not showing media literacy" was indicated.

Table 3

Differences in Behavior by Interest in Information and Reception Media

		Receiving Media																			
		TV				Radio				Internet news sites				Social media				Video distribution/sharing sites				Conversations with others			
	Interest in Information	Action Taken (N=248)	No Action Taken (N=231)	χ^2 test p-value	Residual Analysis p-value	Action Taken (N=142)	No Action Taken (N=337)	χ^2 test p-value	Residual Analysis p-value	Action Taken (N=248)	No Action Taken (N=231)	χ^2 test p-value	Residual Analysis p-value	Action Taken (N=180)	No Action Taken (N=299)	χ^2 test p-value	Residual Analysis p-value	Action Taken (N=178)	No Action Taken (N=301)	χ^2 test p-value	Residual Analysis p-value	Action Taken (N=192)	No Action Taken (N=287)	χ^2 test p-value	Residual Analysis p-value
Type of Information A	High	149	51		***	97	103		***	161	39		***	116	84		***	115	85		***	121	79		***
	Middle	54	59	<0.01		25	88	<0.01		50	63	<0.01		38	75	<0.01		39	74	<0.01		37	76	<0.01	
	Low	45	121		***	20	146		***	37	129		***	26	140		***	24	142		***	34	132		***
Type of Information B	High	138	63		***	91	110		***	152	49		***	114	87		***	117	84		***	118	83		***
	Middle	56	54	<0.01		28	82	<0.01		52	58	<0.01		40	70	<0.01		40	70	<0.01		41	69	<0.01	
	Low	54	114		***	23	145		***	44	124		***	26	142		***	21	147		***	33	135		***
Type of Information C	High	106	45		***	69	82		***	111	40		***	85	66		***	80	71		***	83	68		***
	Middle	60	56	<0.01		32	84	<0.01		54	62	<0.01		41	75	<0.01		43	73	<0.01		48	68	<0.01	
	Low	82	130		***	41	171		***	83	129		***	54	158		***	55	157		***	61	151		***

Table 4

Trust in Various Media and Differences in Behavior by Information Receive Media

		Receiving Media																			
		TV				Radio				Internet news sites				Social media				Video distribution/sharing sites				Conversations with others			
	Trust Level	Action Taken (N=248)	No Action Taken (N=231)	χ^2 test p-value	Residual Analysis p-value	Action Taken (N=142)	No Action Taken (N=337)	χ^2 test p-value	Residual Analysis p-value	Action Taken (N=248)	No Action Taken (N=231)	χ^2 test p-value	Residual Analysis p-value	Action Taken (N=180)	No Action Taken (N=299)	χ^2 test p-value	Residual Analysis p-value	Action Taken (N=178)	No Action Taken (N=301)	χ^2 test p-value	Residual Analysis p-value	Action Taken (N=192)	No Action Taken (N=287)	χ^2 test p-value	Residual Analysis p-value
Trust Target TV	High	148	89		***	83	154		*	138	99		**	99	138			96	141			111	126		**
	Middle	71	81	<0.01		36	116	<0.05		72	80	<0.01		47	105	0.098		50	102	0.298		49	103	<0.05	
	Low	29	61		***	23	67			38	52		*	34	56			32	58			32	58		
Trust Target Radio	High	123	70		***	82	111		***	120	73		***	93	100		***	90	103		***	98	95		***
	Middle	100	100	<0.01		49	151	<0.01	*	98	102	<0.01		66	134	<0.01		68	132	<0.01		70	130	<0.01	
	Low	25	61		***	11	75		***	30	56		***	21	65		**	20	66		**	24	62		*
Trust Target Internet news sites	High	67	36		**	42	61		**	67	36		**	52	51		**	52	51		**	50	53		
	Middle	123	117	<0.01		61	179	<0.05	*	126	114	<0.01		84	156	<0.01		81	159	<0.01		89	151	0.133	
	Low	58	78		*	39	97			55	81		**	44	92			45	91			53	83		
Trust Target Social media	High	31	11		**	26	16		***	30	12		**	30	12		***	29	13		***	28	14		***
	Middle	93	86	<0.01		55	124	<0.01		100	79	<0.01		81	98	<0.01	**	77	102	<0.01	*	77	102	<0.01	
	Low	124	134			61	197		**	118	140		**	69	189		***	72	186		***	87	171		**
Trust Target Video distribution/sharing sites	High	39	12		**	31	20		***	38	13		***	36	15		***	35	16		***	34	17		***
	Middle	95	95	<0.01		56	134	<0.01		102	88	<0.01		80	110	<0.01		79	111	<0.01		74	116	<0.01	
	Low	114	124			55	183		**	108	130		**	64	174		***	64	174		***	84	154		*
Trust Target Conversations with others	High	80	57			53	84		**	83	54		*	64	73		**	66	71		**	72	65		***
	Middle	119	114	0.106		65	168	<0.05		121	112	<0.01		91	142	<0.01		88	145	<0.01		95	138	<0.01	
	Low	49	60			24	85		*	44	65		**	25	84		***	24	85		***	25	84		***

Conclusion and Future Issues

The purpose of this study was to define the showing of media literacy and clarify its aspects through research. The following insights were obtained from the results:

1:By organizing representative definitions and concepts of media literacy in Japan it became clear what elements are included in the definitions and concepts. However it was also revealed that the showing was not clearly positioned and was only pointed out by some studies.

2:By conducting a survey on the showing of media literacy it became clear that the showing of media literacy varies depending on conditions and awareness. These results will be significant in future media literacy education in terms of "enabling the utilization of media literacy."

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School libraries as educational media in the era of information-oriented education

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Abstract Courses of Study mentions school libraries as useful educational media. This research aims to discuss how school libraries contribute to effective teaching making use of ICT. Seventy-nine publicly available best practices at elementary schools utilizing ICT in teaching were collected and analyzed from the aspects of ICT use situations suggested by MEXT and school library availability described by JSLA.

It was revealed that the scope of activities to use ICT in teaching was expanding for higher grade levels. However, it was still limited to improve working efficiency of learning in a class. This suggests a possibility for school libraries to offer adequate equipment use, assistance with application and software use, and effective presentation instruction, as well as to provide information evaluated by library specialists and suitable support in use of digitized contents.

Keywords: Educational Media, ICT, Information Literacy Education, School Library

Introduction

The format of educational media, including digitized resources as well as printed materials, undergoes transformation over time. School libraries have been playing a role as media centers for effective use of such various resources. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) (2017) describes school libraries as useful educational media in its Course of Study. School libraries equip themselves with digital media and tools to support students in their fruitful learning and creative activities as well as in reading. Effective use of school libraries substantially enhances inquiry-based learning activities at schools (Gakkou Toshokan no Seibi Juujitsu ni kansuru Chosa Kenkyu Kyouryokusha Kaigi, 2016). MEXT (2022) also emphasizes that Information and Communication Technology (ICT) is an indispensable basic tool for realizing what it has termed "Japanese-Style School Education in Reiwa", and that optimally combining ICT with conventional practices can solve various issues facing school education and improve the quality of education. The curriculum guidelines for elementary and secondary schools explain how to use various kinds of media for high quality teaching. Itoh (2022) confirmed by the results of analyses of descriptions about media in curriculum guidelines that various media as well as books in a school library should be collected and properly organized to support teaching and learning activities.

However, quite a few studies point out that the effectiveness of using school library media on inquiry-based learning is not yet adequately recognized by schoolteachers and stakeholders. They also suggest that teachers do not know how to select and combine the contents of a textbook with information retrieved from other educational media. The present research aims to discuss how school libraries contribute to effective teaching activities making use of ICT. The researcher targeted best practices utilizing ICT in teaching at elementary schools. These were analyzed on the following points: (1) how ICT was applied for effective teaching, (2) whether each case used a school library, and (3) how school libraries could support teaching in each case. The reliability of the analyses was verified by referring to related documents mentioning the utilization of a school library in teaching. The results will become sources for teaching practices to promote the new way of learning in the Reiwa era promoted by MEXT (2022).

Research Design & Methods

Data Collection

MEXT (2020) shows examples of how to apply ICT to teaching for each subject in various situations. To examine the possibility of effective use of a school library as educational media, the researcher analyzed best practices utilizing ICT for teaching at elementary schools, which were publicly available. These data could be used to develop useful combinations of ICT tools and school library media for effective teaching.

The data were retrieved from the documents by boards of education of local governments available on the Web under the below conditions, and from the reports of the contest for ICT application in teaching organized by the Japan Association for the Promotion of Educational Technology (JAPET) (2022, 2023). Practical cases targeting a particular computing system or software were excluded, even if they were available on the Web. The cases collected were limited

to practices after 2020 when the newest Course of Study went in operation. The GIGA School program by MEXT was advanced due to the COVID-19 pandemic in 2020. Each case had to indicate its subject to make clear what kinds of outcome the teacher aimed for.

Data Analysis

The collected data were analyzed by the following procedures:

1. Each case was arranged under the labels of targeted grade, subject, unit, summary of activities, ICT and/or software used, situations to apply ICT.
2. The cases were classified into the categories of ICT use situations reported by MEXT (2020), which mentioned the following: (A1) displaying teaching materials in a classroom by teachers, (B1) individualized learning, (B2) activities such as information searching and conducting surveys, (B3) experimenting and deepening thinking, (B4) using various techniques to express images and/or thoughts, (B5) study at home, (C1) presentation and discussion within a class, (C2) organizing opinions through collaboration with classmates, (C3) producing collaborative works, (C4) communication with communities outside a school. As some reports applied the above MEXT categories, the researcher referred to the descriptions in the reports to determine applicable categories. More than one category could be applied to a particular activity.
3. The cases were also sorted by the kinds of supporting teachers and/or students by school library referring to the instructions of ICT use in school libraries for teaching by the Japan School Library Association (JSLA) (2021). The researcher set out the types of library services to support teaching based on their descriptions on behalf of this analysis: (1) evaluation of information and collection, (2) instructions to use collections or databases, and reference services, (3) posting useful contents for class activities, video distribution on web page, (4) school library use guidance, (5) information literacy assistance including report writing, (6) computer literacy including tablet and other software applications, and (7) internet literacy including netiquette and security.

Results

Seventy-nine cases were collected in total: 34 from the Board of Education of Hokkaido, 22 from the Board of Education of Yamaguchi Prefecture, 14 from the Board of Education of Tagawa City, Fukuoka and 9 from JAPET. The data were tabulated as shown in this section. None of these cases mentioned the use of school library services. Table 1 shows the results of the cases by grade. Most of the cases of this research were intended for middle and upper grade levels. As for the cases by subject, practices were found for basic subjects of the curriculum such as Japanese, social studies, arithmetic and science, and for the additional subjects of arts and crafts (see Table 2).

Table 1

Distribution by grade

grade	1	2	3	4	5	6	special needs	4・5	4・5・6	3_6	2_6	all
(n=79)	4	9	14	10	18	15	2	2	1	1	1	2
%	5.06	11.39	17.72	12.66	22.78	18.99	2.53	2.53	1.27	1.27	1.27	2.53

Table 2

Distribution by subject

subject	Japanese	calligraphy	social studies	arithmetic	science	life studies	music	drawing and crafts
(n=79)	12	1	9	12	6	4	4	6
%	15.19	1.27	11.39	15.19	7.59	5.06	5.06	7.59

	home economics	physical education	health	moral education	foreign language activities	integrated studies	cross-curriculum	special activities
	2	3	1	1	6	8	2	2
	2.53	3.80	1.27	1.27	7.59	10.13	2.53	2.53

Table 3 shows the results categorized by groups of ICT use situation. All groups were utilized to some extent in the situations analyzed. Studying at home (B5) and communication with communities outside a school (C4) occurred less. Collaborative activities (C2, C3) seemed not actively executed either.

Table 3

Categories of ICT use situation

category	A1	B1	B2	B3	B4	B5	C1	C2	C3	C4
(n=79)	25	35	27	29	32	3	48	20	15	4
%	31.65	44.30	34.18	36.71	40.51	3.80	60.76	25.32	18.99	5.06

Table 4 shows the results categorized by types of school library service availability. The cases were analyzed from their descriptions. The results suggest that school libraries can offer timely dissemination of information and sufficient collection management useful for ICT education and computer literacy instruction.

Table 4
Types of school library service availability

type	①	②	③	④	⑤	⑥	⑦
(n=79)	28	34	6	0	8	64	2
%	35.44	43.04	7.59	0.00	10.13	81.01	2.53

Discussion

ICT use situation

The comparison by grade level for each ICT use situation is shown in Table 5, with grades divided into three levels (lower, middle, and upper). Teachers constantly used ICT to display teaching materials and writings by students of all grades. It was apparent that this method was quite widespread from the fact that the Hokkaido Board of Education already reported the practice in 2018. As students of the lower grades with less developed technical skills were not yet ready to engage in individual learning, investigation activities, and deepening their thinking through such activities, they used tablet PCs mainly in discussion activities to upload their data to cloud storage and share them with each other. Studying at home and collaborative activities were also rarely observed. For the middle grade level, utilization of ICT in investigative activities has not yet been observed, but ICT use was found in all learning situations. Various uses of ICT were found in the upper grade level cases, as students extended their learning activities to conducting surveys using ICT and to searching different kinds of databases.

Table 5
A comparison by grade level for each ICT use situation

category	A1	B1	B2	B3	B4	B5	C1	C2	C3	C4
lower (n=13)	4	5	2	5	7	0	10	3	1	0
	30.77	38.46	15.38	38.46	53.85	0.00	76.92	23.08	7.69	0.00
middle (n=24)	8	10	7	10	9	1	12	6	8	1
	33.33	41.67	29.17	41.67	37.50	4.17	50.00	25.00	33.33	4.17
upper (n=36)	11	16	16	13	14	1	23	11	6	3
	30.56	44.44	44.44	36.11	38.89	2.78	63.89	30.56	16.67	8.33

Viewed by subject, all cases of ICT use were in line with the examples for each category introduced by MEXT. The recommended use of cloud computing by MEXT was also actively incorporated into the cases examined. They showed presentation and data sharing as effective in most of the subjects and regarded such activities as the final goal. Descriptions of these activities reported in the cases examined here suggest that ICT use remains limited to simply improving working efficiency of learning in a class.

School library service availability

Table 6 shows the possibility of school library service availability for each case by grade level. For the lower grades, there is a possibility to help with writing papers through preparing resources from a school library collection. As it is assumed that students of the upper grades use various information sources for their investigation activities, more opportunities could arise for the school library to support teaching by offering appropriate information and digitized contents.

In most cases examined in this research, teachers guided their students to a final summary presentation, which might lead the school library to offer adequate equipment use, assistance with application software use, and effective

presentation instruction. Viewed by subject, individualized learning was introduced to students at the beginning of classes in Japanese and arithmetic and shifted to their activities to deepen their understanding or enrich their learning. This implies the potential for individualized support such as reference services by school library staff. In the cases examined, the social studies and science subjects opted to conduct investigation and collect information by searching databases. This suggests a possibility for school libraries to provide proper information evaluated by library specialists and suitable support of instruction in use of digitized contents.

Table 6
A comparison by grade level for school library service availability

type	①	②	③	④	⑤	⑥	⑦
lower (n=13)	4	3	2	0	0	12	0
	30.77	23.08	15.38	0.00	0.00	92.31	0.00
middle (n=24)	8	11	1	0	4	18	1
	33.33	45.83	4.17	0.00	16.67	75.00	4.17
upper (n=36)	14	16	1	0	4	29	1
	38.89	44.44	2.78	0.00	11.11	80.56	2.78

Conclusion

It turned out that no cases examined in this research considered using school libraries as educational media to promote their teaching with ICT use. This might be due to the limitations of this research, as the cases were collected within a restricted range. The researcher arbitrarily excluded cases done at school libraries, as she attempted to avoid cases where teachers used a school library with a certain intention. In addition, it should be considered that effectiveness of ICT utilization in the cases was not verified as the aim of the reports was to introduce their practical use in class. Despite these conditions, it would be worthwhile to try to examine school libraries for practical situations with ICT use in teaching. The researcher plans to examine the possibilities of school library utilization through proper statistical examination after adding more cases of ICT utilization practices and taking up cases of ICT utilization in school libraries for teaching if any exist. These results will become helpful information to promote the new way of learning in the Reiwa era by using ICT with a school library. They can be expected to contribute to knowledge about how to engage in activities to fulfill the Team Gakkou (school as a team) system recommended by MEXT.

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Reviving the Traditional Campus Radio in the Digital Age: Challenges and Lessons from DYUP Sugbo

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DYUP Sugbo, the official campus radio of the University of the Philippines Cebu, has undergone operational fluctuations in recent years due to financial difficulties and organizational disputes. Despite the rise of new media technologies, a significant demand among students for the station's revival persists. As a laboratory facility, DYUP Sugbo is dedicated to equipping students with essential broadcasting skills, supporting the university's objective to be a regional leader in communication education.

Employing stakeholder theory as a framework, this autoethnographic study involved conducting semi-structured interviews with various stakeholders, including student volunteers who operate the radio station and the administrators overseeing its management. Through thematic analysis of the data, the research aimed to document the resurgence of campus radio in 2023, highlighting the pivotal role of student-broadcasters in the organization's revival.

The findings indicate that the resurgence of the campus radio was driven largely by the students' enthusiasm for campus broadcasting and the university administration's directive for its revival. This study could serve as an insightful resource for other campus radios across the country, providing strategies for achieving sustainability in the face of resource constraints and the expanding presence of online radio.

Keywords: campus journalism, campus radio, digital radio, stakeholder theory, autoethnography

Introduction

DYUP Sugbo has been at the forefront of mainstreaming campus journalism at the University of the Philippines (UP) Cebu and Cebu City, one of the largest metropolitan areas outside Manila. Even though it has been one of the major sources of news and information inside and outside the campus, it continues to face issues regarding sustainability due to multiple factors like the change of faculty supervisors, lack of support from the campus administration, and lack of interest among the UP Cebu community.

In 2023, after a years-long hiatus, efforts to revive the campus radio were successful. With the support of various stakeholders, including students and campus administration, the campus radio was able to broadcast for four hours a day, five days a week during class hours starting the academic year 2023-2024. Manned mostly by student volunteers, they were able to produce a daily news program, two magazine programs, one public affairs program, one program that caters to the student organizations in UP Cebu, one program about literature and books, and one program about technology, which was anchored by a partner student organization. Currently, listeners can tune in to the radio station through its in-campus broadcast, live online streaming via Facebook and YouTube, and pre-recorded podcast episodes on various platforms like Spotify and Apple Podcasts. It airs programs that are mostly produced by students of the campus.

After one academic year of broadcasting, it is imperative to undertake a comprehensive evaluation of the campus radio station's practices. This assessment should identify the most effective strategies implemented and recognize the various pitfalls that need to be avoided in the future.

Review of Related Literature

Many members of campus radio stations have demonstrated that their experiences have provided them with knowledge beyond practical tools, helping them become better people (Laor, 2019). In many countries, community radios play an important role in the higher education system (Bôtošová et al., 2023). However, in today's digital landscape, they must adapt to ensure they do not fall behind (Francisco, 2022).

Community and campus radios can be a powerful tool in facilitating development, especially in rural areas, but they will need more resources to become sustainable to fulfill this role. In Ghana, Radio Univers, the country's first authorized campus-community broadcaster, has significantly contributed to the mediascape as a source of information and an avenue for self-expression (Odartey-Wellington et al., 2020). Using structured interviews from the M3O community radio in South Africa, Moffat et al. (2024) found that the station's failure in various forms of sustainability—financial, social, operational, technical, and environmental—hinders it from reaching its broadcasting mandate. It is also worth noting that other community radios have closed due to similar failures. Another study in Malaysia highlighted the importance of management strategy in ensuring community engagement. Many citizens in Malaysia continue to patronize religious radio stations over commercial ones because they have defined their target audience and employed a good scheduling structure management (Abdul Wahab et al., 2023).

Research Design & Methods

To serve as a theoretical lens for this study, the researcher used stakeholder theory, which posits that organizations aim to generate multiple benefits for different stakeholders (Mahajan et al., 2023).

To gain insights into how DYUP Sugbo operated last academic year, the researcher employed autoethnography as a method. Autoethnography is a research method used to describe and analyze personal experiences to understand cultural phenomena (Ellis et al., 2010). Since the researcher is the current faculty supervisor of the campus radio, they used their personal experiences and observations in managing the radio station as data for this research. Additionally, the researcher conducted semi-structured interviews and focus group discussions with the student-broadcasters of the campus radio. This included the incoming and outgoing station managers, assistant station managers, programming committee heads, publicity committee heads, technical heads, secretaries, and some of the student-broadcasters. Consent was obtained for their participation in this study.

Results and Discussion

After conducting the interviews and focus group discussions, the researcher discovered the following information:

The programming management

For the programming aspect of the radio station, some student-broadcasters believed they produced quality shows throughout the year. There was a variety of shows, such as news programs, magazine programs, among others. However, some student-broadcasters claimed that it was smooth sailing until the second semester. One student-broadcaster revealed that no programming plan was turned over to guide them on what needed to be done in the second semester. This oversight caused some issues with the programming aspect. Since it is also a revival, they were not able to grasp the scope of the tasks under the programming committee, which caused some of the members to feel overwhelmed.

Like the other committees, there is also a manpower-related issue. For example, when no people are anchoring the programs, it can cause delays with the start of the broadcast, which can also cause delays to the start of the succeeding programs. The lack of manpower can also result in the repeated streaming of pre-recorded shows. No new episodes were produced, which affected the overall quality of the programming.

The publicity management

In terms of publicity management for the radio station, some of the students believe they have done an exemplary job. Some of the volunteers in the publicity committee were quick to respond when asked to complete marketing-related tasks. They were also able to produce content consistently throughout the semester, which was helpful since they are still introducing the radio station to the target audience. They produced various content for both offline and online mediums like Facebook, X, and TikTok. Some of the content they posted on these social media sites went viral, highlighting the skills and capabilities of the student volunteers to produce content that converts.

On the other hand, like the technical management of the radio station, the student-broadcasters have also faced some hurdles. For example, some students believe they should have a consistent brand persona throughout their online presence. Some even claim they were unable to make a content calendar for the second semester. They also encountered delays in posting time due to the lack of manpower. Even though the response time was quick, it does not necessarily mean students will take responsibility for all tasks presented. They should also be more meticulous about the type of content posted online. For example, some of the campaigns they initiated involved changing profile pictures online. The publicity committee should determine which events warrant such changes. Additionally, they

should be consistent with their tone and voice online, deciding whether to adopt a preppy or serious persona. They should also invest more in offline marketing efforts, such as posting publicity materials on bulletin boards, since the focus has been primarily on online efforts.

The technical management

Overall, the student-broadcasters saw some successes during the initial run of the broadcast last year despite encountering several issues. One of the most important milestones they achieved was the successful online streaming of the radio programs on both Facebook and YouTube. A few programs also undertook initiatives to improve the technical aspects of their broadcasts. For example, TekToks took the initiative to change some of their scenes in OBS, a tool used for online streaming, to ensure they had their own identity. Despite the lack of monetary resources, the station was able to procure equipment that helped in the initial run of the broadcast.

On the other hand, it is worth noting some of the issues they encountered. Some student-broadcasters observed that several radio programs lacked the manpower to handle the technical needs of each program. Some programs struggled to juggle the different aspects of broadcasting, such as manning the mixer and the computer to ensure the program ran smoothly. Because of the lack of manpower, some broadcasters were unable to turn off the streaming, which led to copyright issues on YouTube when the account was flagged on the platform. Another important issue that needs to be addressed is the unstable internet connection, which affects the audio quality that listeners receive. The wire management inside the booth also needs to be sorted out. The student-broadcasters had a hard time managing the different equipment inside the booth because the wires hindered their movement. Storage and archiving are also issues because the students save their episodes on the Google account assigned by the university. If the station continues to produce more shows in the future, they should look for ways to manage their archiving system effectively.

Stakeholder theory and DYUP Sugbo

One of the main concerns that most of the committees experience is the lack of manpower to handle the various day-to-day tasks of the campus radio station. This significantly affects its operation because responsibilities are left unattended. Therefore, efforts should be made by different stakeholders to be more open to accepting these tasks to ensure the radio station's longevity.

Additionally, other stakeholders in the university, such as the campus administration and the audience, must be actively involved in managing the campus radio. Currently, most of the people managing the campus radio are volunteers. Involvement from the campus administration could greatly assist the members.

Conclusion

With this, it can be concluded that the revival of the DYUP Sugbo has been successful overall despite the various struggles that various stakeholders have faced. For the next set of officers and committee heads, it is essential that they employ better manpower management skills to ensure that the operations will continue. Various external stakeholders like the campus administration and the audience themselves should be given an opportunity to be heard to ensure the progress that this campus radio station will experience is holistic and sustainable.

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The Learning Effects of On-demand Radio-based Graphic Representation Exercises

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Abstract: This article provides an overview of the learning effects of on-demand radio-based graphic representation exercises that have transitioned to online platforms due to the COVID-19 pandemic. Traditional design exercises focused on the expression and presentation of visual forms, involving the study of techniques and theories related to graphic representation by both lecturers and learners. In contrast, this article analyzes how a learning approach starting with listening to spoken words is reflected in the produced works and examines the impact of radio-style instruction on learners.

Keywords: Graphic Representation, Introspection, Narrative, Way of Questioning

Introduction

The act of "trying, experiencing, and understanding" (Sunaga, 2015) is a fundamental principle for discovering the essence of design. In teaching design techniques, lecturers have traditionally encouraged learners to reflect on their own intentions by observing their expressions and questioning them individually. However, with the shift to remote learning, learners started using the mute function for video and audio, making it difficult for lecturers to conduct classes by "observing learners trying and seeking understanding." The author felt frustrated by this "invisibility" and realized that their previous teaching relied heavily on "seeing." As a result, the author attempted to shift from "seeing" to "narrating and listening" by introducing an on-demand radio in the remote learning of graphic representation. The radio-type classes (hereafter referred to as "radio") revealed a significant amount of introspective learning, where learners expressed their understanding through reflective questioning, compared to
the in-person classes. Upon observing this change, the author realized their desire for students to confront themselves and designed the classes with that intention. This paper analyzes how this "learning through listening" attitude manifests in the produced works and examines the impact of radio-type classes on learners.

Overview of the Class

The class under study focuses on learning graphic representation and graphic techniques for conveying ideas. It was originally conducted the in-person for second-year students at Hachinohe Institute of Technology in 2019. In 2020-2021, it was transitioned to remote learning and conducted on-demand for second-year students at Sapporo City University. In both the in-person and remote settings, the lecturer provided mini assignments that could be completed within the class time. The mini assignments in the in-person classes involved learners sharing their drawings with each other to reflect on their expression techniques. In the remote format, the assignments were redesigned to allow learners to independently engage in drawing and introspection through the listening of radio broadcasts. In the in-person classes, learners performed exercises by hand-drawing their solutions on dedicated assignment sheets. In contrast, in the remote format, the author recorded their own practical exercises as radio broadcasts and simultaneously shared the process through blog posts. Learners listened to the radio broadcasts to grasp the key points of the assignments and worked on their own hand-drawn graphic representations in grid notebooks while referring to the blog as supplementary material.

The Reason Why Conduct Graphic Representation Classes in radio

The in-person type of learning formed through mutual attention between the lecturer and learners, or among learners themselves, in trying to understand the intention of expression (Saeki, 1995). When the author first started working on the online format for design exercises, the question of how to create this environment of mutual attention became a design issue. The elements of this problem include the lack of physical presence due to remote participation and the invisibility of behavior caused by muting. However, both issues were caused by my own consciousness of "trying to see and understand" things or my inclination to seek responses from students. Therefore, based on the idea of "not

trying to see," the author attempted to create an on-demand radio for graphic representation exercises by taking on the role of a learner and sharing insights and wisdom gained through introspection with the learners.

Understanding and Conveying Perception Through Graphic Representation

Harada (2010) explains that graphic representation involves using pictures and words to understand and convey one's perception of the world. This method is a technique for confronting the "unknown world." Harada suggests that learners should introspect during these exercises, questioning how they perceive, experience, feel, and derive meaning. When designers engage with diverse communities, they often face behaviors or intentions they cannot fully understand, prompting them to ask, "What is the world I am confronting?" Educational philosopher Yano emphasizes the importance of this self-reflective question, linking it to the broader inquiry of "Who am I?" and "What is this world?" Based on these ideas, the author defines their inquiry in the class as questioning "what is the 'world' I am confronting" and "who am I" through graphic representation. The study compares and analyzes the graphic representations in the in-person classes, which focus on visual observation, with those in online radio classes, which emphasize listening. It examines the differences in thinking processes during expression and introspection in these different settings.

Methods

Analysis of the Impact of Radio-Type Classes on Learners

In this chapter, the impact of radio classes on learners' learning experiences is examined through a comparative analysis of the mini assignment works conducted in both the in-person and the radio. The analysis uses works from the "introspection exercise" as the sample. The introspection exercise is an exercise task that involves selecting one's favorite item and reflecting on why one feels attached to it, aiming to understand the relationship between oneself and the social and living world through objects.
Left side of Figure 1 is a visual example of the lecturer's (author's) favorite forestry jacket, which was used for introspection. In the in-person classes, the lecturer's work was projected to explain how to approach the assignment. On the other hand, on the radio, the lecturer consciously narrated and conveyed to each learner (listener) "Why is the forestry jacket good and what makes it special?" Some excerpts from the radio broadcast are presented below:
"The theme of this exercise is 'What is my uniqueness?' First, choose one of your favorite clothes or something you feel attached to. Once you've chosen, let's start drawing and describing why that piece of clothing is important to you. (Omitted) For me, I conducted a design class where I tried forestry in the mountains of Hachinohe. It was during that time that I discovered this jacket at a shop in Hachinohe that sells forestry equipment. When I encountered this jacket, I thought to myself, 'Hmm, it feels like it represents me.' (Omitted) What I liked the most was the fabric. It's warm and windproof, but it's thin and lightweight with a single material. So, I can quickly put it on and move freely. I thought that by wearing this garment, I could express my mobility..."

After listening to the narrative of the lecturer's artwork (Left-side of Figure 1), the learners engaged in introspective exercises. The center of Figure 1 represents artwork from the in-person classes. In this case, the learner selected her favorite duffle coat. The artwork depicts the coat on the left side of the page, highlighting its features such as short length, buffalo buttons, and cozy pockets. On the right side, she describes how her mother bought it for her when she was in the sixth grade of elementary school, and how she can still wear it thanks to its medium size. She also mentions the soft material and how the hood creates a cute indentation on the top of her head. Although this artwork vividly portrays the factors of attachment, it lacks reflective descriptions regarding her personal qualities. In the in-person classes, artworks that reflected introspective descriptions of the significance and meaning attributed to the chosen object (such as memories or functionality) were highly regarded. On the other hand, the right-side of Figure 1 represents artwork by the listener of the radio. This artwork introspectively illustrates why they came to like Sarada Kinenbi (a tanka poetry collection by Machi Tawara). The heading reads, "When we first met, I wondered, is this what I love?" indicating the learner's introspective inquiry. The artwork portrays a glass cup filled with "ordinary everyday life," pouring in the feelings of "nostalgia and brightness." As a result, her daily life transforms into a pure and sparkling flavor. Through writing tanka poems by Machi Tawara, her perception of everyday life has changed. The artwork visualizes this transformation process. The learner attempts to express her own uniqueness by illustrating the experience of changing their perception through graphic representation. The key point of introspective exercises is not merely to depict the reasons for attachment but to depict the process of introspective questioning. The lecturer (author) highly evaluated this artwork after realizing their intention of designing a learning program that encourages learners to face themselves through assignments.

Figure 1
Differences in Graphic Representations by the lecturer, the in-person student, and the online student

|the lecturer's work| |the in-person student's work| |the on-line student's work}

Analysis of learning methods of radio

The author conducted a survey to assess how students learned and understood the design exercises (mini assignments) in radio during the course. The author distributed radio episodes for 12 weeks (excluding three critique sessions). The survey was conducted twice, in the academic years 2020 and 2021(radio classes, both), and received responses from 100 participants selected from all students who attended the course for two years.
Among the 100 respondents, the breakdown of responses to question 1, 'Did you understand the meaning and effectiveness of diagramming through this course?' was as follows: 46 respondents answered 'I understood it very well,' 53 respondents answered 'I understood it to some extent,' 1 respondent answered 'I did not understand it very well,' and 0 respondents answered 'I did not understand it at all.' It was revealed that 99 out of 100 respondents, or 99%, had a certain level of understanding regarding the learning experience of the radio."
After analyzing the responses of 100 participants, the learning styles of Radio lessons were categorized into the following four styles [see Table 1]: Among the four learning styles, Styles 1 and 4 can be characterized as learning focused on listening. Therefore, 64% of the students in total learned graphic representations using the method of learning while listening.

Table 1
Four types of learning styles in radio-style classes

No.	Learning Style	Content	Ratio
1	Multi-tasking Style	Listening to the radio while doing other tasks, taking breaks in time and place, browsing the Tumblr site, and then engaging in assignments.	58%
2	Traditional Class Style	Sitting in front of the computer like other online classes, listening to the radio, browsing the Tumblr site, and working on assignments.	29%
3	Preview Style	Checking the content of the assignments by viewing the Tumblr site first, listening to the radio, confirming the content again on the Tumblr site, and then working on assignments.	7%
4	Intensive Listening Style	Listening attentively to the radio without moving, then browsing the Tumblr site while working on assignments.	6%

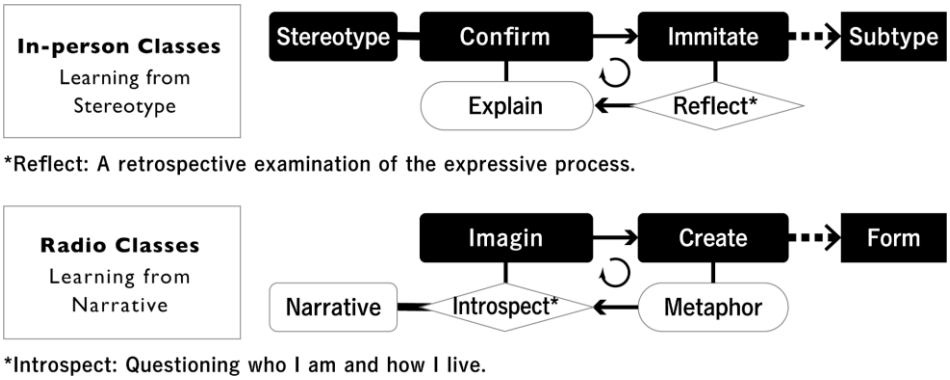
Discussion and Conclusion

Among the 12 the in-person class learners, 11 (91%) depicted the characteristics of their outerwear, such as coats or jackets, that they were wearing that day. It is presumed that these 11 learners mistook the imitation of the provided example lecturer's artwork in Figure 1 (on the left side) as the objective of the assignment. On the other hand, among the 155 radio learners, only 39 participants depicted outerwear. Although some of them may not have been influenced by the lecturer's artwork, the remaining 106 learners (68%) started the assignment by searching for their favorite item with their own inquiries.
Through the comparative analysis of the two assignments, it was found that experiential learning in face-to-face classes and radio-based classes involve different thought processes. In the in-person classes, the lecturer (author) first reviewed the example artwork with the learners. The learners stereotypically recognized the information arrangement of images

and text based on the example. They then confirmed the intended design of the information arrangement while listening to the lecturer's explanation. Using this design confirmation as a basis, they replaced the provided information with their own and reflected on the relationship with their beloved object through a procedural process (check the upper part of Figure 2). On the other hand, in the radio-based classes, the lecturer prompted the learners to listen to the lecturer's own experiences through verbal expressions. This led the learners to pose their own questions and engage in introspection. They then recalled their own experiences through introspection and expressed the physical and emotional meanings related to the events they were connected to by layering sketches in their notes. Attempting to express themselves using metaphors deepened their introspection, and physical and emotional memories that had not been recalled before surfaced. By repeating this cycle, they became able to express complex and composite information metaphorically and poetically (check the lower part of Figure 2). The representation of the "cup filled with ordinary everyday life" is an example of the aforementioned metaphorical expression (check the left-side of Figure 2) .

Figure 2

The difference between learning from fixed "Stereotype" and learning from "Narrative"



As described above, radio proved to be a suitable medium for introspection, but it was effective to direct the learners' learning interest towards the second-person "way of questioning" by narrating and listening to how the presented "form" was generated. As a result, the learners did not simply listen to how to express themselves and try to do the same. The lecturer used expressions to disclose their way of life and narrate. In response, the learners might have thought, "What kind of life do you lead?" In other words, the expressive activity started by questioning one's own way of life. To put it another way, the important aspect of introspective exercises was to depict "how they questioned their way of life." The author realized that they were designing the class with the intention of "wanting the learners to face themselves" through the process of analyzing the works.

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Relationships Between Psychological Traits on Study Habits Through a Learning App

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Study habits are important predictor of academic performance. Identifying psychological traits that form the foundation of study habits is important for providing effective learning support. This study investigates the association between learning logs related to study habits collected by the memory retention application Monoxer and psychological traits. A total of 36 physical therapy students participated in this study. In preparation for an academic test, assignments were delivered through Monoxer. The completion rates of these assignments (CRA) were collected as data reflecting study habits. Additionally, psychological traits were measured using the Japanese Short Grit Scale (Grit-S) and a Japanese version of the Rosenberg Self-Esteem Scale (RSES). Logistic regression analysis was employed to examine the relationship between CRA as the outcome variable and Grit-S and RSES as predictor variables. The analysis results indicate a positive correlation between grit and study habits, whereas self-esteem has a negative influence.

Keywords: Learning App, Physical Therapy Education, Psychological Traits, Study Habits

Introduction

Study habits are potential predictors of academic performance in higher education (Nonis & Hudson, 2010; Stinebrickner & Stinebrickner, 2004). Developing positive study habits is not only important for academic success but also plays a vital role in future careers. While examining the relationship between emotional intelligence and study habits among students of health sciences, Iqbal et al. (2022) concluded that dimensions such as self-awareness and self-motivation are positively correlated with study habits. Although identifying psychological factors that foster study habits is important to provide effective learning support, little research has been conducted on how these habits can be developed. This study focuses on two psychological traits, namely grit, developed by Duckworth et al. (2007), and self-esteem, proposed by Rosenberg (1965). It also investigates the relationship between these psychological attributes and study habits using logs from a learning app for Japanese physical therapy students. This research makes a significant contribution to the existing literature as no other studies have yet attempted to visualize study habits through learning logs or examined their relationship with the psychological traits in higher education.

Methods

Participants

A total of 36 third-year students (19 males and 17 females, aged 21.2 ±0.5 years) from a four-year physical therapy college in Japan participated in this study. The participants received a detailed explanation of the research and signed a consent form in accordance with the ethical principles of the Declaration of Helsinki.

Procedure

Assessment of Psychological Traits

At the end of November 2023, the participants completed the Japanese version of the Short Grit Scale (Grit-S) developed by Nishikawa et al. (2015) and the Japanese version of the Rosenberg Self-Esteem Scale (RSES) developed by Mimura & Griffiths (2007) to evaluate psychological traits. Grit, defined as perseverance and passion for achieving long-term goals (Duckworth et al., 2007), is positively correlated with academic performance (Duckworth & Quinn,

2009; Lam et al., 2022; Wolters & Hussain, 2015) and is composed of two primary dimensions: consistency of interest and perseverance of effort. Consistency of interest involves sustaining one's interests over an extended period despite encountering setbacks and failures. Perseverance of effort refers to the ability to continue working hard and maintain effort toward challenges (Duckworth et al., 2007). Self-esteem is an individual's overall positive or negative attitude toward themselves (Rosenberg, 1965) and is associated with academic performance (Baumeister et al., 2003; Lane & Kyprianou, 2004).

Learning App

The participants used Monoxer, a memory retention application developed by Monoxer Inc., that employs artificial intelligence (AI) to adjust the difficulty level of quizzes and the daily learning amount based on each student's learning history, optimizing memory retention. The quizzes are created by teachers, while the AI customizes them to better suit the learning progress of each student. Learners can access Monoxer on smartphones or tablets (see Figure 1). Monoxer also features a study-planning function that automatically designs and delivers daily assignments, thereby facilitating efficient memorization over a specified period. The completion rates of assignments (CRA) were recorded as a learning log reflecting study habits. The CRA represents the daily assignment achievement rate. For example, if a student completes the assignments of a 10-day study plan over ten consecutive days, the CRA will be 1.0. If the tasks are completed over only five days out of the ten days, the CRA will be 0.5. The CRA does not increase unless the day's assignments are completed. While study habits can be defined both quantitatively and qualitatively, this study assessed them quantitatively using the CRA.

Assignment Distribution and Collection of Learning Logs

In early December 2023, self-study assignments for an academic test scheduled for mid-January 2024 were distributed over four periods via Monoxer, and the average CRA was collected during each period (corresponding to one week). Figure 2 illustrates the flowchart for assignment distribution and collection of learning logs. The academic test comprised 100 multiple-choice questions aligned with the National Physical Therapy Examination on topics such as anatomy, cerebrovascular disorders, orthopedic diseases, and biomechanics.

Statistical Analysis

A logistic regression analysis using the forced entry method was employed with CRA categorized as "Having Study Habit (HSH)" (CRA ≥ 0.1) and "Not Having Study Habit (NHSH)" (CRA < 0.1) as the dependent variable. Grit-S and RSES were used as independent variables. Statistical analysis was performed using the statistical software EZR, with the significance level set at less than 5%.

Results

Table 1 presents the mean and standard deviation of the CRA for each period. Table 2 presents the baseline characteristics of participants in the HSH and NHSH groups. Table 3 presents the results of the logistic regression analysis. The fit of the regression equation was significant ($p = .019$), indicating that Grit-S was positively associated with study habits, whereas RSES was negatively associated with them. The VIFs of the two independent variables were below 5.0, indicating a low multicollinearity.

Figure 1

Monoxer app's screen

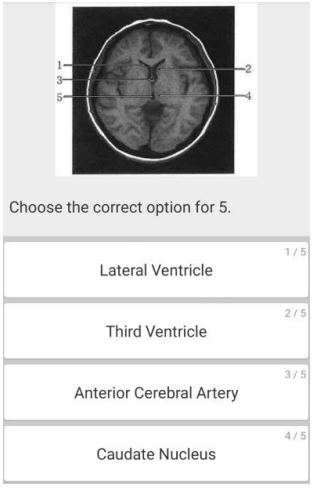

Figure 2

Assignment distribution and collection of learning logs

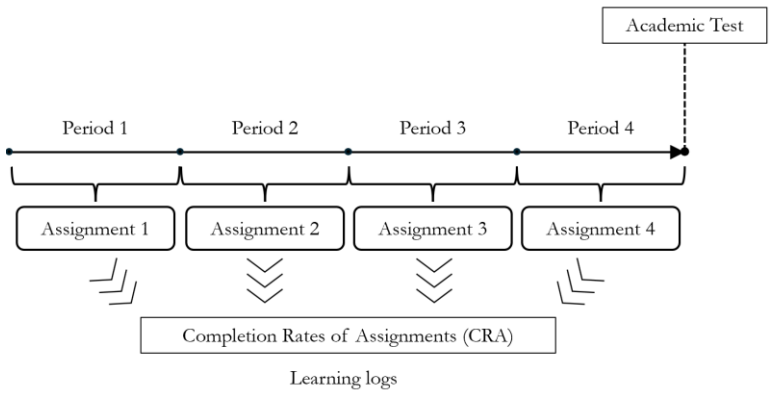

Table 1
Completion Rates of Assignments (CRA) by Periods

	M	*SD*	1	2	3	4	5
1. CRA (period 1)	0.409	0.419	——				
2. CRA (period 2)	0.373	0.435	.84 *	——			
3. CRA (period 3)	0.345	0.461	.85 *	.81 *	——		
4. CRA (period 4)	0.353	0.471	.84 *	.84 *	.98 *	——	
5. CRA (all periods)	0.370	0.431	.95 *	.92 *	.87 *	.86 *	——

*p<.001

Table 2
Baseline Characteristics of the HSH and NHSH Groups

	HSH Group (N=17)	NHSH Group (N=19)	*P* value
CRA (SD)	0.762 (0.309)	0.030 (0.039)	
Females (%)	8 (47)	10 (53)	
Age (SD)	21.1 (0.3)	21.3 (0.6)	.44
Cumulative GPA (SD)	2.7 (0.5)	2.9 (0.4)	.44
Grit-S			
Total (SD)	27.7 (5.8)	24.8 (6.0)	.16
Perseverance of Effort (SD)	15.1 (2.8)	14.6 (3.9)	.69
Consistency of Interests (SD)	12.3 (3.2)	10.5 (3.2)	.10
RSES (SD)	21.4 (5.3)	23.7 (5.1)	.20

Abbreviations: HSH = Having Study Habits; NHSH = Not Having Study Habits; CRA = Completion Rates of Assignments; Grit-S = Japanese version of Short Grit Scale; RSES = Japanese version of Rosenberg Self-Esteem Scale.

Table 3
Results of the Logistic Regression Analysis

Independent Variables	Odds Ratio (OR)	95% Confidence Interval (CI)	*P* value	VIF
Grit-S (total)	1.200	1.020 - 1.400	0.027	1.532
RSES	0.821	0.686 - 0.982	0.031	1.532

Analysis of Deviance: $p = 0.019$

Discussion and Conclusion

This study aimed to clarify the relationship between study habits through the memory retention app, Monoxer, and psychological traits such as grit and self-esteem. Using logistic regression analysis, with CRA as the dependent variable representing study habits, the results indicated that grit was significantly positively associated with study habits, whereas low self-esteem was negatively associated with them.

Several studies have reported a positive relationship between grit and academic performance (Duckworth & Quinn, 2009; Wolters & Hussain, 2015); however, to the best of our knowledge, there are no studies that visualize study habits through learning logs and examine their relationship with grit in higher education. Wolters & Hussain (2015) investigated the relationship between the Short Grit Scale, students' Self-Regulated Learning, and academic outcomes. They reported a significant association between grit and procrastination, indicating that students with low grit tend to delay necessary tasks or decisions. Although the present study design does not permit definitive conclusions, study habits may mediate the relationship between grit and academic performance. Future research should examine this hypothesis through mediation analysis.

These results indicated a negative correlation between self-esteem and study habits. Research shows that self-esteem is negatively related to procrastination and positively related to academic success (Hajloo, 2014; Lane & Kyprianou, 2004); however, some reports suggest that higher self-esteem does not necessarily lead to better academic performance (Baumeister et al., 2003; Pullmann & Allik, 2008). For instance, overestimating one's abilities can result in insufficient efforts to address and improve personal shortcomings and challenges (Golke et al., 2022). Unlike grit, in a few cases, interventions aimed at enhancing students' self-esteem may have an unintended negative impact on their study habits.

This study revealed the relationship between learning logs related to study habits through a learning app and psychological traits such as grit and self-esteem in Japanese physical therapy students. The findings suggest that interventions that enhance grit can be effective in developing study habits, whereas those focused on improving self-esteem may be unproductive. The novelty of this study is its objective measurement of study habits through learning logs that capture these habits based on students' behavioral history. The research findings presented herein are likely to provide a deeper understanding of the importance of cultivating study habits in higher education for meaningful outcomes. This study's limitations are as follows. First, learning behaviors were not measured through methods other than the learning application. Second, study habits were evaluated only in quantitative dimensions. Therefore, future research should address these issues.

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Comparison of EEG Activity According to Self-directed Learning Quotient and GPA in Online Learning

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The purpose of this study is to explore the effect of learners' characteristics on EEG activity in an online learning environment by comparing learners' frontal brain wave activity according to Self-directed Learning Quotient (LQ) and Grade Point Average (GPA) in online learning. The measured EEG activity was compared by dividing the learner's LQ and GPA data into two upper and lower groups, respectively. The research results are as follows. First, learners with high LQ and GPA were activated at a higher level of beta and gamma waves than other EEG in online learning. On the other hand, learners with low LQ and GPA found that theta and alpha waves were activated at a higher level than other EEG in online learning. Second, in online learning, it was confirmed that beta and gamma waves are activated at a higher level in learners with high LQ than learners with high GPA. Through this study, it was found that in an online learning environment, more effective learning occurred when the level of LQ was higher than learners with high GPA.

Keywords: EEG, Online Learning, Self-directed Learning Quotient, GPA

Introduction

Self-directed learning is an important characteristic required by modern society and refers to the ability to learn on one's own by selecting the knowledge, skills, and information necessary to live in a rapidly changing era. With the publication of a book called Self-Directed Learning by Knowles (1975), the theoretical foundation for self-directed learning was systematically established. Knowles (1975) defined a series of processes as self-directed learning, in which learners take the initiative, diagnose learning needs, set learning goals, secure human and material resources necessary for learning, and self-assess the learning outcomes they have achieved using efficient learning strategies.

As such, self-directed learning has been reported to have an important effect on improving learning outcomes by equipping learners with the ability to control their own learning environment (Yang, M. H., & Whang, J. K., 2002; Zimmerman & Martines-Pons, 1990). In particular, in online classes, it is confirmed that the level of self-directed learning of learners directly affects class satisfaction and academic achievement (Park, M. J., 2021). Until now, the importance of self-directed learning of learners in online learning has been emphasized by several researchers (Bae, Y. J., 2015; Choi, Y. S., & Son, E. Y., 2017; Park, H. G., & Yang, A. K., 2015).

Unlike traditional classroom instruction, online learning has loose control of instructors during class. Among them, classes using online content, not real-time video classes, are learned by video recorded by the instructor, so direct intervention of the instructor during class is impossible. For this reason, learning outcomes may appear differently depending on the learner's responsibility and will (Seo, Y. K., Ko, M. H., Kim, S. Y., & Jeon, B. H., 2020).

Recently, the Korean Ministry of Education analyzed the experiences and perceptions of online learning in elementary and secondary schools. According to the study, 68.4% of teachers and 62.8% of parents said that the online classes conducted in full after COVID-19 have changed the level difference between students (Gye, B. k. et al., 2020). 64.92% of teachers answered that the reason for the widening learning gap in online learning is the "Difference in Self-directed Learning Ability" (Kim, H. S. et al., 2021).

Meanwhile, studies were conducted to examine the brain's action involved in self-directed learning with EEG activity. As a result of the study, it was found that the higher the level of self-directed learning, the higher the beta wave and gamma wave of the frontal lobe were activated at a higher level than other brain waves. In particular, it was confirmed that gamma waves were activated higher than beta waves when integration between information processing was achieved during high-level cognitive activities (Cho, H. W., 2019). It was confirmed that the theta wave and alpha wave were deactivated as depression and negative cognition, which are characteristics of students with low level of self-directed learning, increased (Shim, H. S., & Lim, H. K., 2008).

Brain waves are classified into delta wave (0-4Hz), theta wave (4-8Hz), alpha wave (8-13Hz), beta wave (13-25Hz), gamma wave (25-50Hz) (Ramada, Refat, Elshahed, & Ali, 2015; Yoon, J. S., 1999). Theta wave is a neural correlation of learning and is associated with the basis of learning and memory (Eun, H. J., 2019). Theta wave is closely related to memory and information processing speed, and beta wave is related to concentration. Gamma wave is activated during high-dimensional cognitive activity.

This study aims to explore the difference in EEG activity of the frontal lobe according to LQ and GPA by measuring the EEG of learners in online learning. In this study, it is expected that by grasping learners' perceptions as neurological data based on learners' EEG, existing researchers will be able to more objectively grasp the results of confirming learners' characteristics in online learning. The research problems are as follows.

First, what is the result of EEG frequency analysis according to the learner's LQ and GPA levels in online learning?

Second, what is the result of comparing the simple scatterplot of learners' LQ, GPA, and EEG activity in online learning?

Research Design & Methods

Research Design and Procedures. This study was approved by the Institutional Review Board (IRB). After that, the contents of this study were announced and participants were recruited. The subjects of the study were 24 students enrolled in K University. In order to control the characteristics that affect brainwave activity, 24 students without a history of right-handed grip and brain-related history were finally selected among the students who voluntarily applied for research participation.

Before the study, this study method was guided in detail to all subjects at the orientation. The subjects listened to the explanation and agreed to the final consent to participate in the experiment and to provide personal information. An online questionnaire test was conducted to confirm the subject's LQ, and the subject's GPA score for the semester was collected. And the EEG measurement laboratory environment was constructed according to IRB approval and finally checked.

Brainwave measurement experimental research process. Experimental research was conducted on an individual reservation basis. In this experiment, the cerebral frontal EEG activity was measured while the subject was learning online learning contents. EEG measurement tool used MUSE 2 (InteraXon, Canada). This device is a portable wireless device and is easy to wear, but it brings research results similar to expensive EEG measurement equipment. Before the experiment, the subject wore an EEG measurement device and checked in a connected app whether the EEG measurement electrode was well positioned in the '10-20 International Electrode Arrangement Method'. Through preliminary practice, the EEG device and the main experiment were familiarized.

The online learning contents used in this experimental study were abbreviated some of the contents of the online liberal arts classes jointly used by the University Remote Education Support Center, and the class video edited and produced to suit this study was used. This video, which consists of 4 minutes and 30 seconds, was verified for content validity with the advice of 4 educational engineering experts, and was produced with the advice of 6 video production experts.

Data processing and analysis method. First, EEG data were collected as data of 256 Hz and stored in the main computer through Fast Fourier Transform (FFT). FFT is a process of normalizing EEG signals recorded in the time domain to be converted into the frequency domain for analysis. EEG data were converted to absolute values between 0 and 1. In order to compare the activities of the left and right prefrontal integrated EEG (theta wave, alpha wave, beta wave, gamma wave) of the study subjects, the sum values of the left prefrontal (AF7) and right prefrontal (A87) EEG data were used in this study.

Second, the LQ and GPA data of the study subjects collected in this study were analyzed with descriptive statistics using the SPSS/WIN 27.0 program. LQ and GPA were divided into high and low groups, respectively, based on the median. Descriptive statistics and simple Scatter Plots were checked to compare EEG activities in online learning according to LQ and GPA.

Results

1. Results of EEG frequency analysis according to LQ and GPA

As a result of comparing EEG activities in online learning, learners in the group with high LQ were activated slightly lower in the theta wave and alpha wave compared to the group with low LQ, and beta wave and gamma wave showed slightly higher activity. Compared to the group with low GPA, learners in the group with high GPA were activated slightly lower in the theta wave and alpha wave, and beta wave and gamma wave showed slightly higher activity.

In other words, the learners with high LQ and GPA exhibit relatively higher activation of beta and gamma waves during online learning, whereas learners with lower LQ and GPA show relatively higher activation of theta and alpha waves.

Table 1

Results of EEG frequency analysis according to LQ and GPA

Category			Theta wave		Alpha wave		Beta wave		Gamma wave	
		n	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
LQ	High	12	1.041	0.274	1.162	0.219	0.849	0.402	0.540	0.681
	Low	12	1.122	0.317	1.188	0.273	0.762	0.560	0.210	0.657
GPA	High	12	1.039	0.299	1.148	0.255	0.816	0.512	0.393	0.540
	Low	12	1.124	0.294	1.202	0.237	0.795	0.466	0.358	0.814

Category		Theta wave		Alpha wave		Beta wave		Gamma wave	
	n	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Total	24	1.081	0.293	1.175	0.242	0.806	0.479	0.375	0.676

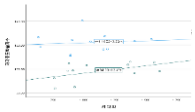
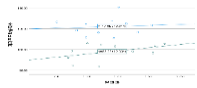
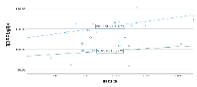
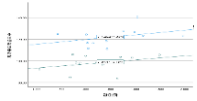
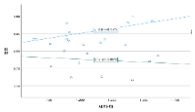
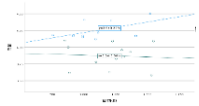
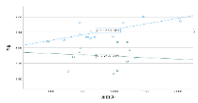
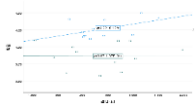
2. Comparison of simple scatterplot of LQ and GPA and EEG activity

The learners in the group with high LQ were found to have a more positive correlation between the beta wave and the gamma wave in online learning compared to theta wave and the alpha wave. Theta wave and the alpha wave tended to have a very slight increase in the simple scatterplot, but maintained almost a certain level. On the other hand, the learners in the group with low LQ had a very slight increase in the simple scatterplot of theta wave, alpha wave, beta wave, and gamma wave in the frontal lobe.

The learners in the group with high GPA showed a positive correlation in which all the simple scatterplot trend lines of the theta wave, alpha wave, beta wave, and gamma wave in online learning increased. In other words, the higher the GPA, the more the learner's frontal brain waves (theta wave, alpha wave, beta wave, and gamma wave) tended to be gradually activated in online learning. However, the learners in the group with low GPA were found to have a negative correlation in which most of the simple scatterplot of the frontal brain waves decreased slightly.

Figure 1

Comparison of simple scatterplot of LQ and GPA and EEG activity

Category	Theta wave	Alpha wave	Beta wave	Gamma wave
LQ				
GPA				

Discussion

Based on the results, the results of comparing learners' EEG activities according to LQ and GPA in online learning are as follows. First, in online learning, learners in the group with high LQ and GPA had relatively high activation of beta waves and gamma waves. According to previous studies, the higher the level of self-directed learning, the higher the beta wave and gamma wave of the frontal lobe were activated at a higher level than other brain waves (Cho, H. W., 2019). Beta waves indicate an active brain function associated with concentration, (Lee, S. A., 2021), and gamma waves are the result indicating that learners are actively performing cognitive tasks (Jang, S. O., & Yi, S. G., 2009). In other words, it was found that learners with high self-directed learning index and high credits showed that brain waves that actively perform cognitive tasks were activated by exerting concentration in online learning.

Second, the simple scatterplot between LQ and EEG activity showed a slightly different pattern from the learner's GPA. In the group with high LQ, the simple scatterplot trend line of the beta wave and gamma wave increased, and theta wave and alpha wave showed a very small positive correlation while maintaining a constant low level. The constant low level of theta wave when the beta wave and gamma wave increase is a phenomenon that occurs during cognitive activity for accepting external information and memory, which can be interpreted as a high level of cognitive information processing (Lee, S. A., 2021). On the other hand, the results of the simple scatterplot according to the learner's GPA in online learning are as follows. The group with high GPA showed positive correlation in the simple scatterplot of the theta wave, alpha wave, beta wave, and gamma wave. The simultaneous activation of theta wave and gamma wave can be inferred that cognitive action of the brain is taking place in a tense state, and it can be interpreted as a result of activation of the core language center of the frontal lobe while learning visual and short-term memory (Kim, Y. H. et al., 2000). In other words, it was possible to infer that learners with high LQ have a high degree of cognitive information processing in a state of exerting concentration in online learning. In contrast, learners with high GPA were able to infer that brain cognitive action occurs in a tense state in which the language center of the frontal lobe is activated during online learning.

Conclusion

In summary, both learners with high LQ and those with high GPA showed brainwave activation that promotes learning in an online environment, but it was found that learners with high LQ showed concentration in online learning rather than those with high GPA, resulting in a high degree of cognitive process. On the other hand, learners with a high GPA were able to confirm that brain cognitive action occurred by activating the language center in a tense state.
For efficient online learning, it is necessary to create a self-directed learning climate in which learners actively participate in classes through systematic online class design. In addition, it is necessary to regularly check the learner's level of self-directed learning and further strengthen the instructor's ability to guide students so that the learner's self-directed learning ability can be gradually improved.
This study compared learners' frontal EEG activities according to LQ and GPA and examined the effect of learners' characteristics on EEG activities in an online learning environment through neurological research. Considering that most of the studies confirming the learning effect in existing online classes were correlation studies through self-report questionnaires or perception surveys, this study is meaningful in that it explored learners' learning process in a more scientific way that guarantees objectivity and reliability by collecting EEG data, which is a precise bio signal.

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Design and Construction of the Virtual Assistant Tool for Self-Directed Learning with ADHD Traits

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This study explores the development of a virtual assistant tool aimed at supporting self-directed learning for individuals with ADHD traits. It builds on previous research and the author's experiences, focusing on a web application designed to address the specific needs of learners with neurodiversity. The study utilizes the Trait-Treatment-Task Interaction (TTTI) theory and a general model of self-directed learning to analyze the required support at each learning stage. Results indicate that specific functionalities, such as media accommodation, self-monitoring, and motivation maintenance, are essential. The study suggests that technology might significantly support learners with ADHD and other Neurodiverse traits by providing tailored support, though further prototype testing and implementation evaluation are necessary.

Keywords: Educational Design Research, Learning Support, Neurodiversity, Self-Directed Learning, Web-Application Development

Introduction

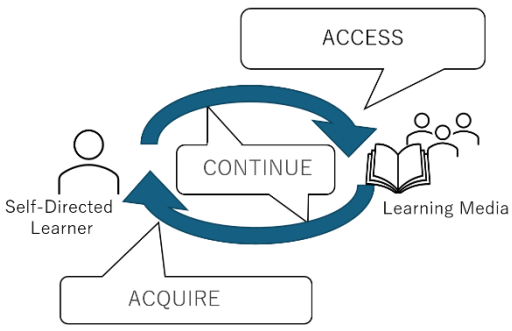
In this age of generative AI and other advanced technologies that have become so accessible, people may not have to continue to suffer from their difficulties any longer. Or at least, students with learning difficulties can now rely on technology rather than trying to do everything in their own brains. Dale & Grut (2015) found by observing whole families that technology support is effective in the daily lives of those with ADHD, or neurodiversity traits, while noting the cost and malfunctioning issues. As they point out, the problems of daily life can be solved by technology, even if they are advanced actions involving metacognition, such as autonomous learning. Moreover, since nowadays Neurodiversity personnel are considered to create an inclusive and emergent society, increasing attention is being paid to brain characteristics such as ADHD, so there is an urgent need to develop technology specifically designed to support learners with such characteristics. This study is a "performative" attempt to explore the design framework of a new web application from previous research and the author's experience as an initial step in Educational Design Research (McKenney & Reeves, 2018).

Research Design & Methods

Trait-Treatment-Task Interaction (TTTI), a classic theory in educational technology and educational psychology, and the General model of autonomous learning by Takabayashi (2020, Figure 1). The traditional theory is still valid for discussions of contemporary diversities such as ADHD and the need for support tailored to the characteristics that underlie this study. The new theory of self-directed learning, on the other hand, is a model of the ideal process of learning, derived from multidisciplinary research, and because it is a simple model, it is easy to apply to individual cases. In order to design appropriate treatment according to TTTI for the case of ADHD, which is the case of some people including the author himself, we will analyze the support needed in each stage of the general model of self-directed Learning.

Figure 1

General Model for Self-Directed Learning (Originally from Takabayashi 2020, Refined and Translated by the author)



In a recent study, Vouglanis and Driga (2023) found that in the special context of COVID-19, ADHD and the prominent characteristic of uneven concentration were barriers to ADHD students' attempts to self-study using online resources from home. This study categorizes these difficulties according to the General Model and organizes the necessary features for a web application-based support tool. The reference for this analysis is the case study of survival skills for adult ADHD by Safren et al. (2017) and Solant (2011) and the author's own experience with ADHD characteristics.

Results

The three stages of Takabayashi's (2020) SDL general model are divided into six components. Among these, three elements, one from each step, were identified as possible troubles with the ADHD trait. Each of these difficulties and the functions of possible support tools are shown in Table 1. Following the table, Figure 2 shows a simplified view of the design when executed on a web application screen on a smartphone.

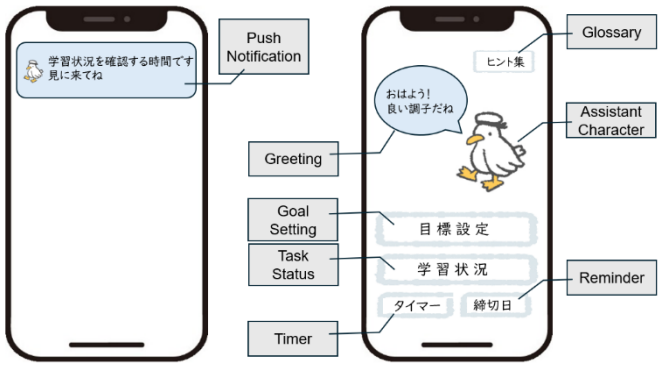
Table 1

Features of the support system web application by Self-Directed Learning Steps

SDL step	Possible trouble with treat	Treatment by the Virtual Assistant
Access	**[Media Accommodation]** One might have narrower range of available media source so they cannot reach the media	-Easy access link to the reliable source -Attention getting navigator to online / physical resources
Acquire	**[Self-monitoring]** One might not sure what and how deep they leaned because of the easily distracted trait and/or hyper concentration	- Visualize spent learning efforts - Send reminder for the learning goal
Continue	**[Habituation]** One might easily lose the continuing motivation but distracted by other attentions	-Send routine reminder with daily changes -Daily attention getter e.g.) icon variation -Own motivative motive for assistant characters

Figure 2

Image of the Virtual Learning Assistant tool on smartphones



Discussion and Conclusion

Based on the concept that technology can enable support tailored to traits, this study organized the necessary learning support tool web application functionality into the steps of the General Model of Self-Directed Learning. Based on this skeleton design, a prototype trial and actual implementation evaluation is needed.

The web application that this study will attempt to design, and construct might initially provide only partial support for some of the learners in Neurodiversity. However, the difficulties shown in Table 1 might apply to large numbers of people, with or without ADHD characteristics, strong or weak. This indicates that this specific analysis could help more learners, and that the General Model of SDL could be brushed up.

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Designing a College Entry Course Relying on Students' Autonomy to Nurture their Autonomy

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Abstract Transformation of in-coming students at an earlier stage of university education is expected to nurture students' autonomy. This paper describes the design of an online course in a middle-range large university with a mixture of 93 students from various colleges, relying on students' autonomy to nurture their autonomy. The course consisted of 7 100-minute sessions in 7 weeks after summer break. Each session required a pre-session report by reading a specified chapter of the textbook and preparing answers to the chapter exercises. Each session had a routine of instructor comments to post-session reflection reports and short lecture on related topics, then groups discussions about pre-session reports. The other 12 chapters in the textbook were set as optional tasks that the students may or may not work on, but encouraged to try out. Overall number of optional tasks submitted within the 7 weeks was 136, 33 students submitted at least one, with an average submission of 4.12, whereas other 60 students did not submit any optional reports. The balance between making tasks mandate and making tasks optional to nurture autonomy is discussed.

Key words: Instructional Design, College Entry Course, Student Autonomy, Optional Tasks

INTRODUCTION

Transformation of in-coming students at an earlier stage of university education is expected to nurture students' autonomy. Efforts have been made to facilitate transformation of high school students of yesteryear to college students today and beyond. Such efforts include a textbook for the first-year college students, to acquire useful skills of learning how to learn, and learning how to learn together (Suzuki & Mima, 2018). On the other hand, some arguments have been made that colleges have been changed to a high school like style of education, with too many helps and requirements so that the students are not having enough chance to grow to be independent. It is always a good idea to provide opportunities to help the incoming students to be autonomous, to get ready for the learning environments with fewer help and guidance. It would be a different story, however, if such help became mandatory by letting the students follow the only pre-determined pathway, to provide less opportunity to think for themselves, to act by their preferences, and to learn from making and fixing mistakes.

This paper reports the design and outcomes of an online course in a middle-range large university with a mixture of students from various colleges, relying on students' autonomy to nurture their autonomy. To nurture autonomy, the students should be given enough opportunity to decide their learning path. On the other hand, each course has its learning objectives set to contribute within the curriculum. Thus, the students may not have a full control of the coursework; there should be a middle ground so that the attainment of learning objectives can be facilitated, and that the student's autonomy would be nurtured at the same time.

COURSE DESIGN TO RELY ON STUDENTS' AUTONOMY

The course consisted of 7 100-minute sessions in 7 weeks after summer break. It was one of the required courses that students read the syllabus to select in advance which class to register. It is one of the required courses to pursue the same learning objectives, but each class instructor was expected to extend the core based on his/her specialty areas. Thus, class selection may lead to a wide variety of study contents, using different textbooks, as well as different learning styles specified by instructors.

In this particular class, each session required a pre-session report: Reading a specified chapter of the textbook (Suzuki & Mima, 2018) and preparing answers to the chapter exercises online before attending a session. Chapter 1 was assigned to the first session, then students voted on which chapters to read for sessions 2-7, out of the 19 chapters of the textbook. The other 12 chapters in the textbook were set as optional tasks that the students may or may not work on, but encouraged to try out. After the vote in the first session, each selected chapter was assigned to sessions 2-7. At the same time, 12 discussion boards were created for the remaining 12 chapters, so that interested students can post their reports at any time to any chapters of their choice. Submitting these additional reports were left optional, but it was announced that submissions would earn "some extra points."

Not only the 7 pre-session reports were required, 7 post-session reports were also required in this course. Post-session reports asked the students to reflect on what they learned in each session. In addition, the final reflection report was required to state what were the 3 best things each student learned in this course, and why they think the selected best 3 were important. Therefore, it was clearly stated in the syllabus that a total of 7 post-session reports, as well as the final reflection report, were required to pass this course. Also stated was the quality of all reports, as well as submission of optional report, would earn "some extra points." It was not stated, however, how much extra points were given, because it was the first year for the instructor, thus wished to reserve some flexibility, not to produce too many dropouts.

Each session had a routine of the instructor comments to post-session reflection reports of the previous session, excluding the first session, with a short lecture on related topics, then groups discussions about pre-session reports. Only those who prepared the pre-session reports were regarded as eligible for participating the group discussion: those who did not were excluded from the groupwork, but spent the time for reading and working on the chapter exercise. This was to encourage the students to submit the pre-session reports so that they also could engage in the groupwork.

RESULTS

Numbers of submissions of post-session report for each of the 19 chapters are described in Figure 1. After studying Chapter 1: *Prepare your environment*, the other 6 chapters voted to study in the sessions 2-7 were as follows: Chapter 2: *Grasp your learning style*, Chapter 9: *Manage your time*, Chapter 10: *Become stronger for failure*, Chapter 11: *Enhance your motivation to learn*, Chapter 14: *Adapt for*

learning tasks, and Chapter 15: *Making learning more practical*, accordingly. Those chapters obtained submissions by most of the 93 registered students: from 92 (99.0%) for Chapter 1 to 74 (80.0%) for Chapter 15. The rest of the 19 chapters that were treated optional, thus obtained significantly less submissions: from 26 (28.0%) for Chapter 3, to 2 (2.2%) for Chapters 18 and 19.

Figure 1: Report submission by chapters

Numbers of submissions of post-session reports by each of the registered students are summarized in Figure 2. The blue solid bars represent reports for sessions 1-7, whereas the red dotted bars represent optional reports for the other 12 chapters. A total number of optional reports submitted within the 7 weeks was 136. Thirty-three students (35.5%) submitted at least one optional report, with an average of 4.12 (*SD*=3.40) (among those submitted), whereas other 60 students did not submit any optional reports.

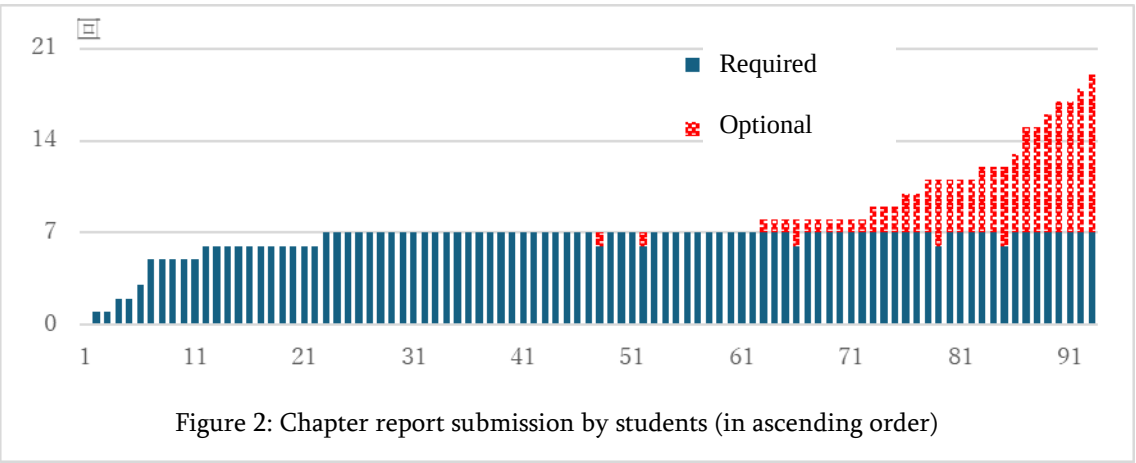

Figure 2: Chapter report submission by students (in ascending order)

DISCUSSION

The results of this first attempt to rely on students' autonomy shows that more than 80% of the students followed the direction required to earn a credit, whereas it was about 30% of students who tried optional reports to widen their learning opportunity by themselves. Seven students (7.5%) submitted reports for 14 or more chapters, doubling their effort from what was required just to pass the course. By

relying on the students' autonomy, more students did not show their autonomy beyond what was required. On the other hand, it was functioned as an opportunity to show autonomy for fewer numbers of students.

There were many factors that may have affected these results. The course was required for graduation, but there was a selection opportunity on student side to choose among multiple classes listed, by examining and comparing syllabi. If the course contents fit with students' interest, then it would have been more motivational for additional learning. However, some students, who were interested in learning more chapters, may have not selected to work on and/or submit optional reports, due to heavy study load from their other courses. Having the textbook at hand, some may have thought that additional work can be done even after the 7 weeks were over, during breaks, or in the future.

Another factor may have been the clarity of evaluation scheme for the optional reports. It was stated that submission of optional report would earn "some extra points," but how much extra points would be given was not made clear in the syllabus. If it were stated in the syllabus that meeting the minimum requirement to pass this course means to earn the passing score of 60, then stronger motive may have been felt, because many students may want to get a higher score than 60 to keep the grade point average higher. Although high quality reports would get "some extra points," some more students may have selected to work on some more optional reports as an "insurance." This may be considered a reaction to external control, which may not be regarded genuine autonomy, but a part of self-regulated learning of correctly grasp the course requirement and act accordingly to be a successful learner in a given condition.

To nurture students' autonomy, it is necessary to include options of student behaviors. Without such student-initiated behavioral options and their consequences, students would have no room but just following what was required to pass the course. From the writer perspective of the textbook, it is always our wish that more students read more chapters, as all chapters are included because of their importance. If all students are exposed to all chapters, it would be the happiest situation, but it may be too much to ask within the 7 weeks in this situation. The balance between making tasks mandate and making tasks optional to nurture autonomy is not an easy design decision. Some more elements of mandate and/or "invitation" will be designed for the next year, so that more students elect to read more chapters without feeling too much burden, just to fulfil the course requirements.

NOTE

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Changes in Professor Trust, Class Engagement, Learning Motivation in Team Project Classes

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Abstract This study examined the changes in professor trust, class engagement, and learning motivation of college students who participated in a team-based project learning (TBPL) course in a university liberal arts class. The study was conducted in a semester-long TBPL class for 26 students in a liberal arts course at a four-year university. The study analyzed how students' trust in professors, class engagement, and learning motivation were affected through team-based individual project learning. The findings are as follows First, there was a significant improvement in students' trust in the professor through TBPL, and the difference was statistically significant. Second, students' engagement in the classroom was enhanced through TBPL, as they expressed their opinions, participated in class activities, extended class activities, and were more enthusiastic about the class. Third, except for relevance, students' motivation to learn, attention, confidence, and satisfaction increased in TBPL classes, and the differences were statistically significant.

Keywords: Class Engagement, Learning Motivation, Professor Trust, TBPL

Introduction

In recent years, universities have focused on developing learners' ability to communicate with others, solve problems, and work responsibly in various life situations after graduation, rather than acquiring more knowledge and information to keep up with the rapidly changing society. As a result, learner-centered education is emphasized, where learners become the agents of their own education and actively participate in learning, rather than classroom lectures that one-sidedly impart knowledge to learners. Learner-centered learning methods that are widely utilized in universities include problem-based learning, team-based learning, flipped learning, project-based learning, habruta, and capstone. Team-based project learning in this study is learning that occurs when members of a learning team collaborate with each other to accomplish a practical task within a limited time frame (Lee, 2013). Team-based project learning is a process of active knowledge formation through reflective reflection and inquiry where members take the lead in the learning process.

Jang (2020) implemented TBL in a liberal arts course called Encountering Literature and Video for 15 weeks and examined problem-solving skills, cooperative adjustment, and sharing spirit, and found that problem-solving skills and sharing spirit increased after the TBL class. Sunyoung Jang (2021) analyzed the reflective journals and interviews of students who participated in team-based learning in a liberal arts department. Students reported that team-based learning was a positive experience that increased their intellectual interest, the value of applying knowledge, the importance of teamwork, and improved their proactive attitude and self-confidence. A review of the literature on the effectiveness of team-based learning revealed that effectiveness can be divided into academic, affective, and behavioral outcomes. Academic TBL is recognized as an educational method that engages individual learners in learning even in large classroom situations while enhancing learners' competencies required by the times (Ha, Chaeyeon, & Lee, Sooyoung, 2014).

In addition, the variable of interest in this study is professor trust. professor trust is an emotional connection with students and an attitude of caring, understanding, and concern, and higher levels of faculty trust have been shown to increase learning motivation and student academic satisfaction, improve grades, and positively affect major satisfaction and persistence. In other words, the sense of connection and intimacy between professor and students has a meaningful impact on college students' social adjustment. University is a place where professors and students interact in academics based on mutual trust, and mutual trust is essential. The degree of intimacy that college students feel toward their instructors can play a positive role during college life when they are adapting to the social environment of college and learning knowledge skills and attitudes for entering the workforce.

Therefore, the purpose of this study was to design and apply a liberal arts course centered on team-based project learning for solving practical problems and to check the changes in professor trust, class participation, and learning motivation.

The following research questions were set for the purpose of this study.
First, does TBPL change students' trust in their professors?
Second, does TBPL affect students' class participation?
Third, does TBPL affect students' motivation to learn?

Research Methods

Research subjects

The participants in this study were students in a liberal arts course at a four-year private university in City G in the second semester of 2023. The course was designed to develop students' study skills and had 26 students, 18 males and 8 females. They had never taken a team-based project class in college before. Of the 26 students, 24 of them participated in the project-based team-based learning, except for two who did not participate in the class from the beginning, and the data in this study are from 20 students who were matched in all pre- and post-test data. After enrolling in the course, they were given an orientation on the teaching methods and assessment methods. The final analysis included 13 male and 7 female students, with the largest number of sophomores (10), followed by 7 freshmen and 3 juniors. The majors of the students were humanities and social sciences and engineering and nature, with 6 students each, 5 students in culture and industry, and 3 students in arts and culture.

TBPL Process

The self-study consulting liberal arts class in the second semester of the 2022 academic year was designed and operated as follows. The specific class operation is as shown in <Table 1>. he participants in this study were students in a liberal arts course at a four-year private university in City G in the second semester of 2023

Table 1
TBPL-based coursework

Class Sessions	Lesson content
Weeks 1 – 4	Pair work during lecture class, TBL lesson guides
Week 5 (TBPL 1)	Team building (determine team name, roles, ground roles, share with class)
Week 6 (TBPL 2)	Goal setting (individual and team work and sharing)
Week 7 (TBPL 3)	Creating portfolio titles, individual and team work and sharing, global sharing
Week 8	Midterm (Formative Instructional Consultation Survey)
Week 9-10	Time Management (PBL) (individual and team work and sharing, reflective journal)
Week 11 (TBPL 5)	Attention (PBL) (individual and team work and sharing, reflection journals)
Week 12 (TBPL 6)	Reading and Writing (PBL) (individual and team work and sharing, reflection journals)
Week 13 (TBPL 7)	Giving Effective Presentations (PBL) (individual and team work and sharing, reflection journal)
Week 14	Portfolio Presentation and Assessment Round 1 (self-assessment, peer assessment)
Week 15	Portfolio Presentation and Assessment Round 2 (self-assessment, peer assessment)
Final Assignment	Final Exam

Measurement tools

Professors trust scale To measure faculty trust, we utilized Park's (2009) Faculty Trust Scale. In this instrument, the faculty trust construct consists of four sub-factors (rapport, professionalism, teaching ability, and leadership) and is a 27-item 5-point Likert scale. The Cronbach's alpha for this instrument was .921 pre-test and .861 post-test.
Class participation scale To measure class participation, we used the 'Learner's Class Participation Measurement Tool' developed and validated by Cha, Min-Jung et al. This scale is composed of five factors: class preparation (2 items), class activity (4 items), class extension (3 items), expression (4 items), and class enthusiasm (2 items). The scale's internal consistency was .912 pre-test and .858 post-test.
Learning motivation scale To measure motivation to learn, we used the ARCS instrument created by Keller and adapted by Lee et al. The scale is a 5-point Likert scale with a total of 20 items, including attention (4 items),

relevance (5 items), confidence (6 items), and satisfaction (5 items). Intrarater agreement was .953 pre- and .927 post-test.

Analysis Methods

A paired sample t-test was conducted to analyze the difference between pre- and post-class trust, class participation, and learning motivation.

Results

The study examined changes in professor trust, class participation, and learning motivation from pre- to post-TBPL. Here are some of the findings

Table 2
Professor trust before and after TBPL activities

Factors	*M*±*SD*		*t*	*p*
	pre	post		
Rapport	4.38±.43	4.70±.37	-3.526*	.002
Expertise	4.42±.48	4.70±.37	-2.923*	.009
teaching ability	4.58±.46	4.85±.31	-2.491*	.022
Leadership	4.15±.67	4.62±.46	-3.329*	.004
Total	4.01±.41	4.72±.31	-7.428*	.000

*p<.05

To examine the difference in professor trust before and after the TBPL activity, we conducted a paired samples t-test and found that post-test scores were significantly higher than pre-test scores for all of the professor trust subfactors: rapport, expertise, teaching ability, and leadership.

Table 3
Class participation before and after TBPL activities

factors	*M*±*SD*		*t*	*p*
	pre	post		
Class expressing	2.67±.77	3.20±.54	-2.268*	.035
class activity	3.93±.81	3.96±.80	-.206	.839
class extending	2.68±.78	3.16±.52	-2.271*	.035
class preparation	2.65±.96	3.07±.63	-1.548	.138
class enthusiasm	3.92±.71	4.25±.80	-2.557*	.019
total	3.17±.62	3.53±.46	-2.681*	.015

*p<.05

To examine the difference in classroom engagement before and after the TBPL activity, a paired samples t-test was conducted, and the post-test scores were significantly higher than the pre-test scores for the sub-factors of classroom engagement: expressing, extending, and enthusiasm.

Table4
Learning motivation before and after TBPL activities

factors	*M*±*SD*		*t*	*p*
	pre	post		
attention	4.03±..77	4.46±.43	-3.216*	.005
relevance	3.89±.66	4.16±.49	-1.927	.069
confidence	3.69±.88	4.05±.51	-2.115*	.048
satisfaction	3.88±.82	4.47±.59	-3.364*	.003
total	3.87±.72	4.23±.44	-2.661*	.015

*p<05

To examine the difference in motivation before and after the TBPL activity, we conducted a paired samples t-test and found that the post-test scores were significantly higher than the pre-test scores for the motivation subfactors of attention, confidence, and satisfaction.

Discussion

This study confirmed that the implementation of TBPL had a positive effect on college students' trust in their professors and their engagement and motivation in class. These results suggest the necessity of implementing learner-oriented instructional practices such as TBPL to improve college students' class participation and motivation.

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Challenges for New Tutors in Writing Center: Focus on Initial Training Period

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In this paper, we focus on the problem diagnosis, one of the tutoring skills that we aim to develop in training new tutors and analyze specifically the challenges that new tutors at the Writing Center face during the initial training period. Tutor training is important in the operation of Writing Centers. Among the training programs, few studies focused on the initial training period. Thus, in this paper, we analyzed what problems new tutors face in the early stages of their employment. The data analyzed are the records of the initial training from April 2023 to May 2024. The analysis results identified that the problems many new tutors face in problem diagnosis are "Insufficient information gathering" and "Inability to identify the issues."

Keywords: Writing Center, Tutor, Initial Training, Problem Diagnosis

Introduction

In this paper, we analyze the challenges that new tutors face with problem diagnosis during their initial training period at the Writing Center.

Writing Centers are being established in colleges to help students develop their writing skills as part of academic support. Writing Center operations often rely heavily on research and practices from American writing education. However, directly applying practices grounded in American academic culture to other countries' contexts is usually challenging, as it fails to account for the linguistic and cultural nuances specific to each region, and there is an increasing demand for international research on writing center practices (Santa, 2009).

In the operation of the Writing Center, training tutors who support students is important, and a various training programs are provided, including initial and ongoing training. In addition, when undergraduate or graduate students are employed as tutors, it is common for tutors to go through an initial training period before they become independent, which means that the tutor can handle sessions on his/her own. Initial training should provide tutors with sufficient expertise to effectively work with a broad range of students in a variety of writing situations: discussion of academic writing conventions and strategies for working with discipline-specific papers and genres; activities to help tutors respond appropriately to student diversity; and discussion of interpersonal skills, such as body language and strategies to begin a session (Boehm, 2009).

In Japan, some research has been conducted on the training and development of Writing Center tutors. Ota et al. (2012) and Nakatake (2017) studied on the development of tutors during their employment period. Among studies focusing on the initial training period, Ota et al. (2013) analyzed what new tutors are aware of during their training, based on worksheets completed by new tutors. However, research focusing on the initial training period has often concerned the development and awareness of the new tutors, and the challenges that new tutors face during the initial training period have yet to be adequately discussed. Thus, the authors are conducting a study to identify new tutors' challenges during the initial training period to design effective tutor training methods. In a previous study, an analysis of challenges faced by new tutors in an exploratory approach revealed that "problem diagnosis and goal setting" and "use of tools and notes" were identified as two common problems faced by many new tutors (Fukuyama et al., 2024).

Problem diagnosis is an activity in which, at the beginning of the session, the tutor reads an essay brought by the student and locates problems (Sadoshima et al., 2014). Tutors will use the results of this problem diagnosis to set goals and proceed with the session. Therefore, new tutors need to be able to conduct problem diagnosis properly to become

independent. Thus, in this paper, we analyze the problems faced by new tutors in the Writing Center, focusing on problem diagnosis among the tutoring skills that we aim to develop in the initial training.

Research Design & Methods

The subjects of this study are 13 of the 15 new tutors employed from April 2023 to April 2024 at Writing Center of Kwansei Gakuin University, who received initial training and progressed to "role-playing training" and "on-the-job training", for which training observation records remained. All new tutors during the study period were master's and doctoral students. The training process for new tutors after they have employed is as follows. First, new tutors attend a classroom-style tutorial to learn about the philosophy and practice of the Writing Center. Then they observe two sessions of experienced tutors. After observation, they go through several "role-play training" in which they simulate mock sessions with the experienced tutor playing the role of a user. On successful completion of the "role-play training", the tutors then undergo several "on-the-job trainings" in which they conduct sessions with real users, with the support of their experienced tutors. Depending on how well the training is going, additional "problem diagnosis and goal setting" training may be offered during the "role-play training" and "on-the-job training." In "role-play training" and "on-the-job training," experienced tutors and staff provide feedback and reflection after each training session, using a sheet known as an "observation sheet" to record practice that new tutors lead.

The data collected in this study were these "observation sheets" and the "training progress records" that the Writing Center staffs recorded after each training. The data collection period was from April 2023 through May 2024 and 195 "observation sheets" and 88 "training progress records" were collected. By analyzing the challenges of new tutors noted in these two types of training records, we examine the challenges that new tutors in the Writing Center face regarding problem diagnosis.

The steps of the analysis are as follows. The first author coded for the statements in the "observation sheets" and "training progress records" regarding problem diagnosis. Then, the authors compared the relationships between the codes and generated categories. The categories are denoted by【】and the codes by [ ] below.

Results and Discussion

As a result of the analysis, five codes and three categories were generated for the challenges of problem diagnosis (Table 1). We found that there are three challenges for new tutors during problem diagnosis: 【Insufficient information gathering】, 【Inability to identify the issues】, and【Reading strategy】. Of these, 【Insufficient information gathering】and【Inability to identify the issues】 were considered more common challenges for new tutors, as more than 11 out of 13 new tutors were pointed out. Thus, in this paper, we analyze and discuss【Insufficient information gathering】and【Inability to identify the issues】. The discussion will be based on specific descriptions in the "observation sheets" and "training progress records".

Table 1

Results of the analysis on the challenges in the problem diagnosis

Categories	Number of tutors in the categories (N13)	Codes	Number of tutors in the codes (N13)
【Insufficient information gathering】	11	[checking information on essays]	11
【Inability to identify the issues】	12	[Failure to recognize problems of the essay]	12
		[Failure to recognize the students' issues]	7
【Reading Strategy】	5	[Not taking sufficient time to read]	2
		[Taking too much time to read]	5

【Insufficient information gathering】

【Insufficient information gathering】is caused by the lack of [checking information on essays]. 11 new tutors have been noted. [Checking information on essays] relates specifically to the failure to ascertain and confirm the situation and the characteristics of the essay brought in at the beginning of the session where problem diagnosis taking place.

The essays students bring to the Writing Center are characterized by the class's discipline, the lecture's content, the purpose of the assignment, the evaluation criteria, etc. It is important to check information about the essays when conducting problem diagnosis at the beginning of the session, as the situation will dictate the session's goals.

According to the specific descriptions in the "observation sheets" and the "training progress records," we propose the following three factors can be considered as causes of 【Insufficient information gathering】 for new tutors: an excessive focus on the text, less assumption that there are various types of essays, and less recognition that sessions vary in content depending on the characteristics of the essay and the student's situation.

The first factor is that new tutors are only focused on the text. The essays that students bring to the Writing Center are composed of many factors: the writer, the faculty member who gave the assignment, the content of the class, and the requirements of the assignment. In problem diagnosis, tutors must consider the totality of these aspects as they explore the issues that will be addressed during the session. However, new tutors are likely to concentrate on reading the text in front of them and searching for problems in the text rather than on the various elements that comprise the essay.

The second factor is that new tutors may not have the assumption that there are various types of essays. Essays vary in format and content depending on what the faculty member require of the students and what they want to assess (Naruse, 2020). Some essays are simply a summary of the class content or a summary of the research, and do not necessarily require the student to formulate a question and cite evidence to make an argument. New tutors, however, have limited exposure to such various patterns of essays. In addition, during initial training, argument-type essays are often used as samples in anticipation of the graduation thesis support. Hence, new tutors are likely to perceive argumentative essays as a template for essays. Thus, the new tutors seem unaware of the need to check general information of an essay because of their limited experience and knowledge of the types or characteristics of essays.

The third factor is that new tutors may not recognize that the content of the session depends on the characteristics of the essays and the student's situation. As mentioned above, the support provided during the session differs depending on the characteristics of the essay. In addition to that, the content covered in the session will also vary depending on the submission date. For example, if an essay is due in two weeks, we often provide fundamental support from the outline of the overall structure and logic, because the student has time on revisions. However, if the submission date is tonight, the tutor will also offer advice on how to write a better essay next time, as drastic changes cannot be made. New tutors are thus unaware that the content covered in a session depends on several factors. New tutors are thus unaware that the content covered in a session depends on several factors. Therefore, they could have forgotten to check information about the characteristics of the essay and the student's situation.

【Inability to identify the issues】

【Inability to identify the issues】 caused [Failure to recognize problems of the essay] and [Failure to recognize the students' issues]. 12 new tutors have been noted.

[Failure to recognize problems of the essay] is a point about missing essential issues in the text or focusing only on specific issues and overlooking others. New tutors can notice mistakes in the formal aspects that are obvious at first glance, such as incorrect citations. Yet they tended to miss pointing out the thematic or overall structural problems.

[Failure to recognize the students' issues] is the challenge of failing to recognize the students' fundamental problems that lead to errors in writing. Since the goal of the Writing Center's assistance is "to produce better writers, not better writing" sessions that only make corrections are inadequate. Therefore, tutors must be aware of the fundamental issues that students don't know or understand during problem diagnosis. New tutors are often unaware of the problems in the knowledge and ability of the students as writers.

Of the challenges related to 【Inability to identify the issues】 for new tutors, [Failure to recognize problems of the essay] was often pointed out in their first role-playing training. This challenge results from new tutors in the early stages of training not yet capable of organizing the kinds, locations, and severity of the issues. Although since improvement in this challenge is seen as the training progresses, this leads to the assumption that the additional training that is currently provided and the session support materials for the tutors are working effectively. Conversely, [Failure to recognize the student' issues] was not always solved during the training, and the trainers' comments only encouraged further awareness. This challenge could be due to two things: an excessive focus on the text, and unawareness of empathizing with students.

As mentioned in [Insufficient information gathering] above, an excessive focus on the text is a challenge caused by the new tutors' concentration on reading the text in front of them and searching for problems in the text. New tutors could be considered less conscious of the writer's own abilities and knowledge that caused the errors. New tutors keep in mind the concept of "to produce better writers, not better writing," which was taught on the first day of training. However, they may have become more concerned with how to improve the essay itself, than with the student's development in the long term, when they do the mock session or actual sessions.

The second factor is the unawareness of empathizing with students. All the tutors in this study are graduate students, who have knowledge and experience in academic writing to some extent. Also, tutors are used to the academic communication in graduate school that they have with other researchers and graduate students. While students as users, lack such knowledge and experience. In Japan, most of the writings in primary and secondary education were impression essays and short essays for entrance exams (Kasuga et al., 2021), and several students are required to write their first argument-based essay on objective facts and data when they first enter college. Even in this situation, new tutors may communicate in an academically to students as well, without considering the knowledge and abilities of students who are beginners.

Conclusion

In this paper, we analyze the problems that new tutors face with problem diagnosis during their initial training period at the Writing Center. As a result of the analysis, we found three challenges: 【Insufficient information gathering】, 【Inability to identify the problem】, and 【Reading strategy】. Especially, [Insufficient information gathering] and [Identification of problems] appeared as challenges that many new tutors had to deal with. Factors leading to 【Insufficient information gathering】included excessive focus on the text, limited experience and knowledge of the types of essay, lower concern about the flexibility of the session. 【Inability to identify the problem】could result from an excessive focus on the text and unawareness of empathizing with students, while the effectiveness of the training programs and materials currently being used was also implied. In this analysis, excessive focus on the text was a common factor in 【Insufficient information gathering】and 【Inability to identify the problem】that many new tutors were noted. In tutoring, the goal is "to produce better writers, not better writing" Therefore, tutors need to provide support, like scaffolding, to compensate for the knowledge and abilities that the student lacks. However, new tutors seemed to focus only on looking for problems in the writing, not on the factors composing the essay or the writer's issues. Accordingly, in the initial stages of employment, it is necessary to devise methods to help tutors become aware of the various elements that constitute an essay and the writer's issues during problem diagnosis.

In this study, we only analyzed the challenges related to problem diagnosis and discussed the factors that contribute to these challenges. To further clarify the factors that cause challenges related to problem diagnosis, it is also necessary to analyze how new tutors perform problem diagnosis. In addition, clarifying the process of how new tutors resolve problem diagnosis challenges during the initial training period would help to devise an effective training method.

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Effect of the Division of Labor in Narrative Creation on Question Generation

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DSTO (Digital Storytelling for Observation) was developed as a learning program to support problem finding and question generation in story creation (Kawai & Watanabe 2023). DSTO allows users to experience question generation while interviewing others' stories and producing Digital Storytelling. The program was designed through cognitive apprenticeship (Modeling, Coaching, Scaffolding, Fading) and embedded semi-structured interviews to create stories of others. As scaffolding to increase opportunities for observation, semi-structured interviews were experienced in rotation in four roles: narrator, fundamental interviewer, exploratory interviewer, and narrative creator. Analysis of the free-response statements to reflect on each role suggests that the experience of the division of labor in creating other people's stories extended beyond the scope of the activity and influenced the quality of the questioning activity.

Keywords: Media Literacy, Narrative Creation, Question Generation, Digital Storytelling, Division of Labor

Introduction

Narrative & Narrative Creation

We are surrounded by narratives. A narrative represents a real or fictional event conveyed from a narrator to a listener (Prince 1987). Branigan (1992) also describes a narrative as an organization of experience that integrates aspects of spatial, temporal, and causal perception. Creating narratives is a way of expressing our experiences and desires of the world in an intelligible way and a fundamental way of integrating experienced events as data (Branigan 1992). He describes narrative schema as consisting of eight components: abstract, orientation, initiating event, goal, complicating action, climax and resolution, epilogue, and narration. Deliberately narrating and re-memorizing one's life is considered to be a fundamental way of personal development and a basic method of education (Clandinin 1990).
Narratives are a form of media, and in the context of media literacy, analyzing and creating narratives is said to contribute to the development of critical thinking skills (Masterman 1985).

As one of the problems in the media activity of creating narratives, Mitoh (2021) points out that it is difficult to find a subject matter to write about. Difficulties in determining the subject have also been reported in report writing research, where support has been provided to help students discover, refine, and set problems (Suzuki & Sugitani 2012).
Inquiry-based learning, which includes problem finding activities, is said to be impossible without critical thinking and question generation (Oyama 2020). Observation and experimentation are said to be effective in generating questions, and interviewing activities, including critical observation, are important processes in creative activities. According to Linda (2010), skilled writers conduct interviews to determine the subject matter. The subjects of their interviews range from television news and newspapers to events that have happened to acquaintances and themselves. This is thought to be the result of interviews, observation, and collection from multiple perspectives by skilled writers, which they utilize in their writing.

Observation & Question Generation

Observation through interviews is considered necessary to determine the subject of the story. Observation, according to Beveridge (1957), is an active mental process rather than passive looking. He points out that to make original observations, it is necessary not only to concentrate on the main points but also to pay attention to the surrounding areas. The act of observation includes not only the discovery of what is visible but also the investigation of what is invisible.

Observation is considered to be an elaboration process to deepen understanding of the subject, and there are many findings in question-generating research in the field of psychology regarding the perspective of observation on what to carefully observe in a subject (King 1995).

According to Anzai (2020), questions trigger creative dialogue and have the effect of generating new and different questions. In the context of media literacy, The National Association for Media Literacy Education (2021) has identified ten categories of reflective questions to be used when analyzing media messages: author, purpose, economy, effect, response, content, technology, interpretation, context, and reliability. From there, it can be said that whether the object of observation is a painting or mass media, dialogue and observation start with the questions. It is also suggested that the questioning facilitates more elaborate observation to generate new questions. Question generation is done to match newly acquired information with prior knowledge, to resolve feelings of discomfort and confusion felt when differences are perceived, and to gain new understanding (Ikuta 2005). Dillon (1998) proposes four processes in question generation (experience of perplexity, asking a question, answering, and conjunction) and focuses on question triggering and collaborative learning as the learning environment that facilitates question generation. Michita (2011) points out the importance of increasing opportunities for questioning behavior, such as being asked questions, asking questions, and observing questions, to develop question generation skills.

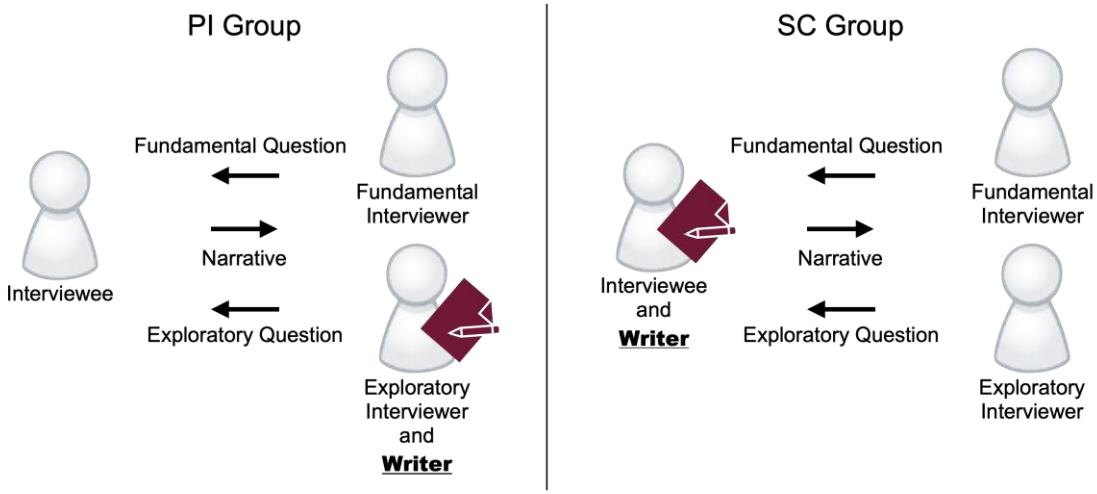
DSTO

For beginners in narrative writing to determine the subject matter, it seems necessary to have an observational perspective and experience in questioning. DSTO (Digital Storytelling for Observation) is a lesson design for developing question generation skills (Kawai & Watanabe 2023).
DSTO is a digital storytelling activity that aims to improve the question generation skills of observers by listening to the narratives of others, conducting semi-structured interviews with the narrators, collecting information, and creating a story. DSTO was developed as a learning program to support problem finding and question generation in narrative creation. Digital Storytelling is a media activity that produces self-revelatory short films that combine life stories, self-voices, photographs, and music (Lambert 2018).

DSTO uses cognitive apprenticeship, semi-structured interviews, and division of labor as design principles to develop question generation skills. Cognitive apprenticeship is an instructional design that aims at proficiency in cognitive processes and includes modeling, coaching, scaffolding, and fading (Collins 1991). Semi-structured interviews allow participants to experience question generation. The division of labor in DSTO is designed as scaffolding to increase opportunities for observation, with participants experiencing the roles of narrator, fundamental interviewer, exploratory interviewer, and narrative creator in rotation.

Kawai & Watanabe (2024) reported that learners who experienced DSTO improved their ability to ask self-reflective questions about creation. However, they did not examine how the experience of division of labor affected the quality of question generation. Kato (2004) reported that the division of labor in collaborative problem-solving situations is frequently used as a form of scaffolding, but the boundaries are blurred, and improvisational adjustments are often made. This study aimed to examine how the experience of division of labor in DSTO affects question generation.

Figure 1
Differences in the division of labor between PI and SC groups



Research Design & Methods

We surveyed 280 students from high schools in Tokyo (40 students per class and seven classes in total). The four classes conducting DSTO were designated as the PI (Peer Interview) group. The three classes conducting conventional DST were designated as the SC (Story Circle) group. Both groups have four roles: narrator, fundamental interviewer, exploratory interviewer, and narrative creator. The narrator talks about their experiences using pictures they have prepared themselves as subjects. The fundamental interviewer asks the narrator basic questions about the narrator's experiences using a list of questions; when, where, who, and what did they do? The exploratory interviewer observes the interaction between the narrator and the fundamental interviewer and asks additional exploratory questions. Exploratory questions are, for example, asking for details of the content or reasons for actions. The narrative creator creates a story based on the content of the interviews. The difference between the two groups is the subject of the interviews. In the PI group, the exploratory interviewer interviews the narrator and creates the narrator's story. In the SC group, the narrator interviews herself and creates her own story. The Participants took on four roles in rotation, and all experienced all roles (**Figure 1**). They created a narrative of approximately 800 words. Informed consent was given to all participants in practice.

The study aimed to examine whether the division of labor, one of the design principles of DSTO, scaffolds question generation. After implementation, all participants were asked to write freely about each role they experienced in the division of labor. The three lead statements in the free-response statements were:

(1) Recall your experience as an interviewer. Describe your impressions, learnings, and realizations about the activity of listening to and questioning the narrator.
(2) Recall your experiences as a narrative creator. Based on the information obtained through the storytelling and questioning, write down your impressions, lessons learned, and observations about the activity of creating a story.
(3) Recall your experiences as a narrator. Write down your impressions, lessons learned, and realizations about the activity of narrating and being questioned about your experiences.

Results & Discussion

A total of 150 participants who took part in all stages of the practice and had no missing values in the pre- and post-questionnaires were included in the analysis. The three main characteristics obtained from the analysis of the free-response statements were:

1. They adjust their work content according to the division of labor.
2. The experience of rotating the division of labor enables them to reflect on their work and to notice differences in their roles.
3. Division of labor encourages the elaboration of work. On the other hand, dual employment crosses role boundaries and adjusts the work content.

Adjustment of Own Work

D122: I listened to the narrator's story in detail to ask questions that were good for the narrator and the other questioners.
B107: When I saw that others were asking for information, no matter how small, I felt that I should listen to what I wanted to hear in detail, even if it was not directly relevant.

These responses are examples of observing the work of others and adjusting the content of one's work.

Reflection by Rotation Work

F51: When I was an exploratory interviewer, I was more of an observer, so I could ask a lot of questions, but when I was a fundamental interviewer, I was more rigid and couldn't ask flexible, simple questions.

This is an example of how the experience of different roles has led to a perception of the characteristics of the roles and, consequently, to reflection.

Elaboration Work

B105: I realized that when I listened to others' stories, I should take note of what I thought was more interesting and ask questions. I realized the importance of organizing the questions asked by others and the narrator's story to understand the timeline.

C38: I focused on how to ask questions to get what I wanted to know to create a story and how to ask questions that the narrator could easily answer.

This is an example of observing the work of others and discovering strategies to improve the accuracy of one's questions. On the other hand, taking on multiple roles was found to mix and transform the work content. From there, the experience of the division of labor, including the opportunity to observe the behavior of others, can provide a scaffold for question generation.

Conclusion

This paper investigates the influence of the design of the division of labor embedded in DSTO on question generation. Analysis of the free-response statements revealed that a division of labor elaborates question generation in narrative creation. It was also suggested that the overlapped labor enhances the link between narrative creation and question generation. Future research will examine the relationship between different interview subjects, the division of labor, and question generation.

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Impact of video material on modeling teachers' strategies for writing historical reasoning texts for students' mastering the strategies: comparison with printed materials

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In history education, the ability to write historical reasoning texts has long been emphasized, with much research on teaching methods using materials and frameworks. However, limited studies have focused on effective strategies for teaching descriptive text writing in summative assessments. This study tested the hypothesis that video recordings of teachers solving writing problems would promote better learning of historical reasoning strategies than printed materials. The experiment involved two high school senior classes divided into control (printed material) and experimental (video material) groups. Results showed no significant difference in step count, but the experimental group had greater character length and more detailed strategies, suggesting video materials may aid in learning strategy details.

Keywords: video materials, modeling, history education, writing

Introduction

The development of historical thinking has long been important in history education. For example, Boxtel & Drie (2018) proposed a framework of historical reasoning, which points to the importance of analyzing historical continuity and change, cause and effect, and similarities and differences. Such historical thinking is also emphasized in Japanese high schools. University entrance examinations now also include tests that require students to write texts on historical reasoning. For example, in the USA, there is one form of university entrance examination, the Document-based Question. In this test, students respond to a historical reasoning task in writing while dealing with several historical sources, and it does not include much knowledge recall. On the other hand, in Japanese university entrance examinations, it is common to present no or little historical sources and ask students to discuss them while recalling their knowledge, and high school students are also trained in this format. In this study, the following discussion assumes the learning of the latter writing strategy in the Japanese context.

Two main types of teaching materials can help students learn how to write answers to such tests: one is the written explanations of the written tests in reference books. The other is for the teacher to demonstrate and explain what the process of writing answers is. The latter was often done in face-to-face classes (Leinhardt, 2000), but it has been made into a video and distributed in recent years. Considering the theory of cognitive apprenticeship (Collins *et al.*, 1987), it is conceivable that video materials that are subtitled and can be reviewed many times may be more effective in learning the strategies.

However, no studies have examined the differential effects of paper and video media on teaching materials for learning strategies for writing historical reasoning texts. As almost all students in Japanese high schools have smartphones, investigating whether video materials are more conducive to the learning of historical writing strategies would provide important insights into the learning environment in history education. Therefore, this study tested the hypothesis that video recordings of teachers solving writing problems would promote better learning of historical reasoning strategies than printed materials.

Methods

Subject of the experiment and theme setting for the argumentative test

The experiment was conducted with third-year students at High School A in Tokyo, Japan. This high school is of average academic standing, with 80-90% of its students attending university each year. All students were also taking Japanese history, and the second author, with 12 years of teaching experience, taught the class. At this high school, the

Japanese history students were divided into two classes with students divided by similar academic ability. Therefore, an experiment was conducted in the classes in which students were required to solve a history argumentative test after a curriculum that taught the financial policies of Okitsugu Tanuma (a politician) during the Edo period in Japan. Specifically, the X class (42 students) on 26th September 2023 was set up as a control group using paper materials, while the Y class (41 students) on 28th September was set up as an experimental group using video materials.

Next, we chose an argumentative test for the 2020 university entrance examination of Kyoto University in Japan on the theme of the financial policies of Okitsugu Tanuma during the Edo period in Japan. Specifically, the question was: ' Write about the basic policy and specific policies of Okitsugu Tanuma's financial policy, focusing on the differences with the Kyoho Reforms'. The question asks for an answer of no more than 200 characters. In Japan during this period, fiscal difficulties persisted, and after the financial policy known as the Kyoho Reforms, which was carried out by the ruler (Yoshimune Tokugawa) in the early 1700s, another financial policy was carried out by the ruler (Okitsugu Tanuma) in the early 1700s. These financial policies had different features and different results. Therefore, they are historical events that have attracted much attention in Japanese history. Historical reasoning in Boxtel & Drie (2018) also emphasizes reasoning about similarities and differences, and the test can be positioned as a test for this type of reasoning.

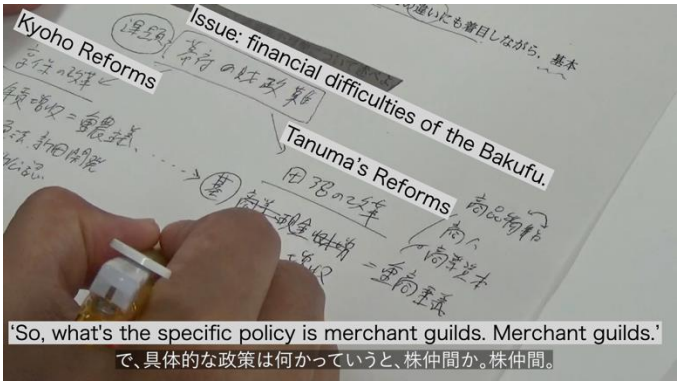
Video and paper materials explaining strategies for answering argumentative tests

The video material explaining how to answer the argumentative test was created using the following procedure. First, the Japanese history teacher of the class videotaped the solving the test. The solution process was visualized by asking the teacher to speak about what he was focusing on or thinking about while solving the test. In the scene where he was drafting before writing his answer, we filmed him so that we could also show what and how he wrote in the draft (Figure 1); in the scene where he was writing a 200-word solution, he only uttered the sentence he was trying to write. Therefore, the video was edited with subtitles for the 5-minute 20-second video before he started drawing his answers. As a continuation of the video, we included a 15-second image of the solution sentences written by the teacher and the notes he had written during the conception. Next, three questions were asked in response to parts of the thought utterances where the reasons were unclear, to visualize the teacher's thinking in more detail. Specifically, we asked: 'Why did you decide to start drawing from the issue background?', 'Why did you decide to use the term commodity crops in addition to mercantilism?' and 'Why did you decide to write about trade in Nagasaki? How do you remember Okitsugu Tanuma's reforms structurally?'. The teacher's replies, which lasted approximately 2-minute 47-second, were also made into a video with subtitles. The resulting video was 8 minutes and 22 seconds long. The number of characters in the teacher's utterances was 1055. On the other hand, the paper material explaining how to answer the argumentative test was prepared according to the following procedure. First, the text was prepared by referring to commercially available reference books describing explanations for this question, so that there would be no excesses or deficiencies with the content of the video material. The structure of the paper materials consisted of a draft answer sheet, followed by an explanatory text on the writing strategy. The number of words was 993.

The similarities between the two materials were that they referred to the following four points: first, grasping the problem statement; second, recalling knowledge; third, reasoning on the problem; and fourth, planning the answer text. The second, the content of the knowledge to be recalled, was adjusted so that the content was the same in both materials. As there are no major differences in the number of characters, the content in both materials can be regarded as common. The differences between the two materials are that the video material visualizes the chronological thinking process, includes a draft structure diagram written by the teacher, and also visualizes the thinking behind why he focused on such a point of view in the first place. In other words, the video material is unique in that it emphasizes the realistic thinking processes involved in actually answering argumentative tests.

Figure 1

A scene from the video material



Experimental procedures and evaluation methods

The experiment was conducted in the following sequence. First, the class was introduced (5 min). Next, the students were given this argumentative test and asked to write their answers (10 minutes). They were then given time to learn how to answer this argumentative test (10 minutes). In the experimental group, the video material was made available on the web for students to view on their smartphones; in the control group, the paper material was distributed for students to read on their own. Both groups were asked to supplement their knowledge by referring to the textbook. After that, they were asked to answer the questionnaire described below (7 min). The students were then shown the paper material in the experimental group and the video material in the control group, to ensure that there were no differences in learning between the two groups (8 minutes). Finally, the teacher gave a summary of how to solve the argumentative test (5 min). The questionnaire asked students to 'Think about what you find effective to do before you start writing your answer to the argumentative test, and divide the steps into as many details as possible and write them down specifically in the numbered order in the following columns. (e.g. "Focus on ~ in the question text", "Write down ~", "Recall ~", etc.). Please do not review any explanatory material that you have looked over immediately before. It is not necessary to fill in all the columns. If a column is missing, please add it yourself.' The students were given a printout with the instructional text. The answer columns were numbered 1 to 10.

The evaluation was conducted from three perspectives. The first was an analysis of whether there was a difference in the number of steps answered. The second was to analyze whether there were differences in the length of the characters answered. The analysis of the number of steps and characters was also analyzed in four categories. The third was text mining to analyze whether there were differences in the number of words written.

Results

Data were collected from 38 respondents from Class Y using the video material and 37 respondents from Class X using the paper material. First, the difference in the number of steps in the answer strategy of the argumentative test was analyzed, as shown in Table 1, with a mean of 5.24 (*SD*=1.30) for the video material and 4.92 (*SD*=1.62) for the paper material. The results of the Student's *t*-test showed no significant differences between the two groups. Furthermore, when the differences in step counts by the four categories were analyzed using Student's *t*-tests, a significant trend was found only in the number of steps in grasping the problem statement.

Next, the difference in the length of words of the answer strategies for the argumentative test was analyzed, as shown in Table 2, with a mean of 108.11 (*SD*=27.00) for the video material and 87.16 (*SD*=43.12) for the paper material. Welch's *t*-test results showed a significant difference between the two groups (p=0.01). Furthermore, when the Student's *t*-test was used to analyze differences in the word length of the answer strategies for each of the four categories, only the word length of grasping the problem statement showed significant differences (p=0.05).

Table 1

Results of analysis of the step counts of the strategies

	Video Material		Printed Material					
	Ave	*SD*	Ave	*SD*	*t*	*df*	*p*	
Total amount	5.24	1.30	4.92	1.62	0.94	73	0.35	
Grasping the problem statement	1.03	0.64	0.73	0.84	1.73	73	0.09	†
Recalling knowledge	2.13	1.17	2.03	0.87	0.44	73	0.66	
Reasoning on the problem	0.82	0.77	0.97	0.76	-0.89	73	0.38	
Planning the answer text	1.26	1.22	1.19	0.94	0.29	73	0.77	

† p <.10

Table 2

Results of analysis of the length of the characters of the strategies

	Video Material		Printed Material					
	Ave	*SD*	Ave	*SD*	*t*	*df*	*p*	
Total amount	108.11	27.00	87.16	43.12	2.51	60	0.01	**
Grasping the problem statement	21.53	17.44	13.11	15.90	2.18	73	0.03	*
Recalling knowledge	44.74	25.31	38.38	20.19	1.20	73	0.23	
Reasoning on the problem	18.92	19.69	18.22	15.5	0.17	73	0.86	
Planning the answer text	22.92	24.28	17.46	19.52	1.07	73	0.29	

* p <.05, ** p <.01

In addition, text mining of the experimental group using video materials and the control group using paper materials was carried out to list the top 10 most frequent words for nouns and verbs (Table 3). The overall trend shows that the same words tend to occur more frequently in the classes using the video material, even if they are the same words. 'Ask' was also identified as a verb that appeared three times more frequently in the experimental group using video materials, despite the word being included in both materials.

Table 3

Results of text mining analysis of the content of the strategies

Video Material (N=38)

noun	N	verb	N
Policy	60	Write	89
Specific	35	Recall	25
Guideline	34	Think	17
Fundamental	29	Ask	12
Finance	23	See	9
Issue	14	Read	9
Background	14	Listen	8
Era	13	Differ	6
Content	8	Find	5
Term	6	Perform	5

Printed Material (N=37)

noun	N	verb	N
Policy	51	Write	64
Finance	21	Think	31
Guideline	21	Recall	29
Content	13	Differ	6
Specific	12	Discover	6
Text	8	Perform	6
Fundamental	7	Read	5
Condition	4	See	4
Politics	4	Come up with	4
Point	3	Ask	4

Discussion

In this section, we consider whether more students could learn the strategies in history writing by watching video materials in which the teacher's thought process was uttered, rather than teaching the strategies in history writing only in written form. First, from the results in Table 1, it can be said that there was no difference between the video and paper materials in terms of learning the steps of the strategies in history writing. On the other hand, as shown in Table 2, the number of words in the history writing strategies was significantly higher in the video material than in the paper material. Furthermore, based on the results in Table 3, it is conceivable that video materials may encourage the learning of more detailed strategies. In particular, the video material suggested that the teacher was carefully thinking and talking about his grasping the problem statement, which may have helped them to learn more about the content of the steps and strategies related to that category. These results showed no significant difference in step count, but the experimental group using video materials had greater character length and more detailed strategies, suggesting video materials may aid in learning strategy details.

A future challenge is to test whether there is a difference between the two based on more creative history argumentative tests. In recent years, more and more questions in history materials are not only based on recalling and discussing knowledge but also on presenting multiple historical sources and then writing more creative texts. It is a challenging task for the future to ascertain how effective video materials visualizing teachers' thinking are in such cases compared to paper materials.

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The Influence of HOTS-Based Learning on Critical Thinking Ability in Long Jump Sport of Class Seven Junior High School

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Abstract This study aims to determine the effect of HOTS-based learning on the Long Jump critical thinking skills of seven grade students of Junior High Schools in Tomohon City. The research design used was quasi-experimental research with a pretest posttest non equivalent group design. The population in this study were all seven grade students of Junior High Schools in Tomohon City which consisted of 2 classes. The sampling technique was carried out using a random sampling technique so that the experimental class was selected with HOTS-based learning and the control class with conventional learning without HOTS involved. The instrument used is a critical thinking ability test. The results showed that, (1) HOTS-based learning affected the critical thinking skills of students in grade seven Junior high Schools in Tomohon City, (2) there were differences in the critical thinking skills of students using HOTS-based learning models and conventional learning.

Keywords: HOTS, Critical Thinking, Long Jump

Introduction

Higher Order thinking (Ichsan et al., 2019) is the thinking ability of students who are at a higher level, in line with (King et al., 2010) high-level and complex thinking activities are a form or understanding of higher-order thinking skills or HOTS. Students who have HOTS abilities must be able to analyze, evaluate, and create innovations in problem solving. HOTS-based learning is not easy. HOTS-based learning demands high reasoning power, creativity, and unusual ways of learning. As said by (Qomariyah, 2017), that HOTS does not only require students to have competence but are also required to have skills and abilities such as communication skills, critical thinking skills, collaborative skills, and creative and innovative abilities. This is a HOTS-based learning strategy, namely problem solving is the main demand (Abdullah et al., 2015).

Juniior High schools in Tomohon City are schools that have implemented HOTS-based learning well. Even so, there are still various problems, obstacles, and challenges found related to the implementation of HOT-based learning. Among them, some equipment in schools is still lacking, lack of socialization or training regarding HOTS-based learning, some teachers have difficulty adjusting to HOTS-based learning, and from the student's point of view there are students who are not familiar with HOTS-based learning

methods. even students or students tend to memorize formulas even less involved or less active in learning so that in learning the ability to think critically is low.

Referring to the existing problems, the researcher was interested in conducting research with the title the effect of the HOTS-based learning model on students' long jump critical thinking skills in class seven of Tomohon City Junior High School with the aim of knowing the effect of HOTS-based learning on students' critical thinking skills in long jump and the average critical thinking skills of students using HOTS-based learning models.

Research Design & Methods

This study aims to identify the effect of HOTS (Higher Order Thinking Skill) based learning on the sport long jump critical thinking skills of seven grade junior high school students in Tomohon. This study uses a quantitative approach with experimental research with a quasi-experimental design: pre-test and post-test design to see the effect of HOTS (Higher Order Thinking Skill) based learning on critical thinking skills. The subjects of this study consisted of 50 grade seven students at Tomohon City Junior High School consisting of 25 students as the experimental class and 25 students as the control class. The sampling technique was carried out by using random sampling technique. Data collection was carried out through tests of students' critical thinking skills in long jump sport. The feasibility of this research instrument was then tested using the validity test: product moment and reliability using Cronbach Alpha. Data analysis was carried out quantitatively descriptively using statistical tests, namely the Anova test and the paired sample t test. Data analysis begins by carrying out an assumption test consisting of a normality test and a homogeneity test.

Results And Discussion

Testing the validity of the instrument was carried out on a test instrument for critical thinking skills in long jumps sport which consisted of 10 questions. The results of the validity test of the long jumps critical thinking ability test instrument showed that the long jumps critical thinking ability test instrument consisting of 10 question items was declared valid. Furthermore, the instrument reliability test using Cronbach Alpha stated that the reliability of the test instrument for long jumps critical thinking skills obtained a score of 0.805 in the high reliability category. This shows that this test instrument is declared reliable.

. The results of the ANOVA test obtained in the research on the HOTS-based learning model for the critical thinking skills of students in grade seven junior high school Tomohon, namely obtaining an Fcount of 34,131 and a significance value of 0.001 or less than 0.05 so that based on the decision making criteria Ha is accepted and H0 is rejected so that it can be it was concluded that there was an influence of the HOTS-based learning model on the long jumps critical thinking skills of seven grade students of junior high school Tomohon City.. One of the abilities that must be perfected in learning long jumps at school is the ability to think critically, because it is a unique thought but has a specific purpose so that when students think in a structured manner they can determine standards of intelligence and apply criteria in thinking (Diva & Purwaningrum, 2023).

The results of the paired sample t test show that there is a difference in the average or mean value between students who study using the HOTS-based learning model and students who learn using the conventional model, in the table it is described that the significance value is in the control class or class using the conventional model that is equal to 0.059 > 0.05 so that it can be concluded that there is no difference in the average critical thinking ability in long jumps sport of seven grade junior high school students in Tomohon City. Whereas in the experimental class or class using the HOTS-based learning model, the significance value is 0.001 <0.05 per week. It can be concluded that there is a difference in the

average critical thinking ability of students in grade seven junior high School in Tomohon City. Strengthened by the average or mean value of students' long jumps critical thinking skills from the control class or class using the conventional model which is equal to 66.76 while the mean value or mean students' long jumps critical thinking ability from the experimental class or class using the HOTS-based learning model is of 79.28 thus it can be concluded that learning using the HOTS-based learning model is superior to learning using conventional models.

Conclusion

Based on the discussion of the research, it can be concluded: 1) the HOTS-based learning model has an effect on the critical thinking skills of seven graders of Tomohon Junior High School 2) There is a difference in the mean value of the long jumps critical thinking abilities of seven graders of Tomohon Junior High School, namely the average or mean value in the class that uses the HOTS-based learning model which is equal to 79.28 while the control class or class using the conventional learning model is equal to 66.76. based on the average value between the control class and the experimental class it can be seen that the class using the learning model is superior in improving students' critical thinking skills compared to conventional learning models.

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Survey of university students' attitudes toward "tables" in arithmetic

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In 2020, the author conducted a survey of 273 upper elementary school students on their attitudes toward "tables" in math class, focusing on two factors: their impressions of "tables" (5 items) and the advantages of "tables" (16 items). The results showed that students, especially those who were not confident in arithmetic and those who were not good at mathematical activities using tables, did not find "tables" enjoyable. Based on this survey, the author asked 103 college students in 2024 to imagine and respond to the children's ideas about "tables" in math. The results showed that the college students' imaginations had the same impressions as the elementary school students themselves, seeing tables as "easy to understand," "convenient," "neat," and "easy," but not as "fun. It was also found that they perceive "tables" as having more usefulness than elementary school students. However, the children were found to be more conscious of using tables as a medium for expressing what they have learned and communicating it to their peers. The university students also found that although they believe that elementary school students can read information from the "Tables" and use it in "Summary," they do not seem to be able to "express the rules found in the 'Tables' in equations," "think using the 'Tables' without instructions from the teacher," and "express what is written in the 'Tables' in words and rewrite them in equations. The students were not able to express what was written in the "table" in words and rewrite them in equations.

Keywords: Table, Impression, Recognition, Thinking Tools, Expression Tools.

Introduction

A survey conducted in 2020 surveyed 273 upper elementary school students on their attitudes toward "tables" in math class. The survey focused on two factors: impressions of "tables" (5 items) and the advantages of "tables" (16 items). The results revealed that students did not find "tables" enjoyable, especially those who were not confident in math and those who were not comfortable with mathematical activities using tables. Learners also identified "tables" as an effective learning tool for problem solving. Based on this survey of attitudes toward "tables" in math classes for elementary school students and the results of the survey, this paper asked 103 second-year students in the College of Education and College of Science and Engineering who are planning to become teachers to imagine how elementary school students think about "tables" and answer the survey as if they were an elementary school student. The purpose of this survey was to see how second-year students in the Faculty of Education and the Faculty of Science and Engineering perceive elementary school students' awareness of "tables" in math classes.

Research Design & Methods

The findings on arithmetic "tables" do not fully reflect their significance in the practice using "tables" (Yada, 2020). Therefore, in order to find out what learners' impressions of arithmetic "tables" are and whether they appreciate them, we surveyed 273 upper elementary school students (grades 5 and 6) in 2020 to determine their attitudes toward "tables" used in arithmetic classes. This was done by focusing on two elements: impressions of "tables" (e.g., "fun," "easy to understand," "convenient," "neat," and "easy") and the advantages of "tables" (e.g., 16 items including "easy to organize data," "information at a glance," and "easy comparison"). In addition, the 2020 survey asked the question, "Are you good at arithmetic?" and asked for responses on a four-point scale of "1, I am not good at arithmetic," "2, I am rather poor at arithmetic," "3, I am rather good at arithmetic," and "4, I am good at arithmetic," but this question will not be addressed in this survey.

(1) Date and time
Monday, June 26, 2024 and Wednesday, June 28, 2024, for about 15 minutes during the class time from 10:30 to 12:00.
(2) Target
Second-year students of the Faculty of Education and the Faculty of Science and Technology, "Teaching Methods for Elementary Mathematics [A]" and "Teaching Methods for Secondary Mathematics I
(3) Valid responses
Of the 116 students surveyed, 103 responded (valid response rate: 88.8%).
(4) Survey contents
(1) "Impression of Tables" (5 items), (2) "Perception of Table's Goodness" (16 items)
(1) Impression of "Table" (Semantic Differentia method) (5 responses)
Well-organized - Messy
Easy - Difficult
Easy to understand - Difficult to understand
Easy to understand - Difficult to understand
Useful - Useless
2) Acquaintance with the quality of the "Table" (4-case method) .
1. read the information from the "table"
2. replace the graph with the "table".
3. when there is an empty space in the blanks of the "Table", think of the number of blanks that apply and fill in the blanks.
4. express the rules found in the "Table" in equations.
5. organize disparate information in an easy-to-understand manner using the "Table".
6. find a rule from the "Table".
7. read the "table" and explain what can be said from it
8. explain which of several graphs the given "table" can be.
9. look at the "table" and read what is written in it. 10. find out what is written in the "table" and explain what can be said from it.
10. summarize what they have studied by writing it on the "table".
11. explain the relationship between the two quantities in the "Table
12. find the number of spaces in the "table" based on the given equation
13. express what they have learned in the "table" and tell the contents to their friends
14. summarize what they have learned by means of a "table
15. use the "table" to think without instructions from the teacher
16. express what is written in the "table" in words and rewrite it in equations

Survey Results for Elementary School Students

The survey results showed that children who were not confident in arithmetic and children who were not comfortable with mathematical activities using tables did not find tables enjoyable. On the other hand, there were many children who had positive impressions of tables, such as "easy to understand," "convenient," "neat," and "simple. However, as a whole, it became clear that only a minority of the children felt that tables were "fun. In addition, although there were some problems in thinking independently and expressing themselves, there were some learning effects and future expectations in reading and writing on the "Tables". In addition, there is a relationship between reading, writing, and proactively using the "table" and explaining. Furthermore, it was found that finding rules from the "table," formulating them, and putting numbers in the blanks of the "table" are mathematical activities that involve difficulties for learners who are not good at arithmetic.

Table 1
Item Means and Standard Deviations of Impressions of "Table" (N=273)

Item	Mean	Standard deviation
Cluttered - Well-organized	3.73	1.03
Difficult - Easy	3.67	1.15
Difficult to understand -Easy to understand	3.88	1.16
Boring - enjoyable	2.93	1.01
Not useful - useful	3.97	1.01

Table 2
Item Means and Standard Deviations of the Perceived Goodness of "Table (N=273)

Item	Mean	Standard deviation
1. read the information from the "Table".	2.63	0.85
2. replace the graph with the "table	2.57	0.91
3. fill in the blanks in the table consider the number of cells in the table and fill in the blanks	2.98	0.95
4. express the rule found in the table in an equation	2.72	0.94
5. to use the "table" to organize disparate information in an easy-to-understand way Organize disparate pieces of information in a way that is easy to understand.	2.64	0.97
6. find rules in a table	2.74	0.90
7. to read the "table" and explain what can be said from it	2.23	0.94
8. explain which of several graphs the given "table" is Explain which of several graphs the given "table" is 2.37 0.90	2.37	0.90
9. read the "table" and understand what is written in it. 2.93 0.89	2.93	0.89
10. Summarize what was researched by writing it on a "table.	2.75	0.85
11. explain the relationship between the two quantities in the "table	2.49	0.94
12. Find the number of empty spaces in the "Table" based on the given equation.	2.84	0.93
13. To express what has been learned in a "table" and tell the contents to a friend.	2.36	0.89
14. Summarize what they have learned by means of a "table.	2.52	0.90
15. Thinks using "tables" without being instructed by the teacher.	2.31	0.89
16. expresses what is written in the "table" in words or rewrites it in an equation Rewrite the table in equations.	2.62	0.97

Survey Results

The results of the survey on impressions of "Table" are shown in Table 3.

Table 3
Item Means and Standard Deviations of Impressions of "Table" (N=103)

Item	Mean	Standard deviation
1. messy - Well-organized	3.92	0.84
2. difficult-easy	3.46	0.97
3. Difficult to understand - Easy to understand	3.92	0.88
4. boring - fun	3.07	1.03
5. not useful – useful	4.43	0.73

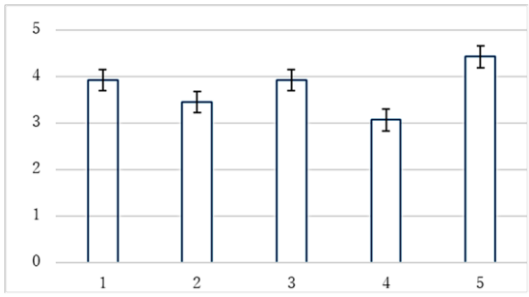
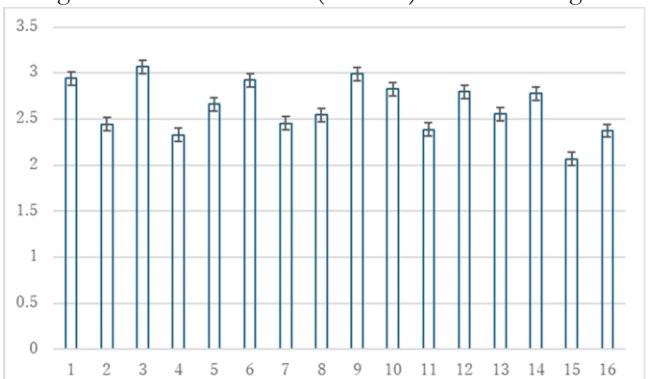


Figure 1: *Average of each item of "Table" impression*

The perception of the goodness of the "Table" (16 items) is shown in Figure 2.



Mean	2.94	2.45	3.07	2.33	2.66	2.92	2.46	2.54	2.99	2.83	2.39	2.796	2.55	2.78	2.07	2.37
SD	0.76	0.82	0.8	0.89	0.82	0.77	0.86	0.83	0.757	0.89	0.8	0.896	0.82	0.76	0.75	0.78

Figure 2: *Means and standard deviations for each item of the perceived goodness of the "Table".*

The impressions of the "Table" (5 items) showed high values, except for "boring - fun". The mean values for the elementary school students and the university students were almost the same in rank order (almost means that the values for 1. and 3. are the same). Overall, the mean for college students was higher than that for elementary school students, especially for "useful - useless" at 4.43. Only "difficult - easy" was higher than that for elementary school students. Only "difficult-easy" had a lower mean than that of the elementary school students.
The overall trend in the perception of the quality of the table (16 items) was similar between elementary school students and university students. College students' mean values below 2.5 were 2, 4, 7, 11, 15, and 16, and relatively high values were 1, 3, and 6. For 1 and 13, college students' mean values were higher than those of elementary school students, and for 4, 15, and 16, the mean values of elementary school students were higher than those of college students. The university students thought that the elementary school students were able to read information from the "Table" and use it in the "Summary," but they did not seem to be able to "express the rules found in the 'Table' in equations," "think using the 'Table' without instructions from the teacher," and "express what is written in the 'Table' in words and rewrite it in equations. The students were not able to express what was written in the "table" in words and rewrite them in equations.

consideration

The impressions of the "Table" (5 items) showed high values, except for "boring - fun". The mean values for the elementary school students and the university students were almost the same in rank order (almost means that the values for 1. and 3. are the same). Overall, the mean for college students was higher than that for elementary school students, especially for "useful - useless" at 4.43. Only "difficult - easy" was higher than that for elementary school students. Only "difficult-easy" had a lower mean than that of the elementary school students.
The overall trend in the perception of the quality of the table (16 items) was similar between elementary school students and university students. College students' mean values below 2.5 were 2, 4, 7, 11, 15, and 16, and relatively high values were 1, 3, and 6. For 1 and 13, college students' mean values were higher than those of elementary school students, and for 4, 15, and 16, the mean values of elementary school students were higher than those of college students. The university students thought that the elementary school students were able to read information from the "Table" and use it in the "Summary," but they did not seem to be able to "express the rules found in the 'Table' in equations," "think using the 'Table' without instructions from the teacher," and "express what is written in the 'Table' in words and rewrite it in equations. The students were not able to express what was written in the "table" in words and rewrite them in equations.

Conclusion.

The 2020 survey of elementary school students and the 2024 survey of college students revealed that there are many similarities in their perceptions of "tables" in math. In particular, while they perceive tables as "easy to understand," "convenient," "neat," and "easy," they have in common that they do not find them "fun. In future educational settings, it will be necessary to devise ways to make learning tables enjoyable. This is expected to help children make active use of tables and increase the effectiveness of their learning. In addition, tables have a function as a learning tool as well as an expression tool. In order for learners to appreciate the usefulness of tables, it is essential to develop teaching materials in which regularity can be discovered, and to practice using tables repeatedly. We would like to ask prospective teachers to understand the educational significance of using "tables" in this way. In this paper, we compared the perceptions of elementary school students and university students regarding "tables" and discussed how to utilize tables in the educational field. We reaffirmed the educational value of tables and showed the importance of devising ways to make learning tables enjoyable.

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Classroom Design for Just the Right Use of ICT in Mathematics Education: Practical Use of Interactive Whiteboard in Teaching Trigonometric Graphing

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Abstract: The purpose of this study is to practically verify the effectiveness of using interactive whiteboards (IWBs) as an ICT tool in high school mathematics education. Focusing on trigonometric graphs, the lessons incorporate three strategies: displaying the same coordinate plane on the IWB as in the students' handouts to teach the graphs of sin, cos, and tan efficiently; using the traditional blackboard alongside the IWB to teach the principles of translation and scaling; and using dynamic software and YouTube to enhance students' interest. Three lessons were conducted with 30 first-year high school students, and evaluations were based on lesson observations, a post-lesson questionnaire, and a confirmation test one week later. The results showed that students' interest and understanding of trigonometric graphs were generally positive. However, some students found the principles of translation and scaling difficult, indicating a need for continued instruction.

Keywords: Interactive Whiteboards (IWBs), Trigonometric Graphs, ICT Tool ,High School Mathematics Education, Translation and Scaling Principles

Introduction

In this study, we focus on interactive whiteboards (IWBs) as an effective example of ICT use in high school mathematics education. The use of IWBs in mathematics education has several advantages. They facilitate visual representations like figures and graphs, aiding in the understanding of abstract mathematical concepts. Additionally, since teachers can write directly on the IWB, it captures students' attention, allows for interactive lessons, and real-time comprehension checks. Furthermore, IWBs enable dynamic content presentation and flexible responses, potentially leading to more engaged learning (Kennewell & Beauchamp, 2007; Mercer, Hennessy, & Warwick, 2010). However, there are challenges in using IWBs, like the time needed for preparation, the risk of one-sided teaching assuming clear presentations mean understanding, and the disparity in ICT skills among teachers affecting outcomes (Ruthven, 2007).

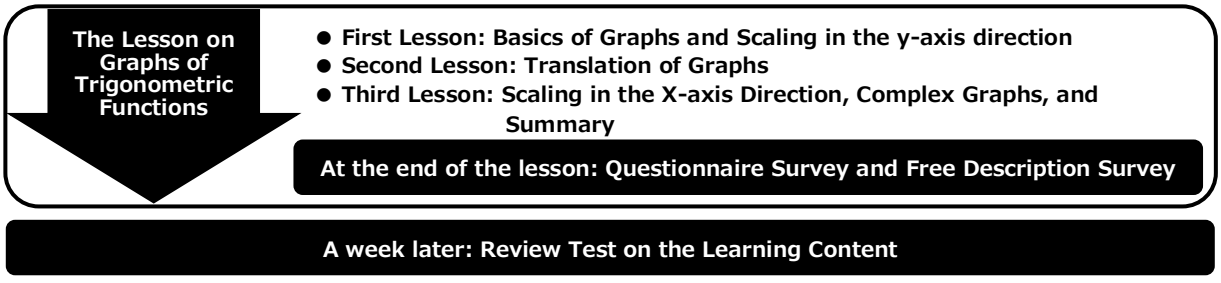
The goal of this study is to conduct a practical evaluation focusing on using IWBs in the unit on trigonometric functions in high school mathematics. Previous studies, such as Kemp (2005), have incorporated ICT in modeling periodic phenomena with trigonometric functions. This study, however, focuses on using IWBs to enhance textbook comprehension while engaging students' interest and fostering a deeper understanding of the material.

Methods

In three lessons focused on the graphs of trigonometric functions in high school, the study designs and evaluates the effectiveness of using IWBs. The evaluation is conducted from three perspectives: students' behavior during the lessons, a questionnaire and open-ended responses collected after the 3 lessons, and a confirmation test administered one week later. The research flow is outlined as follows (see **Figure 1**).

Figure 1

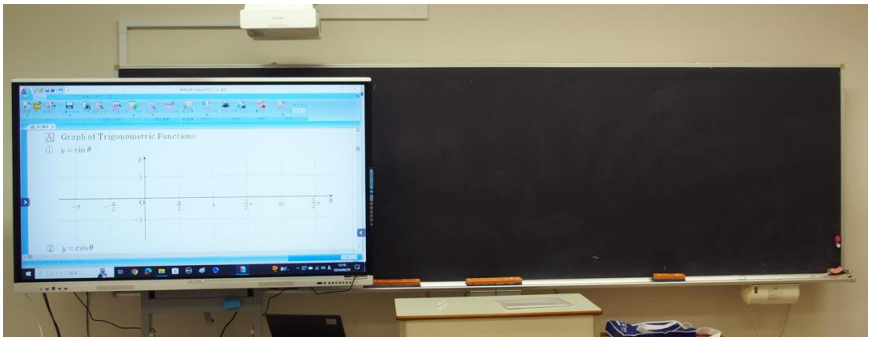
Research Flow



The subjects of this study are 30 first-year high school students. The classroom is equipped with a blackboard and an interactive whiteboard (IWB). The IWB is installed on the left half of the traditional blackboard (see **Picture 1**), and it is often used in conjunction with the traditional blackboard. When the IWB is not in use, the lessons can be conducted solely with the traditional blackboard. Additionally, each student possesses a Chromebook. However, Chromebooks will not be used in this study.

Picture 1

IWB classroom environment



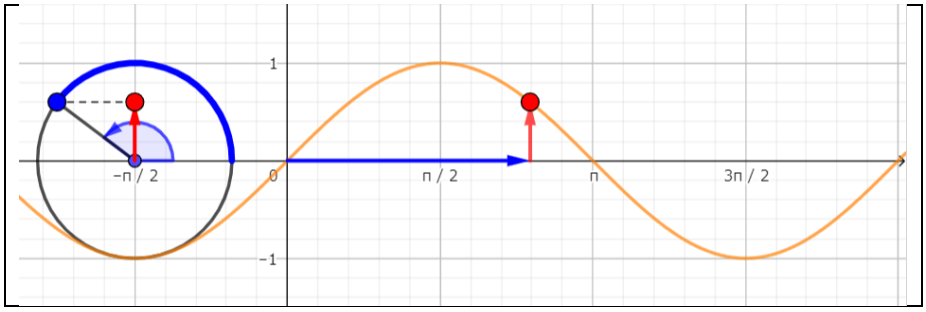
Classroom Practice

Three strategies are incorporated into the lesson design. The first is to display the same coordinate plane on the IWB as on the students' handouts to efficiently teach the graphs of sin, cos, and tan. The second is to use the traditional blackboard alongside the IWB when teaching the principles of translation and scaling. The third is to enhance student interest and engagement by utilizing dynamic software and YouTube.

The first lesson was conducted as follows. Trigonometric functions are more difficult compared to the linear and quadratic functions previously studied. Ultimately, students need to be able to draw the coordinate plane from scratch, but initially, it is important for them to learn to draw the graph first, leaving deeper theoretical understanding for later. Students plotted several points on the graph and then connected them to confirm the graph of y=sin(θ). Similarly, they confirmed the graphs of y=cos(θ) and y=tan(θ). Using dynamic software (see **Figure 2**), they also confirmed the relationship between y=sin(θ) on the unit circle and its graph. Following this, they plotted points on the graph to understand vertical stretching and shrinking intuitively (see **Pictures 2 and 3**).

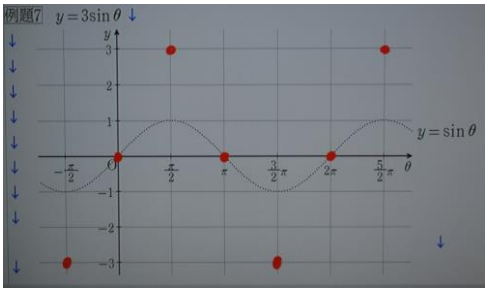
Figure 2

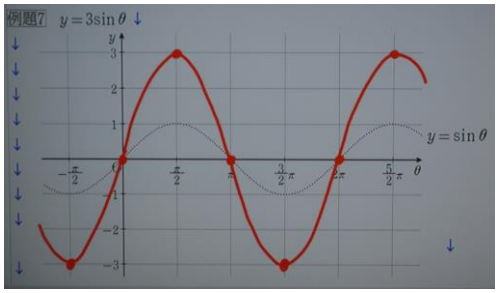
An animation showing the relationship between points on the unit circle and the graph using GeoGebra (GeoGebra Team., 2024)



Picture 2, 3

The coordinate plane and plotted points displayed on the IWB (left, Picture 2) and the graph (right, Picture 3)



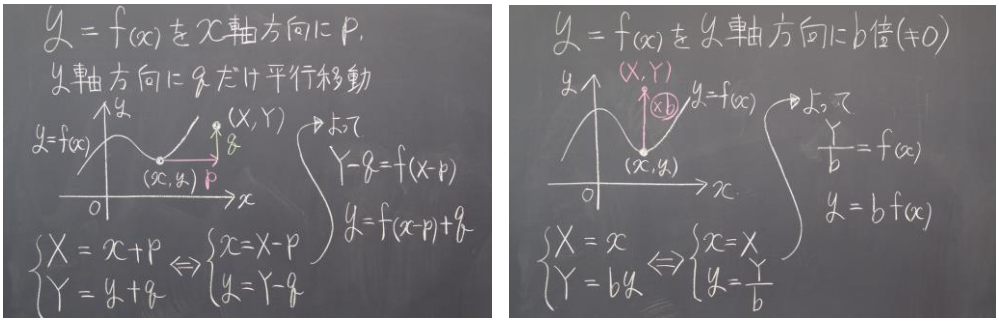


The second lesson was conducted as follows. A review of the first lesson was done on the IWB, and the principles of translation were confirmed using quadratic functions as examples. Then, students practiced drawing the graphs of y=sin(θ), y=cos(θ), and y=tan(θ) translated by 'a' units along the x-axis. In the latter part of the lesson, the reason why a graph of y=f(x) translated by 'a' units along the x-axis and 'b' units along the y-axis becomes y-b=f(x-a) was confirmed (see **Picture 4**). At the end of the lesson, an experiment with a mosquito tone was conducted.

The third lesson was conducted as follows. Building on the explanation of the principles of translation at the end of the second lesson, the principles of scaling transformations along the x-axis and y-axis were explained (see **Picture 5**). Based on these principles, students practiced drawing the graphs of y=sin(θ), y=cos(θ), and y=tan(θ) scaled by 'a' times along the x-axis. Finally, they practiced drawing graphs that involved a combination of translations and scaling.

Picture 4, 5

Reasons for translation (left, Picture 4) and reasons for vertical scaling (right, Picture 5)



Results

The study was conducted using three methods: observing students during the lesson, a post-lesson questionnaire, and a follow-up test conducted one week later.

Observations During the Lesson

During the lesson, students were able to draw trigonometric function graphs efficiently because the same coordinate plane they were working on was projected onto the IWB. Additionally, there were audible reactions of surprise during the use of dynamic software in the first period and the mosquito tone video in the second period. While some students found the principles of translation and scaling somewhat challenging, they made visible efforts to understand the material.

Survey Conducted at the End of the Third Lesson

At the end of the third lesson, a questionnaire consisting of six questions using a 5-point Likert scale and an open-ended survey was conducted. Responses were collected on a 5-point scale. The results are as follows (see **Table 1**).

Positive evaluations were obtained for the use of the IWB and the dynamic software, and it can be inferred that students understood the translation and scaling of graphs. However, there were challenges in explaining the principles behind translation and scaling.

Table 1

Results of the Five-Point Likert Scale Survey Conducted at the End of the Third Lesson (N=30)

Item	1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
Did the use of the IWB help your understanding?	0	0	0	**3**	**27**
Did you understand the translation of the graph?	0	0	0	**12**	**18**
Can you explain the reason for the translation of the graph?	2	5	9	**13**	**1**
Did you understand the scaling of the graph?	0	3	3	**9**	**15**
Can you explain the reason for the scaling of the graph?	2	7	6	**14**	**1**
Did the dynamic software help deepen your understanding?	0	0	0	**4**	**26**

In the free-response survey, many comments supported the five-point Likert scale survey mentioned above, such as "It was easy to understand the trigonometric functions by watching the videos," "The explanations using the IWB were clear," and "I thought it was a difficult topic, but I feel like I understood it quite well."

Follow-Up Test Conducted One Week Later

One week after the lesson, a follow-up test on the entire trigonometric functions unit was conducted. Two problems related to trigonometric function graphs were analyzed: Problem 1 $y=\sin(x-\pi/2)$ and Problem 2 $y=2\cos(x/2)$. The number of correct answers was 26 for Problem 1 and 22 for Problem 2 (see **Table 2**). While overall understanding was confirmed.

Table 2

Results of Two Trigonometric Graph Problems from the Follow-Up Test Conducted One Week Later (N=30)

Problem	Incorrect	Correct
Problem 1: Draw the graph of $y=\sin(x-\pi/2)$	4	**26**
Problem 2: Draw the graph of $y=2\cos(x/2)$	8	**22**

Discussion

In this study, we projected the same coordinate plane as the students' handouts onto the IWB to enable efficient graph drawing. The principles of translation and scaling were explained using both the IWB and the traditional blackboard. Additionally, dynamic software and YouTube were used to enhance students' interest and engagement. Observations of students during the lesson, the post-lesson questionnaire, and the follow-up test results indicated generally positive understanding of graph translation and scaling in trigonometric functions. Positive feedback was also received regarding the usefulness of the IWB and dynamic software. However, continuous instruction is necessary for explaining the principles of translation and scaling.

While the IWB has many advantages, pre-prepared slides can sometimes hinder flexible interaction during the lesson. In this practice, we prioritized effectiveness and efficiency by using the IWB for graph drawing, but for explaining principles, we used the traditional blackboard to facilitate interactive communication with students. Yılmaz Zengin, H., Furkan, H., & Kutluca, T. (2012) conducted a comparative controlled experiment demonstrating the usefulness of the dynamic mathematics software GeoGebra. The usefulness of tools such as the IWB and dynamic mathematics software is undeniable. However, the traditional blackboard should also be considered based on the learning content and students' needs. The same applies to the use of tablets and traditional notebooks. It can be said that we are in an era where lesson design must always be tailored to the actual needs of the students in front of us.

Conclusion

Although some challenges were observed, integrating the IWB and traditional blackboard effectively deepened students' understanding of trigonometric functions without overburdening ICT use. It is essential to design lessons tailored to the students' actual needs.

In the future, I plan to share this study's model with colleagues to develop an even more effective approach. This is expected to improve mathematics education quality and enhance both teachers' and students' ICT understanding and skills.

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Reframing Definition and Measurement of Conceptual Knowledge in Mathematics

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Abstract The acquisition of conceptual knowledge is required in mathematics education. However, the definition of conceptual knowledge includes many elements, making it difficult to determine appropriate teaching methods. Therefore, we conducted a specific classification of conceptual knowledge based on the framework of Crooks and Alibli (2014). As a result, we could identify the conceptual knowledge that students lack. Furthermore, the productive failure approach was identified as an effective instructional strategy for acquiring such conceptual knowledge. However, productive failure is ineffective with students who don't have confidence in mathematics. This study focused on an approach that uses scaffolding for productive failure. We plan to implement this approach in practice in the future.

Keywords: Mathematics Education, Productive Failure, Conceptual knowledge, Scaffolding

Introduction

Understanding mathematical concepts is important (OECD, 2023). In educational psychology, understanding mathematical concepts is called conceptual knowledge (Rittle-Johnson 2019). Acquiring conceptual knowledge facilitates learning transfer and retention (Crooks & Alibali, 2014). However, much of the mathematical education focuses on rote learning rather than conceptual knowledge (Jonsson et al., 2022). It is difficult to acquire conceptual knowledge through rote learning. Therefore, it is necessary to consider a teaching method that encourage students to acquire conceptual knowledge.

Various instructional design (ID) theories are effective when designing classes. ID is models and research fields that combine methods to foster educational activities' effectiveness, efficiency, and appeal (Suzuki 2005). ID emphasizes an alignment of learning objectives, evaluation methods, and teaching methods. That is, it is necessary to consider appropriate teaching methods based on clear learning objectives.

However, few current conceptual knowledge studies clearly define conceptual knowledge (Crooks & Alibali, 2014). Then, Crooks & Alibali (2014) reviewed studies on conceptual knowledge and proposed a framework in which conceptual knowledge is viewed in two aspects: "knowledge of general principles" and "knowledge of principles underlying procedures". However, further subcategorization is necessary to clarify appropriate teaching methods for acquiring conceptual knowledge. In addition, the framework does not reflect important research findings on concept image (Tall & Vinner, 1981) and conceptual change (Posner et al., 1982). Concept image is visual representations, mental images, impressions, and experiences associated with concepts. Furthermore, Conceptual change is changes in the understanding of knowledge. Hence, the framework needs to include this point.

Classification of Conceptual Knowledge

To clarify appropriate teaching methods for acquiring conceptual knowledge, the framework proposed by Crooks & Alibali (2014) was specifically categorized based on how conceptual knowledge is defined in previous studies.

Crooks & Alibli (2014) describe general principles as knowledge of rules, definitions, aspects of domain structures. that can be known without reference to specific procedures. These can be known without relation to specific procedures.

This definition extends De Jong & Ferguson-Hessler's (1996) definition of conceptual knowledge as "declarative knowledge about facts, concepts, and principles within a domain. However, understanding principles is also included in knowledge of general principle. Considering that Koedinger et al. (2012) distinguishes knowledges with and without rationales, these should be dealt with different learning objectives.

Crooks & Alibli (2014) also state that classifying some knowledge into specific categories is included in knowledge of general principles. In psychological research, there are two main types of concepts, which can be divided into "relations between variables" and "associations between connotation (essential characteristics of cases) and denotation (specific

sets of cases) (Fushimi, 1995). These indicate that conceptual knowledge also includes the ability to apply definitions and laws to concrete cases. Then, determining whether a case is included in a concept based on the concept's connotation and predicting changes in each case based on the relationships among variables should be treated as different learning objectives. Furthermore, in conceptual change research, the application of incorrect rules (misconception) has been pointed out in the application of concepts (Sato & Kudo 2021). Therefore, the classification of conceptual knowledge should distinguish with and without misconceptions.
Finally, it is useful for students to understand concepts in connection with graphical representations (Ichikawa, 2000). Considering Tall and Vinner's (1986) research on concept image, the ability to connect definitions with correct graphical representations should also be treated as conceptual knowledge.
Based on the above, the conceptual knowledge classified in this paper and examples of each are listed in Table 1, with five subcategories for knowledge of general principle and two for knowledge of principles underlying procedures.

Table 1

Classification of Conceptual knowledge and example

Type	Subcategory	Example
General principle knowledge	Declarative knowledge of principles (definitions, laws, rules, formulas, domain structure)	Be able to state the definition of variance
	Application of principles to specific cases	Predict changes in variance in each case
	Application of knowledge and judgment to cases that induce misconceptions	Correctly find the limit value of a non-differentiable function
	Rationales for Principles	Explain why the formula for variance is defined as it is
	Conversion of expression format	Can select the one with the largest variance from several given scatter plots
Knowledge of principles underlying procedures	Why a particular procedure is effective for a particular problem	It is useful for integer problems to transform conditional expression into equation is literal products equals integer. Explain why it is.
	The connection between each step of the procedure and its purpose and rationale	Explain the meaning of each operation in Euclid's reciprocal division

Jonsson et al. (2022) pointed out that much of the mathematical education focuses on rote learning rather than conceptual knowledge. Then, students probably do not understand rationales for principles and why certain procedures work for certain problems. This would correspond to "Rationales for Principles", "Why a particular procedure is effective for a particular problem", and "the connection between each step of the procedure and its purpose and rationale", as shown in Table 1. Instructional approaches for acquiring these conceptual knowledge should be considered.
Koedinger et al. (2012) pointed out that sense-making processes can acquire these conceptual knowledges. Sense-making is making connections among mathematical facts, procedures, ideas, concepts, and students' existing knowledge (Buenrostro & Ehrenfeld, 2023). One of the approaches included in the sense-making process is productive failure (Loibl & Rummel 2014).

Productive Failure

In recent years, productive failure, an approach in which problem-solving involves unlearned concepts before instruction, has attracted attention in learning sciences (Sinha & Kapur, 2021). Productive failure involves two phases: a problem-solving phase followed by an instruction phase (Kapur & BIelaczyc, 2012). The problem-solving phase allows students to generate multiple solutions to complex problems. The instruction phase affords opportunities for comparing the relevant student-generated solutions to canonical solutions (Loibl & Rummel, 2014). Productive failure significantly outperforms traditional instruction in conceptual understanding and transfer (Kapur, 2016).
Conversely, instructional strategies are generally selected based on learning objectives and learner characteristics in instructional design. Instructional design is a field of models and research that combines methods to foster educational activities' effectiveness, efficiency, and appeal (Suzuki, 2005).
Nishimura et al. (2017) pointed out that the way of perceiving and valuing failure influences the effectiveness of productive failure. The way of perceiving and valuing failure is called failure beliefs. Lim & Chapman (2013) noted

that attitudes toward mathematics have been noted to influence mathematics learning. However, few studies on productive failure focus on the relationship between the effectiveness of productive failure and learner characteristics (Sinha & Kapur, 2021). Therefore, clarifying the relationship between developing conceptual knowledge due to productive failure and failure beliefs is necessary.
In our previous research, to clarify the influence of learner characteristics, failure beliefs and attitudes toward mathematics on the effectiveness of productive failure, we conducted a class on productive failure for high school students in 2023. The results suggested that the utilization-possibility of failure and self-confidence in mathematics influence the effectiveness of productive failure. Bandura (1994) noted that students with low self-efficacy tend to give up on tackling difficult problems. Thus, Wood et al. (1976) pointed out scaffolding reduces student frustration. This showed that scaffolding is effective in the problem-solving phase of productive failure. In addition, Sinha et al. (2020) also showed that failure-driven scaffolding (nudging students to generate suboptimal solutions) is suited to acquiring conceptual knowledge. However, failure-driven scaffolding has not been tested to determine whether it is more effective than productive failure.
The present study addresses the following research questions.

RQ: Which is more effective PF with failure-driven scaffolding or PF without failure-driven scaffolding?

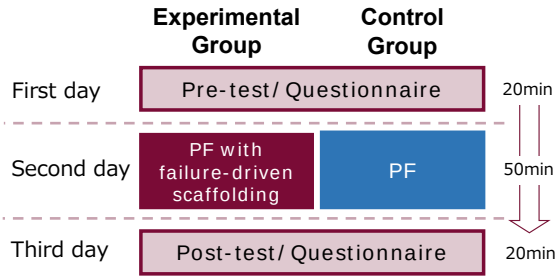
Research Design & Methods

Procedure

The practice is scheduled to be conducted in October 2024. This paper discusses a practical plan.
The participants are 121 second-year high school students from Japan who have been divided into experimental and control groups. The experimental group will receive instruction with PF with failure-driven scaffolding, while the control group will receive Productive Failure. The content is vector. Figure 1 shows the practical plan for this study.

Figure 1

The practical plan for this study



Data

To identify learners for whom PF with failure-driven scaffolding is effective, the pre-questionnaire will use Attitude Toward Mathematics (Tapia, 1996) and the way of failure beliefs (Nishimura et al., 2017). In the pre-test and the post-test, we will survey conceptual knowledge. In the post-questionnaires, engagement surveys will be conducted to determine the quality of the student's efforts in those classes.

As the method of analysis, we will compare the means of the post-tests and engagement between the two groups. This will allow us to assess the impact of class interventions. Moreover, we will survey the impact of failure belief and attitudes toward mathematics on post-tests and engagement in PF with failure-driven.

Future tasks

In future research, we will apply and test the practical plan in this study and present the collected data and the requirements for acquiring conceptual knowledge.

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Multimedia Integration Learning Transformation and its Implications in Critical Thinking Aspect

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Abstract 'Multimedia Integration Learning Transformation and its Implication in Critical Thinking Aspects' discusses the concept of multimedia integration learning transformation (MILT) and its potential to revolutionise education. The authors highlight the challenges faced by the education system in keeping up with rapid technological advances and the need to utilise multimedia technologies to improve learning outcomes. Researcher propose that MILT can improve learner motivation, engagement and understanding, making learning more interactive and flexible. The paper also explores the implications of MILT on education management, including infrastructure development, teacher training, content development and curriculum redesign. It conclude that successful MILT implementation requires careful planning, investment in infrastructure and ongoing support for educators, and has enormous potential to transform education by making it more engaging, personalised and accessible

Keywords: MILT, Crititical thinking, multimedia, learning

Introduction

The Background of Multimedia Integration Learning Transformation as a Progress in Educational System

In this fast-paced digital era, the world of education is faced with inevitable challenges and opportunities. The main challenge is to keep up with the rapid development of the times, where today's young generation is bombarded with information and technology in their daily lives. Meanwhile, the opportunity lies in the utilisation of such technology to improve the quality of learning and create a more interesting and meaningful learning experience for learners (Huang, et al., 2017).

One innovative solution to address these challenges and opportunities is to implement multimedia integrated learning. This learning approach combines various types of media, such as images, video, audio, animation, and simulation, into the teaching and learning process. Multimedia integration is believed to increase learners' motivation, engagement, and understanding, as well as making learning more interactive and flexible. Traditional, text-based learning methods are rapidly evolving as multimedia technologies become more accessible and sophisticated. Multimedia encompasses a variety of media formats, including text, images, audio, video, and interactive elements. Integrating these elements into the learning process creates a more engaging and effective experience for students.

The field of multimedia learning and cognition has expanded in parallel with theories of learning and new affordances of technology. In particularly, we have seen an explosion in the uses of multimedia to support cognition and learning in a variety of educational platforms that include pedagogical agents that serve as intelligent virtual tutors, simulation-based environments and multimedia game environments that present immersive learning experiences, and communication-based video technologies that present opportunities for communities of inquiry. This phenomenon, known as Multimedia Integration Learning Transformation (MILT), is revolutionizing education. By understanding the concept, benefits and implications of multimedia integration learning, it is hoped that education stakeholders, such as teachers, principals and policy makers, can take strategic steps to integrate this learning approach into the education system in Indonesia. This is expected to bring positive transformation in the world of education and produce a smart, creative and adaptive young generation in the digital era.

Implications for Education Management

The adoption of MILT necessitates adjustments in various areas of education management. Here are some key considerations:

- **Infrastructure Development:** Schools and institutions need to invest in reliable technology infrastructure to support multimedia content delivery and interactive learning activities.
- **Teacher Training:** Educators require training to effectively integrate multimedia tools into their teaching practices. This includes content creation skills, selecting appropriate technologies, and utilizing them for assessment purposes.
- **Content Development:** High-quality, engaging multimedia content is crucial for successful MILT implementation. Education management can explore partnerships with educational technology companies or invest in in-house content creation teams.
- **Curriculum Redesign:** Existing curricula may need to be revised to leverage the strengths of MILT.

Huang et al. (2017) explored the use of multimedia-based teaching materials that include three view diagrams (3D) and tangible 3D materials to teach 3D modelling course. This was aimed at determining the influence of multimedia technology in meta-cognitive behaviour of students. In addition, Davies and Cormican (2013) identified the fundamental principles needed when designing a multimedia training tool or material for effective teaching and learning. Another research was conducted by Ilhan and Oruc (2016) The effect of multimedia tools on the performance of 67 grade 4 students of social studies in Kayseri, Turkey was presented. Teaching tool with Computer representation with text, audio, video and animation as its components applied on a control group and an experimental group. The study concluded that academic performance of students in social studies was greatly improved when multimedia technique was applied as compared to traditional classroom. Overall, these studies provide strong evidence that multimedia-based teaching materials and the transformation system this era can be a valuable asset in the classroom, promoting deeper learning and improving academic performance in educational system.

Multimedia learning research is grounded in seven principles of instructional design that reduce cognitive load and enhance effective cognitive processing by paying attention to individual differences, by enhancing and processing through two coding channels, and by providing opportunities for learning by interaction with technology (Lajoie, 2019). The field of multimedia learning and cognition has expanded in parallel with theories of learning and new affordances of technology. The field has supported many types of learning. Multimedia helps learners build mental models of complex systems – for example, how to brake a car or how a heart works – through the use of multiple representations that make the underpinnings of complex systems more obvious.

Research Design & Methods

This research aims to investigate the concept, benefits, and implications of implementing Multimedia Integration Learning Transformation (MILT) in the Indonesian education system. Employ quantitative and qualitative analysis techniques to analyze data collected through surveys and case studies. Quantitative data from surveys might involve statistical analysis to identify trends and patterns. Qualitative data from interviews and observations will involve thematic analysis to identify key themes and insights. Select a few schools in Indonesia that have successfully implemented MILT. Conduct case studies by interviewing teachers, observing classrooms, and analyzing student learning materials to understand the practical applications and effectiveness of MILT in real-world settings. By employing a mixed-methods approach that combines literature review, surveys, case studies, and interviews, this research will provide a comprehensive understanding of MILT, its potential benefits and challenges in the Indonesian context, and its implications for education management.

Results

The samples in this study were class XA as experimental class and class XB as the control class. Data were collected using test instruments in the form of questions about concept mastery and critical thinking skills that have been tested for validity, and reliability.

Table 1 Research Design

Class (Variable)	Design	Treatment	Pre-test	Final test
Experiment	O1 X1 O2	X1	Yes	Yes
Control	O3 X2 O4	X2	Yes	Yes

X1 = Using interactive multimedia.
X2 = Using conventional learning

Data management techniques using descriptive and statistical analyses. The increase in the results of the initial test and the final test of mastery of concept mastery and students' critical thinking skills were calculated using the normalised gain formula (N-gain) (Meltzer, 2002) in (Muh.Tawil, 2012:4).

$$g = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$$

In this case state the final test score; states the initial test score, and states the maximum score. The N-gain level criteria can be seen in table 2 below:

Table 2 N-Gain Level Category

Limitations	Categories
g **> 0,7**	high
0,3 **≤ g ≤ 0,7**	medium
g < 0,3	low

Comparison of N-gain scores between the experimental and control classes was tested using the t-test at a significant level of 5% after going through the normality test and homogeneity of data variance.

Experimental Class Thinking Skills Data and Control Class using multimedia

Histogram image of critical thinking skills data each indicator of experimental class and control class are as follows:

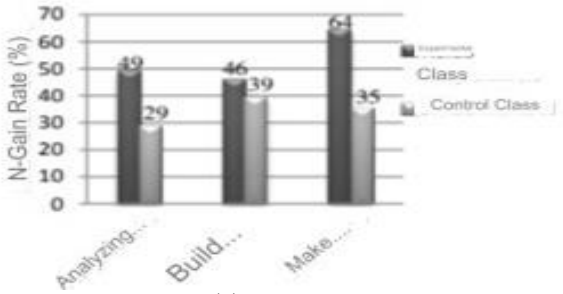

Figure 1 Result for Critical Thinking skills in Class for 2 variables

Test results and the final test of critical thinking skills resulted in an experimental class N-gain of 66% and the control class by 54% The average N-gain for the experimental class and control class are categorised as medium. Based on these data, it can be seen that the average N-gain for the experimental class is higher than the control class.

Based on the t-test results, it was found that there is a significant difference between the improvement of critical thinking skills of the experimental class and control class with a value of tcount = 3.32> t table = 1.671, this indicates that the use of multimedia critical thinking skills in the experimental class and the control class. This indicates that the use of interactive multimedia interactive multimedia is more effective in improving critical thinking skills than learning without interactive multimedia. The existence of an increase in critical thinking skills after the use of interactive multimedia shows that there is an the effect of using interactive multimedia on the increase.

Discussion

According to Munadi (2015), there are several advantages and disadvantages of interactive multimedia. advantages and disadvantages of interactive multimedia as learning media include: (1) The advantages of interactive multimedia are: (a) Interactive meaning that this multimedia programme is programmed or designed to be used by students individually (self-study), (b) Providing an affective climate individually individualised means that it is more affective in more individualised way, never forgetting, never bored, very patient in running the programme. never bored, very patient in carrying out instructions, as desired, (c) Increase motivation to learn (d) Provide feedback (response) and (e) Since interactive multimedia is programmed for self-learning, the control of its utilisation is independent learning, the control of its utilisation is entirely up to the user.

The role of multimedia also promotes interactivity during the learning process and is appropriate for children or students in primary schools with high curiosity. (Dollah Abdillah & Hussain Munir, 1995; Shakila Che Dahalan, 2015), is integrated during the learning process using multimedia, interactivity is an important factor. According to Warsita (2008), interactive means the purpose of two-way communication or something that is action-oriented, active and interrelated, and reciprocal. Thus, the interaction of the word interaction is very synonymous in the world of education where collaborative methods and constructivism engage students actively instead of just listening to teachers' explanations. Through interactive learning students have the opportunity to ask questions, answer questions, come up with ideas and do assignments given by the teacher individually or in groups. This way of learning focuses on the process but does not emphasize it the result that students gain knowledge through their own experience rather than memorizing techniques

Multimedia technologies offer vast potential for enhancing personalized learning experiences. By leveraging the power

of multimedia, educators can create dynamic, interactive, and engaging learning environments that cater to diverse learning styles and promote individualized learning journeys. Interactive learning platforms, video-based learning, gamification, adaptive learning systems, mobile learning, personalized feedback and assessment, as well as collaborative multimedia projects, are all avenues through which the benefits of multimedia can be harnessed.

The integration of multimedia technologies in personalized learning experiences has the capacity to transform education, making it more accessible, engaging, and effective. As technology continues to advance, it is crucial for educators and stakeholders in the field of education to embrace and leverage multimedia to its fullest potential. By doing so, they can unlock new possibilities for personalized learning, empowering learners to thrive in a rapidly evolving digital landscape.

The process of learning and passing on knowledge from teachers to multimedia-based students should cover all aspects related to specific techniques, strategies, methods, tools and resources. When methods, resources and programs are tailored to the student's learning level such as how to present the lessons and the steps involved in learning activities, the student's academic achievement and attitude change. Using multimedia teachers can redefine the areas that need to be emphasized. Instead of using this multimedia material, students are free to explore, move and use their entire senses. At the beginning the history teacher should guide students to access information from multimedia encyclopaedia or materials from the internet and then manipulate the information collected. Transformations and improvements made to the subject can foster critical thinking, problem solving, authentic learning experiences and build student knowledge through social interaction.

In terms of teacher preparation and skills it is necessary to use multimedia that meets the curriculum requirements and supports an approach to the teaching and learning process in the classroom which can be seen in the teaching and learning aspects of multimedia student teaching. It is the wisdom of teachers to apply computer technology and learning aids by making various innovations to be successful as a scientific medium to their targets. Also, when teachers are planning for a teaching process first the teacher needs to ensure that the technology is in good working order so that the activities that the students will carry out are not interrupted and that they do not meet the objectives. This means that individual or group learning shows that students enjoy using multimedia, which learning is fast, that they can see and have an active communication environment that motivates students and that they can provide instant feedback.

Conclusion

Multimedia Integration Learning Transformation holds immense potential to transform education by making it more engaging, personalized, and accessible. However, successful implementation requires careful planning, investment in infrastructure, and ongoing support for educators. By proactively addressing these considerations, education management can ensure a smooth transition and reap the benefits of MILT for students and educators alike. The integration of multimedia technology in education has significant implications for education management. By leveraging these technologies, educators can create engaging, personalised and accessible learning experiences that meet the diverse needs of learners. This approach not only improves educational outcomes but also supports the digital transformation of educational institutions, positioning them for success in the modern education landscape.

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Exploring the Relationship between Web Third-Person Effect of Misinformation and Critical Thinking Disposition

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This study aimed to investigate the occurrence of the Web Third-person effect (WTPE) in the reception and dissemination of misinformation and explore its relationship with critical thinking. Participants (N = 520) evaluated the impact of misinformation on oneself, close others, and distant others and their likelihood of sharing misinformation. They also completed the Critical Thinking Disposition Scale. Results demonstrated WTPE in both the reception and dissemination of misinformation, with a stronger effect observed for distant others than close others. Furthermore, aspects of critical thinking disposition, such as "inquiry-mind," "objectiveness," and "evidence-based judgment," could be linked to the attitudes of critically judging others' online behaviors. Conversely, "awareness for logical thinking" could be linked to the attitude of strictly reflecting own behaviors.

Keywords: Critical thinking disposition, Misinformation sharing, Misinformation spreading, Social networking service, Web Third-person effect

Introduction

With the popularization of receiving and disseminating information through social networking services (SNS), the spread of misinformation has become a serious social issue. How individuals perceive their own and other users' attitudes toward misinformation is an important aspect of studies on misinformation. Davison (1983) introduced the third-person effect (TPE) and posited that individuals tended to perceive others (third persons) as more susceptible to media messages than themselves. However, recent web media, such as SNS, have crucially different characteristics from traditional media in that users can generate and share information. Therefore, the term Web Third-person effect (WTPE) was adopted (Antonopoulos et al., 2015) as it focused on web media.

Research has demonstrated that the social desirability of the messages is a key component of TPE. Individuals tend to overestimate the influence of media messages on others when they perceive them as socially undesirable, such as pornography, TV violence, and gambling (Perloff, 2002). Conversely, they tend to perceive the impact of socially desirable messages on them more or equally compared with others. Regarding misinformation, TPE emerged owing to the social undesirability of being a victim of misinformation (Ştefăniţă et al., 2018). Research has demonstrated the presence of WTPE related to receiving misinformation, with individuals perceiving others as more prone to believing misinformation than themselves (Ştefăniţă et al., 2018; Yang & Tian, 2021). In studies on TPE, self-enhancement need (Gunther, 1995) is considered a key theoretical base that underpins the effect of social desirability on WTPE. Individuals are motivated to maintain and enhance their positive self-image by believing that they are cognitively sophisticated than others. Since sharing information is a main activity for users of web media, self-other discrepancies in the estimation of sharing misinformation might also have emerged. However, studies have not sufficiently examined this aspect. This study seeks to fill this gap and examines the self-other discrepancy in the evaluation of the likelihood of sharing misinformation, called "WTPE in the dissemination of misinformation."

Social distance is a significant variable for the WTPE. In considerable research, individuals perceived that media messages more greatly influenced those who are distanced from them. This also stems from the aspect of the self-enhancement need. According to the social identity theory (Tajfel & Turner, 1979), individuals tend to emphasize their similarities with socially close others and differences from socially distanced others. Therefore, they are likely to favor close others to enhance and maintain a positive self-image. This study considers social distance and compares the perception of self, close others (family and friends), and distant others (the general public), following Antonopoulos et al. (2015) and Ştefăniţă et al. (2018).

In addition, critical thinking is an important factor associated with the spread of misinformation. It is the ability to examine and analyze content to understand and assess values, assumptions, and logical connections, rather than simply taking propositions at face value. Improving critical thinking may be an effective intervention for preventing the spread of misinformation on the Internet (Ecker et al., 2022; Pennycook et al., 2021). According to Hirayama and Kusumi (2004), critical thinking disposition comprises four sub-factors: awareness for logical thinking, inquiry-mind, objectiveness, and evidence-based judgment. This study uses this framework and examines the association between the WTPE and four subfactors of critical thinking disposition.

Purpose

This study aims to (1) investigate the occurrence of WTPE in the reception and dissemination of misinformation and (2) explore its relationship with critical thinking disposition.

Research Design & Methods

Participants and Procedure

We recruited 520 participants (aged 20-49 years, M = 35.45, SD = 8.48; 260 men and 260 women) via an Internet survey tool, Freeasy, operated by iBRIDGE Corporation, Japan. All data were collected online.

Measurements

Web Third-person effect The WTPE measure comprised 18 items. To measure WTPE in the reception of misinformation, participants rated items that pertained to the impact of misinformation on themselves, close others, and distant others. Evaluation of the impact of misinformation on oneself was measured via three items: "Fake news attracts my attention," "The content of fake news is persuasive to me," and "Fake news influences my decisions." Responses were rated on a 7-point scale that ranged from 1 (not at all) to 7 (very). Regarding the evaluation of the impact of misinformation on close and distant others, the questions replaced "my/me" with "my family and friends," and "the general public," respectively. This measure was adopted from Yang and Tian's study (2021) and expanded to evaluate others' susceptibility to misinformation. To measure WTPE in the dissemination of misinformation, participants rated items that pertained to the likelihood of themselves, close others, and distant others sharing misinformation. Evaluation of the likelihood of themselves sharing misinformation was measured via three items: "I may share misinformation knowing it is inaccurate," "I may share misinformation without checking its accuracy," and "I may share misinformation believing it is accurate." Responses were rated on a 7-point scale that ranged from 1 (not at all) to 7 (very). Regarding the evaluation of the likelihood of close and distant others sharing misinformation, the questions replaced "I" with "my family and friends" and "the general public," respectively.

Critical thinking disposition Participants completed the Critical Thinking Disposition Scale (Hirayama & Kusumi, 2004), which comprised 18 items that assessed awareness for logical thinking (five items), inquiry-mind (five items), objectiveness (five items), and evidence-based judgment (three items). Responses were rated on a 5-point scale that ranged from 1 (not at all) to 5 (very).

Demographic Participants reported their age and gender.

Ethical considerations

This study was approved by the Ethical Review Committee of the University of Yamanashi. Participants were informed of the survey and their consent was obtained.

Results

Preliminary analyses

All data were analyzed using R version 4.3.0. Reliability coefficients for the three items of the impact of misinformation were sufficient: self (ω = .93), close others (ω = .91), and distant others (ω = .89). Therefore, "self-score," "close-others score," "distant-others score" were calculated by additionally averaging the three items: M = 3.14, SD = 1.50, M = 3.39, SD = 1.45, and M = 4.02, SD = 1.36, respectively. Reliability coefficients for the three items of the likelihood of sharing misinformation were also sufficient: self (ω = .92), close others (ω = .92), and distant others (ω = .90). Therefore, "self-score," "close-others score," "distant-others score" were calculated by additionally averaging the three items: M = 3.17, SD = 1.53, M = 3.51, SD = 1.47, and M = 4.11, SD = 1.46, respectively. The reliability coefficients of the subscales of the Critical Thinking Disposition Scale were also adequate. Therefore, each score was calculated by additionally averaging the items of the subscale: awareness for logical thinking (ω = .67, M = 2.84, SD = 0.81), inquiry-mind (ω = .89, M = 3.12, SD = 0.89), objectiveness (ω = .89, M = 3.30, SD = 0.67), and evidence-based judgment (ω = .89, M = 3.40, SD = 0.83).

Web Third-person effect

To assess the Web Third-person effect (WTPE) in the reception of misinformation, we conducted an ANOVA with a within-participants design (self/close-others/distant-others score for the impact of misinformation). Results revealed the main effect of the score, $F(2, 519) = 133.37$, $p < .001$, $G\eta^2 = .06$, *95%CI*[.05, .08]. Multiple comparisons indicated that self-score was significantly lower than close-others ($p < .001$) and distant-others ($p < .001$) scores. Furthermore, the close-others score was significantly lower than the distant-others score ($p < .001$).

Similarly, to assess WTPE in the dissemination of misinformation, we conducted an ANOVA with a within-participants design (self/close-others/distant-others score for the likelihood of sharing misinformation). Results revealed the main effect of the score, $F(2, 519) = 126.40$, $p < .001$, $G\eta^2 = .06$, *95%CI*[.05, .08]. Multiple comparisons indicated that self-score was significantly lower than close-others ($p < .001$) and distant-others ($p < .001$) scores. Furthermore, the close-others score was significantly lower than the distant-others score ($p < .001$). Therefore, WTPEs were involved in both the reception and dissemination of misinformation, with a stronger effect observed for distant others compared with close others.

Relationship between WTPE and critical thinking disposition

To examine the relationship between critical thinking disposition and WTPE in the reception of misinformation, we conducted multiple regression analyses with close- and distant-others scores for the impact of misinformation as dependent variables, and self-score, age, and gender as control variables. The four factors of the Critical Thinking Disposition Scale were utilized as independent variables. Results revealed that close-others score had a significant negative association with awareness for logical thinking ($b^* = -.07$, $p = .038$, *95%CI*[-.14, -.01]) and significant positive associations with inquiry-mind ($b^* = .09$, $p = .032$, *95%CI*[.01, .17]) and evidence-based judgment ($b^* = .12$, $p = .006$, *95%CI*[.03, .20]). Furthermore, distant-others score had a significant negative association with awareness for logical thinking ($b^* = -.18$, $p < .001$, *95%CI*[-.27, -.10]) and significant positive associations with objectiveness ($b^* = .13$, $p = .013$, *95%CI*[.03, .24]) and evidence-based judgment ($b^* = .29$, $p < .001$, *95%CI*[.19, .39]). No significant associations were observed between the other variables.

Similarly, to examine the relationship between WTPE in the dissemination of misinformation and critical thinking disposition, we conducted multiple regression analyses with close- and distant-others scores for the likelihood of sharing misinformation as dependent variables, self-score, age, and gender as control variables, and the four factors of the Critical Thinking Disposition Scale as independent variables. Results revealed that close-others score had a significant negative association with awareness for logical thinking ($b^* = -.07$, $p = .026$, *95%CI*[-.13, -.01]) and a significant positive association with inquiry-mind ($b^* = .12$, $p = .002$, *95%CI*[.04, .19]). Results also revealed that distant-others score had a significant negative association with awareness for logical thinking ($b^* = -.14$, $p = .002$, *95%CI*[-.23, -.05]) and a significant positive association with evidence-based judgment ($b^* = .32$, $p < .001$, *95%CI*[.21, .43]). No significant associations were observed between the other variables.

Discussion

This study demonstrated that participants perceived close and distant others to be more vulnerable to misinformation than themselves. Thus, in line with studies, such as Ştefăniţă et al. (2018) and Yang and Tian (2021), the Web Third-person effect (WTPE) in the reception of misinformation was confirmed. Furthermore, participants perceived that distant others were more susceptible to misinformation than close others. This result was consistent with the ideas of the effect of social distance on WTPE (Antonopoulos et al., 2015; Ştefăniţă et al., 2018).

This study extended the perspective of WTPE and revealed the WTPE in the dissemination of misinformation in that participants perceived that close and distant others were more likely to share misinformation than themselves. This could be interpreted as social desirability and self-enhancement need in a similar manner as WTPE in the reception of misinformation. People may see sharing misinformation as socially undesirable. Hence, they tend to perceive themselves as less likely to take such an action to maintain or enhance their positive self-image. In addition, this study demonstrated that participants perceived that distant others were more likely to share misinformation than close others. The effect of social distance on TPE in the dissemination of misinformation could also be explained by the social identity theory (Tajfel & Turner, 1979) and self-enhancement need. People may perceive that close others are less likely to share misinformation than distant others to maintain and enhance their positive self-image.

This study also suggested that the relationship between WTPE and critical thinking disposition may not be straightforward. However, each subfactor of critical thinking disposition had a different association with WTPE. "Awareness for logical thinking" had significant negative associations with close- and distant-others scores for both the impact of misinformation and the likelihood of sharing misinformation. Hence, higher attitudes toward thinking

logically may be linked to perceiving the self as equally or more susceptible to misinformation than others. A possible interpretation is that it may encourage people to strictly reflect on their own online behaviors, in which they tend to turn critical thinking disposition toward the self. In contrast, "inquiry-mind" had significant positive associations with close-others score for the impact of misinformation and the likelihood of sharing misinformation. "Objectiveness" also had a significant positive association with distant-others score for the impact of misinformation. Furthermore, "evidence-based judgment" had significant positive associations with close- and distant-others scores for the impact of misinformation and distant-others scores for the likelihood of sharing misinformation. These results suggested that having a higher inquiry mind, thinking from an objective perspective, and judging things on an evidence-basis may be linked to perceiving others as more susceptible to misinformation than oneself. Inquiry-mind, objectiveness, and evidence-based judgment could promote the attitudes of critically judging others' online behaviors, in which people tend to turn critical thinking dispositions toward others. Thus, even among SNS users with high critical thinking disposition, their estimation of self and others' vulnerability to misinformation may differ based on the direction of their critical thinking disposition toward the self or others.

Conclusion

This study investigated the Web Third-person effect (WTPE) in the reception and dissemination of misinformation. Results revealed that people tended to consider that others were more influenced by and shared misinformation than themselves. Furthermore, they tended to perceive distant others (i.e., the general public) as more vulnerable to misinformation than close others (i.e., family and friends). This study also examined the relationship between WTPE and critical thinking disposition. Aspects of critical thinking disposition, such as inquiry-mind, objectiveness, and evidence-based judgment, may be linked to the attitudes of critically judging others' online behaviors. Conversely, awareness of logical thinking may be linked to attitudes that strictly reflect one's own behaviors.

Acknowledgment

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After Effects of Misinformation on the Internet Following 2024 Noto Peninsula Earthquake: Preliminary Study on Newspaper Articles and their Educational Potential for the Senior Generation

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Overcoming misinformation on the internet is one of the major issues facing the world today. Japan frequently confronts this issue of misinformation on the internet. The 2024 Noto Peninsula Earthquake also led to widespread misinformation. For those who are out of school, especially seniors, opportunities to learn how to deal with internet misinformation are relatively limited compared to those available to younger generations. Seniors are the primary readers of newspapers in Japan. The study examined the potential role of newspapers in educating the senior generation. The study collected articles dealing with the earthquake and misinformation published by two Japanese newspapers. Descriptive statistical data revealed that the number of articles has declined over the months. A preliminary content analysis at newspaper company A showed that articles on strategies (how to behave as a citizen) are fewer compared to other articles. This study further reports future directions.

Keywords: Content Analysis, Misinformation, Newspaper, Senior Generation, 2024 Noto Peninsula Earthquake

Introduction

The issue of misinformation has likely existed since the dawn of history. Even in times when people lived in small communities, they must have generated misinformation and communicated with each other. However, this issue took on new dimensions with the advent of the printing press, radio, and television, and more recently, the proliferation of the internet. This study first explains the relationship between information receivers and senders before and after the spread of the internet, and the impact of this change, particularly in relation to the problem of misinformation during disasters. Thereafter, the study positions itself and outlines its purposes and methods, reporting on the conducted surveys, results, and discussions.

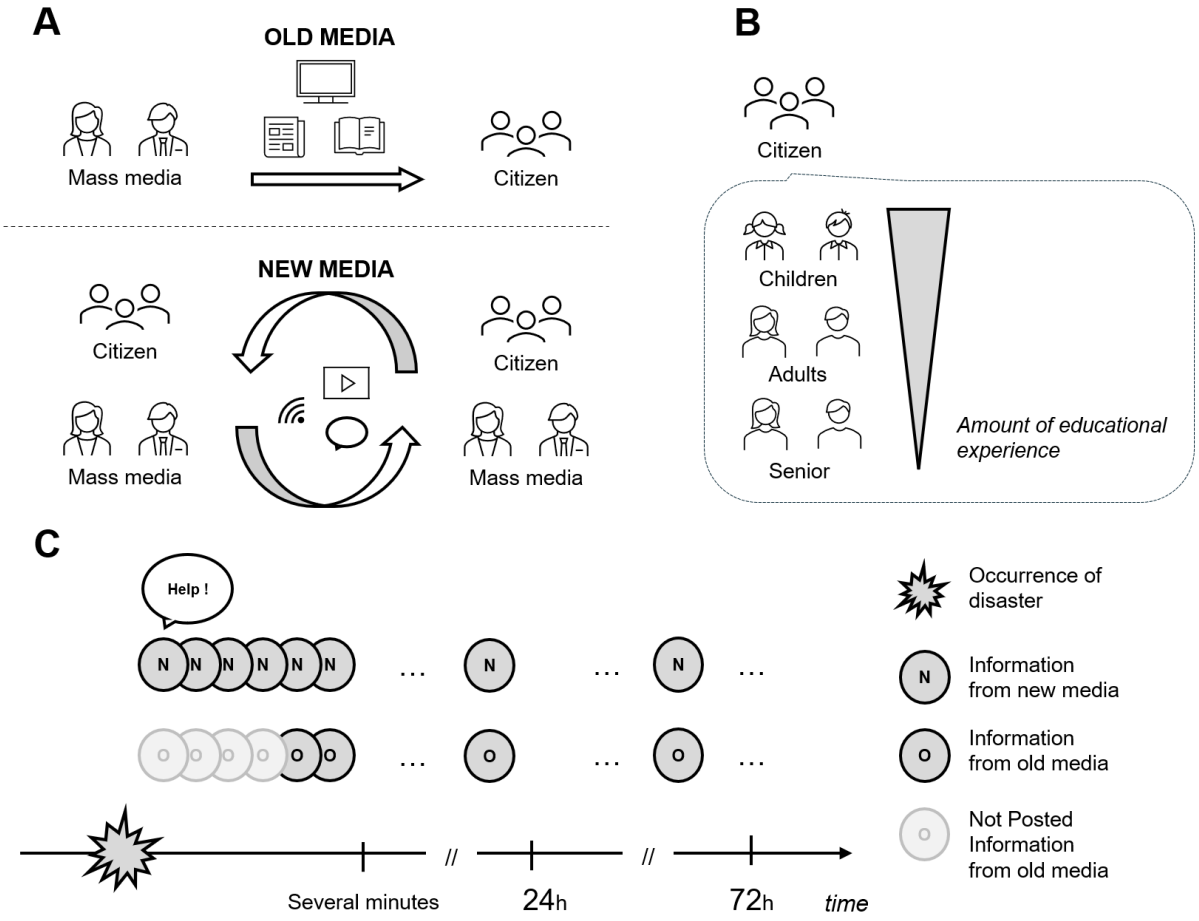
Before the internet, the distinction between information senders and receivers was straightforward compared to the period after the internet, which will be discussed later. Information senders were those who transmitted information through newspapers, radio, and television, while receivers were those who consumed this information. However, the proliferation of the internet advanced the issue of misinformation to a new stage. The spread of the internet transformed information receivers into information senders (as illustrated in **Figure 1A**).

The internet enabled ordinary citizens, beyond just those working in mass media, to disseminate information, allowing anyone to freely provide information at any time. For the citizens, it has become commonplace to share information in various media formats on platforms such as Instagram, X (formerly Twitter), and Facebook, reaching an unspecified large audience.

This era, where all of humanity can disseminate information, might be seen as bringing positive effects to society from the perspectives of freedom and equality. It can also be said that there were benefits during and after disaster responses. Even in past disasters, despite having both advantages and disadvantages, people have benefited from this capability. However, during the 2024 Noto Peninsula earthquake, the disadvantages became particularly pronounced.

During the 2024 Noto Peninsula earthquake, misinformation became a significant issue, just as it had in past Japanese disasters such as the Kumamoto earthquake, but it reached an even larger scale. There were, for example, multiple posts requesting help from non-existent addresses on X. Additionally, another issue on X was meaningless retweets aimed at gaining impressions. These problems arose during the 2024 Noto Peninsula

Figure 1
Information Sharing Flow in Old and New Media (A), Amount of Educational Experience Among Citizens (B), and Information Posting Flow in New and Old Media After Time Elapsed Since Disaster Occurrence (C)



earthquake, presenting us with significant challenges (as illustrated conceptually in **Figure 1C**). The chances to save lives immediately after a disaster are currently being closed off.

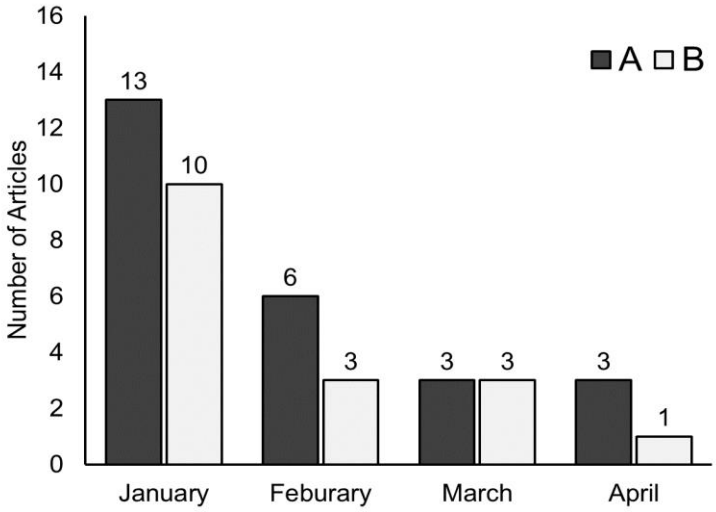
The Japanese government is attempting to implement measures to address this issue. Among these national efforts, practical approaches are needed to educate citizens on how to develop media literacy skills to respond to such problems. However, these efforts might reach the elderly generation to a very limited extent, unlike the younger generation (as illustrated in **Figure 1B**). Considering that the elderly are particularly vulnerable during disasters and likely lack sufficient training in using new media, it is urgent to develop appropriate and swift approaches to address this issue from the perspective of saving lives in crisis situations.

What kind of measures could effectively help the senior generation acquire a kind of media literacy in our society? This study focuses on the educational role of newspapers. In Japan, the elderly are a significant portion of newspaper subscribers compared to other age groups, and thus there is a potential for newspapers to have a strong educational impact. Before examining this educational effect, this study first aims to collect and organize articles related to misinformation published in the four months following the most recent major earthquake in Japan, the 2024 Noto Peninsula earthquake.

Methods

The analysis focused on articles from two newspapers (A and B). Articles were collected from January 1 to April 30. The keywords used for the article search were set as "earthquake AND (misinformation OR false information OR inaccurate information OR fake news OR fact-check[地震 AND (デマ OR 偽情報 OR 誤情報 OR フェイクニュース OR ファクトチェック) in Japanese])."

Figure 2
Trends in the Number of Articles



Results and Discussion

As a result of the search, a total of 25 articles were obtained from Newspaper A, and 17 articles from Newspaper B. In both newspapers, the number of articles was highest in January and then decreased in the following months. For content analysis, articles that were irrelevant or inappropriate for the current study were identified. As a result, six articles were deemed outside the scope of this study (for example, indexes or unrelated content). Next, the remaining articles were categorized as either those describing strategies for individuals to deal with misinformation or those that did not (for example, articles explaining the mechanisms of misinformation or those discussing the issue of misinformation on social media during the Noto Peninsula earthquake). As a supplementary note, these proposed strategies are considered to function as an educational aspect for newspaper readers.

Although there are limitations to classification by a single person, six articles were categorized as being related to strategies. The proposed strategies included the following: (s1) Do not spread information until it is verified, (s2) Consult reliable alternative sources, (s3) Do not react immediately, (s4) Consider the appropriateness of spreading the information, (s5) Be aware of specific past examples of misinformation, (s6) Verify information especially when driven by prosocial emotions (as the spread of information is often motivated by such emotions).

As described above, this study examined the trends in the number of articles and conducted content analysis for one newspaper company. Regarding the number of articles, it was confirmed that they indeed decreased over time, similar to the concept of memory decay in psychology. Furthermore, in terms of content analysis, it was found that articles discussing strategies were even more limited among those related to misinformation. Additionally, it was discovered that not all the strategies identified in this study were proposed in a single article. This study originally focused on the educational role of newspapers. The assumption was that the presence of educational aspects would be determined by whether the articles included content related to strategies. Under this assumption, it was suggested that the discussion of individual-level responses to misinformation in newspaper articles may have significant potential for further development.

Finally, the limitations and future directions of this study are discussed. First, the content analysis was conducted with articles from only one newspaper company. Future research will include content analysis of articles from both targeted companies. Second, the validity of the content analysis is a limitation. In this study, a single rater judged the presence of strategies and identified them. To enhance the validity of the results, future studies will involve more than one rater in the content analysis. Third, while this study focused on the presence of strategies as the direction for content analysis, other classifications are possible. Future research will explore the educational potential of articles from perspectives other than strategies. Fourth, although slightly outside the scope of this study, discussing practical communication methods to deal with misinformation is an important direction for future research. In the future, we aim to deepen discussions on the educational role of newspapers for the elderly in a more practical manner.

Note

In this study, ChatGPT-4 (paid version) was used to translate from Japanese to English.

Developing a System for Visualizing and Evaluating Information Collection in Inquiry Learning

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When students engage in inquiry learning, they need to gather resources using a variety of methods and are often required to compile these into a reference list along with their completed product. However, it is difficult for teachers to grasp the progress being made before the submission of the final product and even then, understanding the references used by the students' can be difficult to visualize. The original Reference Management System was developed to help students organize their collected references and allow their teachers to view their progress and references at any time. While the system can display the collected references, visualization and evaluation of the references remains difficult. This paper proposes several additions to the Reference Management System to aid in quick and informative reference visualization and evaluation to understand at a glance the state of the resource collection process.

Keywords: Information Collection, Inquiry Learning, System Development, Visualization

Introduction

In inquiry learning, it is necessary for information to be gathered through a variety of methods, including books, the Web, and interviews, in order to solve a problem which was set by the learner (Ministry of Education, Culture, Sports, Science and Technology, 2008). Traditionally, the type of information that learners collect and refer to when compiling this information into products has been determined by extracting relevant descriptions from their portfolios or by checking the reference lists of the products. This makes it difficult for teachers to properly grasp the situation and provide guidance and support when learners are collecting information. It is also problematic for teachers and the learners themselves to grasp the scope of the information collected thereby complicating the matching of learners who are working on related topics or supporting the application of the information of this joint learning. Therefore, in this study, the web-based system is being developed while focusing on the following three points: (1) the visualization of the process of information collection by learners and how this changes over time, (2) to understand the themes/areas of information collected by learners and to visualize its expansion, and (3) to visualize not only the status of information collection by individual learners but also the status of information collection in any given group or class. Furthermore, when visualizing the collected information, the system will be linked to various open data via APIs to streamline the input process and automatically classify the information. This paper outlines (a) improvements made to the system from its predecessor, the Reference Management System, as well as (b) the implementation method used to realize (1), (2), and (3).

Background

To date, little research has been conducted which attempts to visualize and evaluate resources gathered by students prior to the presentation stage of inquiry learning and few systems have been developed to assist with the organization and display of the gathered information. For evaluation of gathered resources, Nemoto (2012) conducted an inquiry learning competition and the learning process used by the students was analyzed. Among these analyses was an investigation into the reference lists of the students who won the competition. While the reference list of a completed product can be analyzed based on the information contained within, this does not help teachers to guide students during the learning process itself.

For visualization, Kasai (2000) proposed to color-code the collected references via the use of "mediagraphy cards" to better see the types of resources which students' used while conducting their investigations. Building on this idea, Noborimoto et al. (2017) designed the Reference Management System to assist students and educators manage the resources gathered during the inquiry learning. A downside of both of these approaches is how they depend on students inputting correct classification information for the resources they used. This puts the burden of correctly recording the resources' information on students (and the teachers responsible for checking their work) and limits the kinds of visualizations which can be achieved.

Furthermore, Rieh et al. (2016) reviewed the literature on the relationship between learning and information seeking and pointed out the need for systems that can support interactions with various types of information during the process of critical and creative learning (i.e., inquiry learning). To assist students and teachers with both the ongoing evaluation of gathered resources and to properly visualize that information, a new system, which will be built upon the Reference Management System framework and is tentatively called RefViz (short for Reference Visualization), is proposed which will be capable of semi- or fully automated information retrieval and storage while also allowing for a variety of visualizations to be creatable based on this expanded volume of information for the students' gathered resources.

Improvements already made to and planned for the system

RefViz has already undergone several improvements over its predecessor, the Reference Management System. Firstly, is the integration of the OpenBD API for automated collection of bibliographic data for written works via an ISBN search function. This saves the students time, since they will not need to find all the relevant information manually, and ensures accurate data is recorded. To complement this API integration, a camera function for reading ISBN numbers from barcodes was also implemented. According to Human Rights Education and Student Guidance Division (2024), approximately 20% of students from 4th grade elementary to 3rd grade senior high school within Okayama Prefecture use smart phones, tablets or computers to interface with software and applications related to their study. With all students now having access to a computer thanks to the GIGA School Project (MEXT, 2023), the camera reader is an easier way for students to input an ISBN number on their devices. The ability to create reference lists in a customized MLA style (to the specifications of the testing high school's teachers) was also added to the existing functionality allowing students to not only record their references but to simply create a properly formatted reference list. Finally, the user interface (UI) was changed to account for the many users who access the system via devices with smaller screen sizes. The system detects the size of the user's screen and displays the appropriately formatted layout to the user.

Further improvements to the system are also planned to add new functionality and further improve existing functions. The first of these planned functions will be the ability to link the service with Google accounts and Gakushu e-Portal, a digital learning environment for elementary and secondary schools within Japan which was designed to facilitate interoperability of different software and to make better use of various educational data (ICT Connect 21, 2024). This linkage will enable the system to determine the schools which students and teachers belong to and allow for, at the discretion of both schools, inter- and intra-school groups to be easily formed. Additional API integration into the system is also planned, such as CrossRef, J-Stage, CiNii and GoogleScholar, to further enhance the data collection process and provide additional information for reference visualization and evaluation (Maas et al., 2024). The ability to set and change "tags" for each reference will also be added which will allow for more customized classification and organization of the references and inclusion of certain references in certain group products.

Visualization and Evaluation of referenced sources

In addition to the new features introduced above, it is planned to incorporate various visualization and evaluation functionality to RefViz to assist students, groups and teachers to better understand the references that are being used. As per Inagaki et al. (2024), there are four main areas which can be visualized from the gathered information, the types of media used, the difficulty of the media, the main themes present in the media, and a time series of when the sources were found. While the Reference Management System can display the types of resources gathered by individual students in table form, it currently lacks the ability to create groups of students and therefore cannot show the progress of the group as a whole or an individual's contribution to that group. It also only shows a summary of the gathered

resources at the current point in time and doesn't not attempt to show any deeper patterns which may exist in the collected resources. An example group researching the effect of Buddhism on the development of a town is shown in figure 1. The figure shows the pace of resource collection over the 4 weeks (Timeline plot) before breaking that down into the types of media which the students gathered (Media plot). To demonstrate what could be possible from the extra data collected via API implementation, the "books" category is further analyzed, showing the themes which were covered by the books the students found (Themes plot).

Figure 1

Example visualization of Group A's resource collection progress showing a timeline of when the resources were collected, the types of media, and the themes covered by the "books" media.

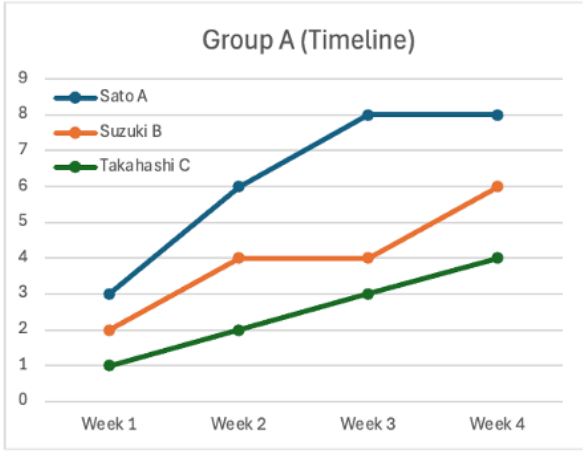
Group A	Total	Sato A	Suzuki B	Yamada C
Week 1	**6**	3	2	1
Week 2	**12**	6	4	2
Week 3	**15**	8	4	3
Week 4	**18**	8	6	4

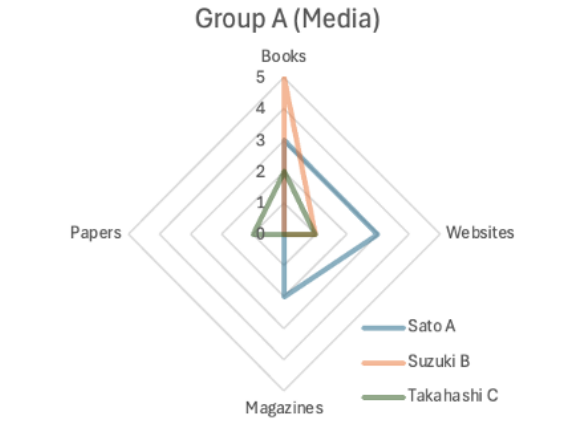
Breakdown by media type

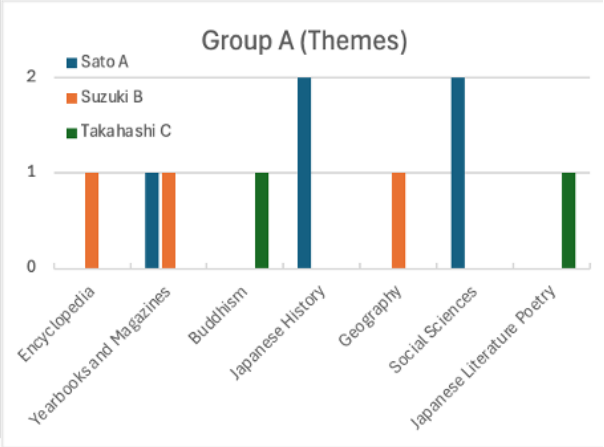
Group A	Total	Sato A	Suzuki B	Yamada C
Books	**10**	3	5	2
Magazines	**2**	2	0	0
Websites	**5**	3	1	1
Papers	**1**	0	0	1

Themes of books

Group A	Total	Sato A	Suzuki B	Yamada C
Encyclopedia	**1**	0	1	0
Yearbooks and Magazines	**2**	1	1	0
Buddhism	**1**	0	0	1
Japanese History	**2**	2	0	0
Geography	**1**	0	1	0
Social Sciences	**2**	2	0	0
Japanese Literature Poetry	**1**	0	0	1







When compiling their references for inclusion in a reference list, various reference styles (such as MLA or APA) are often requested depending on the school or teacher overseeing the project. Manually creating this list is time-consuming and often requires a guidebook to ensure that the style is being correctly followed. While the existing system can output the selected references in an MLA format, it is planned to incorporate more reference styles via the utilization of Citation Style Language (CSL) files. The time saved by automating the formatting of the reference list can then be spent by teachers and students to ensure other aspects of the inquiry learning is being conducted efficiently.

Additionally, a search function will also be added where students and teachers can search created references by various fields such as author, title or tag.

Conclusion

During inquiry learning it is necessary for students to gather resources from various sources to support their investigation. However, the status of this data collection prior to the completion of the final product and submission of a reference list is murky and difficult for the teacher guiding the students to understand. The existing Reference Management System took a step in the right direction by allowing students to record their resources in a central location and an organized manner. Teachers can view the resources collected by students at any stage of the process and give advice as needed. Several weaknesses in the existing system have been identified and a newly proposed system, RefViz, aims to address these weaknesses. It will assist both students and teachers with the collection, storage and display of various resources found during inquiry-based learning activities by individual students or any group of students, show visually the types of resources which have been collected and when they were collected and allow the teacher to more quickly grasp the status of all their students or groups thereby optimizing the efficiency and timeliness of their guidance. Since it is currently unknown which visualizations will be the most beneficial to the students and teachers, RefViz will be developed and tested during classes to gather feedback on how better to adapt it to the needs of the users.

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Implementation of the Civic Education Curriculum for Pre-service Teachers

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The need for civic education is growing. Korea's Ministry of Education and the Korea Research Foundation supported a four-year project to strengthen the civic education capacities of pre-service teachers. The purpose is to foster prospective teachers to equip with civic education capabilities and lead a harmonious community. The project team specified the keywords as 'conflict, understanding, and coordination.' Over the past four years, the project group has developed and offered four liberal arts courses, improved and operated 77 courses. The prospective teachers were encouraged to participate in personality tests for self-understanding, write book reviews, attend special lectures, get involved in voluntary activities, and etc. Taking actions to become change agents of local community was considered a model example of civic engagement.

Keywords: Civic Education, Pre-service Teachers, Curriculum Development

Introduction

Background

There is concerns about the narrow focus on reading, math, and science and the importance of civic education is being emphasized (Levine & Kawashima-Ginsberg, 2017). Due to the development of technology and advent of diverse society, Korea's Ministry of Education and the Korea Research Foundation supported a four-year project to strengthen the civic education capacities of pre-service teachers. Six out of 13 education universities and 6 out of 46 education universities were selected to receive budget support for four years.

What is civic education?
It is an education that improves the capacity of a democratic citizen so that independent citizens with critical thinking skills can respect the values of democracy and coexist with each other. Various topics such as human rights, equality, peace, environment, and media literacy can be the content of democratic citizenship education, but civic education is not just about acquiring the knowledge of education by these topics, but is a comprehensive education that enhances

civic values, attitudes, and capabilities and expands them to participation and practice. <Comprehensive Plan for Revitalizing Democratic Citizenship Education, 2018.11>

In the background of these initiative lies the assumption that individual diversity will prevail in the future society, and conflicts between people, organizations, and countries are to be amplified due to gush of various opinions and interests. The overarching goal of the project is to equip prospective teachers with civic attitude and skills plus the ability to effectively teach them to their pupils. The key theme of the project was 'conflict, understanding, and coordination,' which is to serve with programs to deal with conflict situations. As stated by McIntosh and Youniss (2010), political engagement in a democracy 'almost always involves some levels of conflict (p.28)', and decisions are rarely made unanimously.

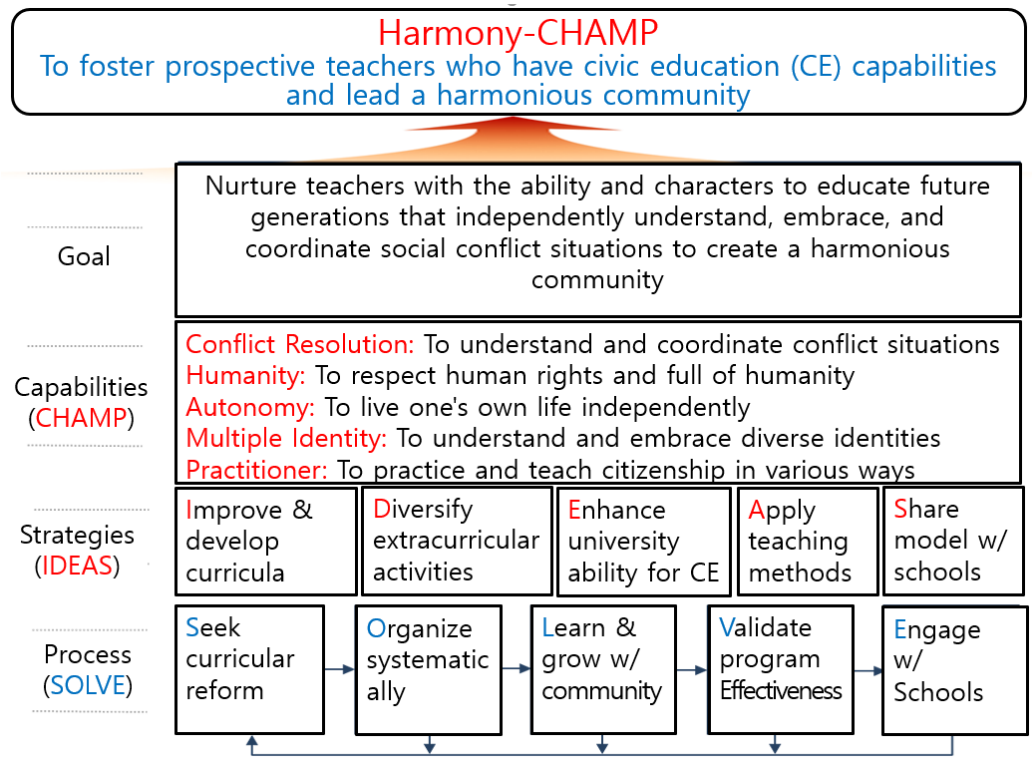
The following are the aspects of education that the team focused on.
First, improvement and development of curriculum for training teachers in civic education. In order to equip future teachers, the education system to train them should be structured as such.
Second, application of teaching-learning methods suitable for civic education. Prospective teachers learn the teaching methods that are known to be effective in civic education field, and the most effective ways is to be taught in that manner.
Third, sharing and spreading excellent civic education curriculum to other institutions and schools. Exemplary cases should be documented and disseminated to other institutions and schools to accelerate new findings and experiences.

Three areas, civic knowledge and skills, civic values and dispositions, and civic behaviors, were the focus of development (Howard, 2001). The following elements of successful programs for young adults were employed (Finlay, et al., 2010): (1) an explicit civic orientation and opportunities, (2) mentoring by supportive adults, (3) structured guidelines and encouragement for completion, (4) diverse social networks, and (5) a clear focus on young adults.

Methods

Harmony-CHAMP competencies were identified through related literature research, experts FGI, teacher workshops, and diagnosis of 37 subjects (major, liberal arts, and teaching). The project team specified the keywords as 'conflict, understanding, and coordination' and the Harmony-CHAMP framework was laid out as to control the overall process and execute it. Five capabilities (components), strategies, and process were established (see Table 1).

Figure 1
Civic education curriculum development and dissemination framework



Results

Following are some of the main outcomes of the projects.
First, 38 faculty members out of 72 (53%) and 412 (45%) students out of 912 participated in the project throughout 4 years. Four courses were developed and 77 were modified to adapt civic elements into the courses. The developed courses are Citizenship Education through Art, Conflict Society and Citizens, Citizen Education Practice in the Age of Diversity, and the Citizens Science for a Sustainable Society.
Second, application of 'self-understanding' based civic education through personality strength test was implemented. It is crucial for an individual who is the starting point of civic education to understand one's representative personality strengths and use them in educational practice activities (class guidance, student guidance, peer and relationship with supervisors or supervisors) to create a system in which individual's sustainable development and civic education development ultimately complement each other.
Third, various extracurricular activities were introduced. Civic education book report, lectures, film festivals, book discussion club, education policy proposal presentation contest, mentoring school students, CE teaching contests, visiting local civic activist groups, oversee outreach, and etc. Student participation in local office of education's policy improvement and discussion with the superintendent was one of the representative cases. Videos of teachers sharing their expertise were filmed and uploaded on YouTube.
Table 1 is the summary of the project results.

Table 1

Project goals and results.

Criteria	Unit	1st year		2nd year		3rd year		4th year	
		Goal	Results	Goal	Results	Goal	Results	Goal	Results
Developed Courses	Courses	2	2	1	1	1	1	0	0
Modified Courses	Courses	18	18	24	24	22	22	13	13
Faculty participation	%	20.0	33.8	30.0	49.3	30.0	53.5	35.0	57.1
Student participation	%	-	18.3	18.5	17.5	18.7	35.7	18.8	40.7
Disseminated events	Events	2	7	3	6	5	8	5	5
Course satisfaction	%	-	-	82.5	95.2	85	100	90.0	100.0
Extra-curricular satisfaction	%	80.0	100.0	82.5	90.9	85	100	90.0	100.0

Discussion

The number of participating professors and participating students continued to increase over the four-year period. In particular, in the fourth year, 13 departments adopted the 'Change Maker' activity, a follow-up program that helps the community through the enactment of necessary self-governing regulations within the department and on campus, increasing students' efforts to improve their understanding of citizenship and contribute to the community in relation to their community.

The results of the project are mostly 'tangible' outcomes that could be evaluated by the authorities who funded the project. However, to the faculty who are involved with the project and the students who actively participated in the project testify that the impact of it is huge. The importance of civic education has made an influence on the prospective teachers that CE is indeed indispensable in future education. Furthermore, CE was officially reflected on the specialization strategy and project content of the College of Education mid-to long-term development plan.

Conclusion

The funded project ended after four years of implementation. Even after the end of the project, CE is embedded in the courses content and methods in the teacher education program. The programs that had contributed to enhancing the capacity of pre-service teachers such as education policy proposal presentation contest need to be operated in a sustainable manner.

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Connecting learning to daily lives through transformation of worldview in creative activities

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Abstract: We examine two workshops we designed and conducted for connecting learning to daily lives and to the society: one in which college students created what they needed using trash, and another in which company workers were engaged in creative collaboration in team works. In both workshops, the participants learned to transform their view to more fluid and connected one. We discuss implications for education in terms of the importance of engagement in creative activities with actions on real materials and people. We suggest that lectures and instructions tend to facilitate more fixed and detached worldview while active actions and concrete materials tend to facilitate more fluid and connected worldview. We discuss some implications of these analyses for connecting learning experiences with daily lives and with the society.

Keywords: Connected Learning, Creative Collaboration, Fixed vs. Fluid Worldview, Workshops, Reflection

Introduction

Learning detached from daily lives and the society

To prepare our students to face many issues of global scale, such as the climate crisis and destruction of natural environments, education should try to connect their learning with what's happening in the world in a global scale as well as with what they are doing in daily lives (Miyata, et al., 2019). However, in many educational settings, including school classrooms and workshops the learning experiences are often detached from global issues as well as from their experiences in daily lives. One problem is that in schools, knowledge is often given to the students as something fixed and cannot be created or changed by them. They tend to create a boundary between the world and themselves and learn that the world is something that they cannot change by their actions. Well-designed workshops could integrate body, heart and mind in learning to facilitate active learning about the environment and the community. However, they often have the limitation that the learner tends to attribute the experience to the special quality of the learning environment, and as a result creates a boundary between the learning experience and his/her daily life making it difficult to find meaning of the learning experience in everyday life.

Workshops

We have designed and conducted many workshops to connect students with the global world (Miyata, 2013) and with the local community (Miyata & Ho, 2017). In this paper, we will present and analyze some workshops with creative activities in which boundaries were crossed to connect the learning experiences with daily life as well as the society. We will also illustrate that creating something meaningful in one's daily life could transform one's worldview from a detached and fixed one into a more connected and fluid one in which they feel their potential to change their daily lives as well as the society.

Designing Everyday Things

We conducted a workshop (Miyata & Suzuki, 2022) in which a total of about 300 college students in Japan designed and created many kinds of things they needed in daily lives, from bookshelves and lanterns, to presents for family, using wastes at home such as plastic bottles and cardboards. Their reflections revealed that their experiences of designing and making one thing using wastes have transformed their view of the world.

To a survey before the workshop, most students replied that they buy most of the things they use daily, and that they don't create them because they did not think they could make anything useful and creating things would not be fun.

After the workshop which consisted of four weekly meetings and creative activities at home, many of them reflected that they enjoyed the experience, especially the process of designing and creating with trials and errors. Also, most of them liked what they created because they could design and keep improving as they used them to match their tastes.

Many of them reflected that they used to think that things are either useful, or useless, and therefore things they finished using were useless and to be thrown away. However, after the experience of creating something useful using trash many of them reported that they started to view things that they finished using not as trash but as something they could make into useful things. Some of them mentioned that "trash" was only a concept they had created in their minds but did not exist. Many of them mentioned that they realized that they could contribute to the society by not throwing away "trash" and thereby reducing carbon emissions in burning or processing them.

Digital Team Transformation Workshop

Background and setting of the learning environment

"In our shift work environment, sometimes it feels like living in a narrow cave. I had never seen the big picture of the community. I had never seen the picture of this organization." an employee of a large conglomerate company reflected in a conversation about his work context. Silo working environment is a common challenge for many organizations. Breaking down complex processes into small tasks is a common solution in work distribution, however, it creates the gap between departments that affect continuity, coherence and collaboration in work process. These reflections illustrate how workers in large organizations are trapped into narrow worldview detached from outside their small sections and therefore cannot understand the meaning of their works but feel unable to change their work environments.

Learning by Play and Co-constructing an almost impossible task!

Digital Team Transformation workshop (Tutiyaphuengprasert, 2018) is a 4 days workshop provided by Darunsikkhalai School for Innovative Learning in Bangkok. This workshop was designed to allow participants to learn about collective leadership, collaboration and digital thinking. According to the school's main learning philosophy of Constructionism (Papert, 1980), the facilitator designed a workshop that allows learners to create concrete projects to learn.

This workshop assigned complex tasks to the community of 20-30 learners in each class. Nobody can achieve this task alone. Participants will need to think and solve problems together in order to accomplish the task. Everyone contributes something to the group challenge which is Rube Goldberg machines. The Rube Goldberg machine is a long line of connecting contraptions that create continuous movement of the objects from the beginning of the line to the end of the last contraption. The workshop creates constructionist "rich learning" environment (Papert & Harel, 1991) where learners will feel like playing in constructing something challenging together. Participants are divided into teams of 2 people. Each team creates the contraptions under provided conditions; use of a microcontroller, showing basic six simple machines, and use of a secret object (a random object that learners will need to creatively integrate the random object into their contraption). With a time limit of 12-13 hours to finish and limited resources, this creates so much challenge for the participants.

Learning and working: learn how we act and relearn to react in project-based learning context

Besides the challenge of the project, in group work situations, participants will also encounter challenges in working styles. Facilitators encouraged learners to take this opportunity to learn about different working styles in people. 4 types of leadership had been presented as prompts for participants to observe in real life situations. As they work, plan, design, discuss and face problems, participants are assigned to observe and try to understand different types of traits. At the end of the day, facilitators set time for reflection. The group conversation will discuss both the progress of the project and the challenges they faced and what they had learned. These are some reflections from participants.

"I learned that people are different, and we can adjust ourselves according to the people we're working with. I learned to be less "fixated" in the way we think and act. If we understand the differences, we can unstuck and be flexible for our team."

"I learned to trust other people. I had never worked with him before. I felt unsure how we could co-create this together. I normally will give instructions to the team exactly what we will do. But this time, I can't tell my teammate what to do. I have to trust him when we have only a general idea about what we want to make but we can't give the details. We both need to try and improvise in many things. However, it turned out that our work was very impressive and much better than I thought it should be."

Participants learned to face the challenge and suspend their judgment and learn to observe to understand instead of reacting to situations so quickly. In the workshop situation, participants get to apply, try new strategies, and learn from new concepts in real world contexts. Knowledge has been integrated in real life situations. Hands on learning has developed awareness and experience of how it looks like and feels like when they are using this knowledge in real situations.

Living lessons: knowledge is relevant to real life

Participants are also introduced to grounding practice. Grounding is a short meditation practice in which participants will learn to reconnect with their body, calm their mind with sitting and breathing. As learners walked through tough challenges, instead of getting stressed and stuck with the problem, facilitators invited participants to learn to take a little break from the task and practice grounding together. Facilitator leads grounding practice at the beginning of every gathering. Then following up with a short check-in from everyone to reconnect the community together. The workshop aims to show everyone an alternative way to work, to live, to rest, to learn together in the process and invite everyone to try this new lifestyle in the workshop. At the end of the workshop, participants chose to reflect about grounding in many ways.

"I like grounding. I would like to bring it back to my life and my team. It helps refresh our mind in every time we start something or when we are facing a problem. When the machine got stuck, we reset them. Our mind needs to be reset, too."

"I also would like to bring grounding and check-in back to my team. It's interesting and important to connect everyone together to know how everyone is doing before getting into the work."

Instead of teaching and lecturing instruction or philosophical concepts on the slides to teach, the facilitator can design a situation that allows participants to "use" and to "learn" the knowledge in the act. Learners can actually "try" and see its result from direct experience.

An effective reminder in a real-world challenge.

After attending the workshop, memories of the tough and successful Rube Goldberg project still remain in the mind of participants. From the interviews, participants still discuss how the powerful experience in this workshop has impacted their work and how they respond to the world, especially when they are facing challenges.

"I still encountered problems but I had changed the way I responded to it. Those memories reminded me to think of the common goal instead of focusing on who is right or wrong. It reminded me to think of the common goal, what will be the most beneficial to our clients. Then we adjusted ourselves and worked together as a team.", a short interview with a nurse who had attended the workshop once and still works in the same hospital.

Interesting and emotional experiences can last long in our memories. This learning environment effectively helps learners to understand the content and creates new impressions about difficult problems and alternative ways to cope with the challenges. In real life, the problems are still there but they now have the second thought to remind them to stop and think of the situation, reframe the problems and generate alternative responses.

Discussion

Fluid vs. Fixed View of the World

In the world we live in, there are natural things as well as artificial things. The natural world can be characterized as basically fluid. Living things like plants and animals, including us humans, grow, die, and become soil to nurture the next generation. Water drops as rains, flows as rivers into the ocean, some nurturing many life forms, and some may evaporate to make more rains. Even rocks and mountains are never permanent. In contrast, we tend to treat artificial things as fixed: for example, automobiles, home appliances, and other tools and devices that we use daily are not supposed to change their shapes and functions or at least they are usually designed not to change (although some may argue that old Japanese temples were designed to change as the materials age). However, they are made of natural materials and therefore will eventually change and when they can no longer function as designed, they become unusable. Animals, plants and all living things, when they die, are decomposed and regenerated as new life forms, but artificial things are in general not designed to be decomposed and used for new purposes, or we treat them that way. In an industrialized society, most of us are surrounded by artificial tools that are designed to make our lives convenient but using these tools may lead us to have "fixed worldview" in which we believe that they are given to us, and we are not supposed to change them. When we finish using them or they are no longer usable, they become "trash" without any value. We will discuss implications of our workshops by examining what kind of learning the people involved in

these workshops experienced. We try to focus on the change in how they view the world and what processes led to these changes.

Designing Everyday Things

In the Designing Everyday Things workshop, the reflections by the students indicated that their fixed world view could be made more fluid in two senses: Firstly, through the experience of turning what they thought was useless could be turned into something meaningful for them, they learned that artificial things around them are not fixed but can be transformed by their actions. Secondly, they seemed to have learned from the experience that their everyday lives are connected with the society at large and their actions can actually contribute to the society. Overall, their view of the relation between themselves and the rest of the world was transformed from a detached and fixed one into a more connected and fluid one. These observations indicated that their world view has changed from one in which their daily lives were detached from the society into one in which things they use daily, and their daily behaviors were parts of the society tightly connected with each other.

Digital Transformation Workshop

In the Digital Transformation Workshop, the participants' reflections often suggested that in their daily work environments the workflow tends to be fixated to make it more efficient. But this seemed to have led them to focus on what was right or wrong. Also, it seemed to have minimized communication and collaboration, and made it difficult to understand each other among the team members.

During the workshop, the participants made many comments to suggest that such fixated way to view their works was transformed into more fluid one in which they learned to focus on the common goal, rather than what was right or wrong, and learned that people had different approaches to their works.

It is interesting that many participants reflected that "grounding" practice was effective in "resetting" their mind, and helped them "unstuck" themselves and free their minds from states fixated on a problem and find new paths. These reflections indicate that calming down their minds and reconnecting with heart and body with grounding helped to transform their worldview from fixed and detached one to more fluid and connected one.

In both workshops, the participants learned to transform their worldview to more fluid and connected one, not through lectures on some conceptual theories or instructions, but through concrete actions on real materials and people. This suggests that lectures and instructions tend to facilitate more fixed and detached view while concrete actions tend to facilitate more fluid and connected view. In fact, real materials and people are basically fluid and lectures and instructions are basically fixed. In the conference, we would like to discuss implications of these analyses for connecting learning experiences to daily lives and to the society.

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A Study on Media for Learning Experimental Practices in a Community of Practice

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This study investigates the function of media in enhancing learning by sharing the quality of experience within communities of practice. Through empirical observations and theoretical analysis, we illustrate a plausible story that explains the functions of a learning medium focused on sharing the quality of experience. Focusing on a case study of a community of practice in value-creating marketing, the findings highlight the importance of Reflective Writing, where practitioners document the connections between actions and outcomes. Such knowledge, recorded in the medium, benefits future practices. Our study concludes that Reflective Writing serves as an essential learning medium, facilitating the sharing and learning of experimental practices within large communities of practice.

Keywords: Communities of Practice, Experimental Practice, Reflection, Experimental Learning, Quality of Experience

Introduction

Communities of practice has been an important concept in the study of learning environments that facilitate practical and experiential learning. Initially proposed by Lave & Wenger (1991), this concept presents a perspective of learning as a process of *legitimate peripheral participation*, which involves direct engagement in practice. For example, a daughter grows up observing her mother at work as a midwife, an apprentice carefully watches a master tailor at their craft to learn the trade, or a sailor learns to steer a ship through hands-on experience. In such relatively small groups, media for learning or communication were not discussed as problematic due to the scale that allowed for direct interaction.

However, when discussing communities of practice in larger or more dispersed groups, as represented by cases like those discussed by Wenger et al. (2002), media becomes a significant issue. For instance, the means of communication among internationally dispersed members in global companies (Hildreth et al., 2000) or networking between communities of practice within schools and those of external experts (Yamauchi 2003) have been discussed. These cases are just a few examples, but it can be said that the media for interaction among community members has been investigated.

This study particularly focuses not on the media for such interactions, but on the media that share the *quality of experience*, as described by Dewey (1938). According to him, what is important for education and learning is to arrange qualitative present experiences that lead to desirable future experiences. Additionally, Jarvis (2012) highlights that the experiences which particularly serve as criteria for learning are those characterized by experimental and creative actions. This study refers to such actions as *experimental practices*.

This study aims to capture and illustrate the form of media within communities of practice that facilitates the sharing and learning of experimental practices, based on the case studies and theoretical considerations introduced below.

Research Design & Methods

Case: Community of Practice on Value-Creation Marketing

This study conducted a case study on the community of practice on *WAKUWAKU Aesthetics of Business* (hereafter referred to as WAB). WAB is a community of practice that learns the business theory and methods developed by its founder, Yuji Kosaka (Ph.D. in Informatics). These are based on Affective Engineering and are known as *value-creation marketing*. Value-creation marketing is a practice field that follows the principle that "sales are created by customer

behavior." It involves creating and appropriately conveying affective information that becomes valuable to the customer, thereby encouraging their behavior. Over 1,500 small and medium-sized business owners from all over Japan participate as members, representing all industrial categories. Since its inception in 2000, WAB has been active for 24 years.

This community is particularly interesting because it has cultivated its own unique media for knowledge management. WAB publishes a monthly medium called "*Practice Information Journal*" (hereafter referred to as the Journal). This Journal contains two types of documents. One type is the practice reports shared by WAB members, detailing what they have practiced in their own stores or offices. Each document ranges from 1-2 pages for shorter reports to over 10 pages for longer ones. Each issue of the Journal includes 8-10 reports, totaling about 40-50 pages. The other type of document is commentary on the practice reports, written by two mentors, including Kosaka. These commentaries amount to about 15-20 pages.

The process of publishing the Journal and delivering it to members is as follows. Members write reports about their practices to share their experiences and submit them to the WAB office by the monthly deadline. Currently, around 100 to 150 reports are submitted each month. All submitted documents are read by the mentors, who then select the reports deemed valuable to share with the entire community. For each selected practice report, commentary from the perspective of value-creation marketing is written. The commentary and the selected reports are compiled into the monthly Journal, which is then delivered to all WAB members.

Observed Subjects and Approach

This study investigates the media for sharing the quality of experience by combining empirically observable facts from the Journal and theoretical concepts that can explain the underlying logic of those facts. This approach of combining empirical observation with theoretical concepts is called *logical compound synthesis* in social sciences (Itami & Numagami, 1992). The goal of this paper is to present a theoretical hypothesis that can logically explain the reality of the media for sharing the quality of experience.

The subjects of observation were 30 issues (30 months) of the Journal published over the five years from 2016 to 2020. The reports and commentaries included in these issues totaled 268 entries, amounting to over 1,300 pages. Although WAB provided all the Journals, it was difficult to cover the entire period due to the vast amount of data, so we limited our focus to the aforementioned period. Nevertheless, we judged that this sample size was sufficient for our purpose.

In the following sections, we first observe the reports written by the members to investigate (1) whether what they are writing about can indeed be considered experimental practices, (2) how they are writing about these practices by analyzing the textual indicators, and (3) theoretically examine the functions of the Journal as a learning medium.

Results

Characteristics of Experimental Practices in the Community

First, we observed the practices described in the reports to investigate in what sense the practices shared in this community can be called experimental. For this analysis, we used the KJ Method as a qualitative research method (Sato et al., 2019). We derived textual features from the reports to make cards, clustered these cards, and mapped out the semantic structure of the practices. In this process, we randomly selected 30 documents from the target period, made 90 cards, and conducted the clustering.

As a result, we were able to map out three semantic structures: the italicized phrases are keywords derived through the KJ Method. First, their practices can be described as *habit-changing trials*, where they engage in new challenges different from their usual routines to improve the current situation. For these trials, they have goals and hypotheses about the approaches to achieve them: in this sense, their practices are conducted based on *goal-oriented hypotheses*. To achieve these, they employ *creativity grounded in Kata*, meaning they exercise creativity based on the fundamental manners of value-creating marketing they have learned in this community.

Practices that exhibit these three semantic structures can be considered experimental practices in the sense that they are new attempts made in relation to hypotheses. Not all practices carried out within a community of practice are necessarily experimental. As Jarvis (2012) noted, it cannot be ignored that not all practices lead to learning. Therefore, it is meaningful to empirically verify through this approach that the practices (reports) shared in the learning media are indeed experimental practices that can lead to learning.

Report Elements: Descriptions of Action-Outcome Relationships

Next, we examined how practitioners write reports to share their experimental practices and described the structure of the texts. Since the Journal is the most important learning material for WAB, it is significant to verify the information structure of the reports published in it. Upon investigation, we discovered the following structure present in all the reports (the capitalized words indicate the structure). TITLE: The theme of the report is indicated. CONTEXT: The background of the practitioner and the circumstances leading to the practice are described. ACTION: What the practitioner did based on the hypothesis. OUTCOME: Finally, the results and insights from the practice are presented.

In the context of this study, it is particularly notable that the descriptions of Actions and Outcomes are extensive and detailed. For example, consider the following report. In a cleaning store, the owner not only provides cleaning services but also sells food and goods at the storefront. Noticing that a particular product had poor sales for two consecutive years, he hypothesized that "customers might not be aware of this product's existence." To address this issue, he placed the product not only on the shelves but also at the checkout counter and displayed promotional POPs. As a result, he started getting customer responses, and sales increased fivefold compared to the previous year. This series of events is detailed, including photos and data. While this is just one example, all reports share this structure, describing the Actions taken based on hypotheses and their Outcomes.

It is notable that the practitioners not only provide detailed descriptions of Actions and Outcomes but also analyze and identify the relationships between them. For example, in the case mentioned above, he examines how the height at which the product is placed (Action) affects customer responses (Outcome). As observers, we cannot regard the practitioners' detailed descriptions as self-evident. This is because they could also simply choose to report, "I did this" and "I got these results," without further analysis. Additionally, considering the busy schedules of business owners, it is surprising that they have the incentive to write such detailed practice reports.

It seems that the learning function realized by this learning medium is embedded here. How can we explain the practitioners' writing that connects Actions and Outcomes?

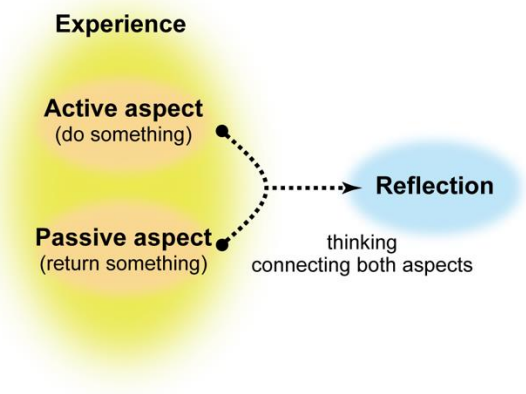
Reflective Writing

A theoretical concept that effectively explains the above empirical observations is Dewey's (1916) concept of reflection. According to him, reflection is not merely recalling or remembering what was experienced, but rather discovering the specific relationships within the experience. These specific relationships refer to the connection between the active and passive aspects inherent in the nature of the experience (Figure 1). In other words, reflective thinking involves discovering the link between doing something and undergoing the results of that action.

The importance of reflection in learning lies in the fact that the knowledge about the actions and results, connected through the reflective thought process, steers future experiences. According to Dewey (1938), the quality of an experience has both an immediate aspect, such as present pleasure or discomfort, and a future aspect, which influences subsequent experiences. He refers to the latter aspect, stating that it is the educator's business to arrange for such qualitative experiences. At the core of this business is reflection (Dewey, 1916).

Figure 1

Reflection connects the active and passive aspects of experience, based on Dewey (1912)



Paraphrasing the above theoretical concepts into our empirical observations, we can explain it as follows. The practitioners at WAB are not merely reporting the facts of what they experienced through their practices. They are exploring the connections between the active aspects (Actions) and the passive aspects (Outcomes) of their practices and reporting these discoveries; in other words, they are reporting records of reflective thinking. These findings become knowledge that serves as a basis for future practice decisions for both the authors of the reports and other members who read them.

Thus, the reports they write embed reflection, which is why this Journal functions as a medium that enhances learning within this community. If the reports were composed solely of facts about whether the practice succeeded at that moment, the quality of experience that steers future practices would be compromised, and it would not lead to learning. Consequently, the community would not have been able to sustain its learning and knowledge management for over 20 years. Based on the above, we would like to conceptualize their community's Journal as a generalized learning medium under the term *Reflective Writing*.

Discussion

Up to this section, we have explored the learning media of the community of practice that shares the quality of experience through empirical observations and theoretical considerations of the reports in WAB. Finally, we will consider the different functions of this media for the learners who participate in it.

One such function is providing opportunities for learners to deliberate their practices. In small groups where media is not necessary, learning through practice occurs directly, and the emphasis may be on what Schön (1983) calls reflection *in* action. However, in learning mediated by media, there is an inevitable distance from the practice, which increases opportunities for reflection *on* action. Dewey (1916) stated that the experiences of reflection "make thinking itself into an experience" and create opportunities for learning. In this sense, Reflective Writing can be considered to serve the function of generating deliberative experiences in large communities of practice.

Conclusion

In this study, we conducted a case study of WAB, a community of practice on value-creation marketing. Through empirical observations and theoretical considerations, we developed a plausible logical story explaining the functions of a learning medium that shares the quality of experience. In a medium that shares the quality of experience, it is essential to share experimental practices. When sharing these practices, it is crucial to record reflective thinking in the medium, which connects actions and outcomes. This is because such records become knowledge that benefits members' future practices. We conclude that the medium of the community of practice, which fulfills this function, can be termed Reflective Writing.

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Mutual Understanding and Learning Opportunities in – Collaborative Cooking with Disabilities and Locals–

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The purpose of this study is to explore the process of mutual understanding and empathy between people with disabilities and local residents in the community through eating together, and to alleviate the sense of loneliness and isolation in the community. Meals, an everyday activity for everyone, are seen as a medium that brings people together. In this study, a workshop was conducted in which users of welfare facilities for persons with disabilities and local residents jointly cooked and ate together. The workshop provided a valuable opportunity for local residents to learn the importance of "inclusion," "diversity," and "coexistence. People from different backgrounds experienced the significance and value of working together and deepened their respect and understanding of each other's differences. This study suggests that food, an essential part of life for everyone, is an effective means of understanding barriers and individual differences within a community.

Keywords: Food Communication, Disabled Person, Local Community, Eating Together, Neighborhood

Introduction

In Japan, the population is rapidly aging, and loneliness and isolation among the elderly and disabled have become serious community problems. According to the Ministry of Internal Affairs and Communications, the elderly population aged 65 and over accounts for about 28% of the total population and is expected to increase further in the future. Similarly, it has become clear that many people with disabilities are isolated from society because they are unable to receive the support they need. In addition, these problems are further exacerbated by the COVID-19 epidemic beginning in 2020. The voluntary refraining from going out to prevent the spread of infection and the spread of remote work have reduced opportunities for people to interact with each other, and situations of social isolation are increasing, especially among the elderly and the disabled.

These issues of loneliness and isolation need to be viewed not only as individual problems but also as community issues. The isolation of the elderly and the disabled within the community risks weakening the cohesion and cooperation of the community as a whole. It is important to provide opportunities for interaction within the community and create opportunities to live together and help each other.

Research Design & Methods

Purpose

The purpose of this study is to explore the process of mutual understanding and empathy that may occur between local residents with disabilities and local residents through cooking and eating together, and its possibilities of learning and reducing loneliness and isolation in the community. Since this study considers "to eat" or "food," which is an everyday activity for everyone, as a medium that relatively easily mediates people, the action research has been conducted by using workshops in which the disabled and their local residents cook and eat together.

Previous studies

In terms of the study of using food as a medium to promote understanding between people, the "Neighbor Days" is a quite successful case. This community event, which began in France, aims to deepen exchanges among neighbors by having them bring their own food and share a meal together, thereby contributing to the revitalization of the local community. Hiratsuka (2020), who has been conducting research on shared kitchens, found that a place for sharing food builds weak ties as participants cook and eat together in a shared kitchen.

These previous studies suggest that communal eating activities in local communities are an effective means of reducing social isolation and fostering ties among local residents. Based on that, this study considers food as a

medium and research on whether a similar effect can be obtained by conducting a workshop in which users of support facilities for the disabled and local residents cook and share meals together.

Research methods

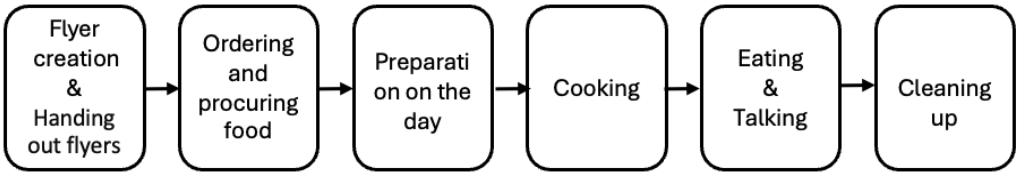
In this study, an event titled "Small Neighbors Festival" was held at A Juridical Person for Social Welfare of Ibuki (thereafter IBUKI) in Gifu City, Gifu Prefecture, once a month from September 2024 to January 2025, for a total of five events. The purpose of this event was to encourage local residents and the disabled to work together to cook and enjoy a meal together. The dates and cooking details of each event are as follows.

1st	2nd	3rd	4th	5th
2/9/2023	21/10/2023	23/11/2023	16/12/2023	20/1/2024
Paella	Pizza	Imoni	Miso soup with pork	Curry

Conditions of Participation

The participants in the Small Neighbors Festival were users (mentally and physically disabled persons) of the IBUKI and local residents in the neighborhood. Each local resident was required to bring one dish and an empty plate for daily use to the event.

Process of the Small Neighbor Festival



Evaluation and Recording

- Participant observation: Pay attention to the behavior of the participants during collaborative cooking, the interactions between participants, and the content of the dialogue during communal meals.
- Semi-structured interviews: After the event, interviews were conducted with participants and stakeholders to learn about their impressions of the event and any issues they faced.

Results

Result of analysis

This chapter is based on participant observations during the activity. Previous research has shown that cooking together and eating together within a community is expected to increase a sense of solidarity within the community as well as tolerance for different opinions and customs. This research expected that by holding the event every month, it would become recognized as "Small Neighbors Festival" in the community, and it would be possible to encourage participation from people who are lonely and isolated. It was also expected that the disabled would continue to be interested in the event and be able to demonstrate skills that they would not be shown through activities only in the facility.

Reasonable adjustments in communal meals

Two weeks prior to starting the event, an event poster was made at the IBUKI, and flyers were posted in the neighborhood by the disabled on their way to take a walk around the area. Although some of the participants seemed puzzled by their first time posting, as the number of times they did so increased, they became more aware of the importance of putting flyers in the mailboxes and changed to putting them in spontaneously. During the day's work, we increased the number of tasks that did not require the use of tools so that many people could participate in the

work. We also made reasonable adjustments[1] to provide visual support and assistive devices for those who had difficulty using their hands and fingers or understanding numbers.

Knives are not normally used in activities within the facility, but local Participant H asked User A to cut *asparagus* with her. Although the staff assisting her at the facility prohibited her from doing so, Participant H gave User A a knife and assisted User A himself. User A held the knife correctly without being instructed, and he curled the fingers to tuck them under. This behavior suggested that User A had learned to use a knife in the past or had experience using it. Even people with weak grip strength could participate in the work of loosening *shimeji* and *maitake mushrooms*, so when I showed them the work and assisted them, I saw them actively doing the work. *Mushrooms* were selected as an ingredient in all of the dishes five times. As the number of events has increased, the children have become able to spontaneously participate in the task of loosening *mushrooms* when they see them, even without explanation. This indicated that through repeated practices, the disabled have learned how to dispose of *mushrooms*.

In one session, participants made *paella*, and as the dish neared completion, people gradually gathered around the pot and sporadic conversations occurred. As Hiratsuka mentioned that as the dish is completed, communication becomes more active and the physical distance between participants becomes closer (2020), a similar situation was observed at this workshop. Participants who were initially confused gradually deepened their interaction with each other. Based upon the observation, not only did the physical distance become closer, but also the psychological distance was getting closer. Users also changed over the course of the workshop. For example, User A was an active participant from the first *paella* but had little communication with community members or the facilitator. At the *pork miso soup* party, an old woman with her grandchild (a 6-year-old girl) and a woman from Sri Lanka (called Participant S) joined; the girl greeted Participant S in English, which she had just learned. The facilitator asked Participant S in English if it was okay to use *pork*, which may not be eaten in her country. Participant A said that she knew that there were foods she could not eat for religious reasons, but she had not thought about taking them into consideration.; at the fifth *curry* party, the facilitator took off the apron she was wearing and put it on User A, who sang the "Curry Rice Song" while stirring the pot. The facilitator took off the apron and put it on User A, who stirred the pot while singing the "Curry Rice Song." Participants searched for the "Curry Rice Song" on their smartphones and sang the song together, creating a sense of unity among the participants. An elderly local Participant T shared her memories of chopping vegetables and putting them in *curry* for her child, who had many likes and dislikes, while cooking the *curry*. Furthermore, Participant Y, who is raising a child, began to discuss how to eliminate her child's likes and dislikes, and other conversations ensued.

Food selection and process innovation

This workshop also revealed that the selection of food, where to eat it, and the process have been greatly influenced by communication. The menu of the second event was *pizza*, and the facilitator prepared the *pizza* dough, and in preparation for the toppings to be put on the *pizza*, the participants worked together to loosen the *mushrooms* into bite-sized pieces. We prepared approximately 20 cm of *pizza* dough, and each person added their own toppings. Facility staff F was in charge of baking the *pizza*. Since eating was to be done in an indoor activity room, the people making the *pizza* and the people eating it were separated. Even though *pizza* topping was a collaborative process, there were many situations in which participants worked alone, and it was confirmed that the type of food and the way the work progressed greatly influenced the number of interactions and dialogue among participants. In particular, the *pizza* baking and eating were done in separate locations, resulting in a lack of a sense that everyone was working together. Based on this experience, we decided to conduct all subsequent workshops in the same space from cooking to eating.

Interview

Although the users were bewildered by their first time making and posting flyers, they tried to make contact with local residents. Handing out flyers created communication, and stories about the plates and chopsticks they brought with them became conversation starters. Staff F also commented, "We had a fixed concept of what they could do, and we had set a hurdle for them that they could only do so much. This time, we went beyond that and found that they could do many more things than we had imagined." In particular, the task of unraveling the *shimeji mushrooms* was very familiar to the disabled, and as each session progressed, we saw more and more people spontaneously participating in the work, which increased their involvement and motivation in the event.

Staff A said, "When I go for a walk with the users as an activity, they have always greeted me, but now I greet them in a louder voice. I feel like I am accepted," she said. Through the Small Neighborhood Festival, the number of people who knew each other increased and they became recognized in the community. Although there was a sense

[1] Reasonable adjustment differs from reasonable consideration in that it refers to adjustments that refer to specific measures and changes to the difficulties and barriers that people with disabilities encounter in society through various devices.

of distance between the participants at the beginning, this gradually changed and mutual involvement deepened. In some cases, the roles were too clearly defined, resulting in fragmentation into individual tasks, but by reflecting on and sharing the initial objectives and individual roles among the staff members, it was possible to adjust the course of the event from then on. In particular, when making curry, a sense of unity was created as participants worked together to cook and enjoy the meal together. On rainy days, tents were set up to create space, and on cold days, people naturally gathered around the stove, further deepening interaction. The event also provided an opportunity for the elderly in the community to come into contact with the younger generation and foreigners, and to experience diversity.

Discussion

Through the practice of a series of small neighborhood festivals, cooking and eating together provided an opportunity to involve third parties such as local residents in a closed community within a support facility for persons with disabilities, and broke down stereotypes that people had about persons with disabilities. For the participants, including local residents and the staff members, the event deepened their interactions with others, expanded their social connections, and deepened their awareness and understanding of the disabled and their potential for social participation. Furthermore, for all participants, not just those with disabilities, new perspectives and skills were gained, and the mutual involvement, understanding, and respect of participants provided an opportunity for all to challenge each other equally, unlike the relationship between caregivers and receivers.

In addition, many studies have shown that the act of eating together creates the capacity for empathy, but by involving participants not only in the preparation of the food, but also in the cooking and preparation stages, the act of "eating," which everyone does, promotes active involvement. In addition, food has the power to evoke emotions and memories, allowing individuals to share their personal experiences and stories through specific dishes and ingredients. Sustained and multi-generational exchange in the community has been created, and community efforts have become more inclusive and diverse. Specifically, the older members of the community came into contact with the younger generation and foreigners, which naturally led to greater mutual understanding and multicultural education. Not only did the participants learn practical skills through cooking activities, but they also had the opportunity to recognize the importance of cooperation and communication through collaborative work.

In conclusion, this study considered food as a medium that promotes understanding between people. In other words, food is a medium that involves a variety of activities at multiple stages including preparation, cooking, eating, and cleaning up. Above all, it differs from other media in that it provides a place where people can enjoy the pleasure of eating together and share their own stories with each other. This study suggests that the use of food as a medium for eating together can be an effective means of learning barriers and individual differences existing in our society. In the future, it will be useful in creating a sense of solidarity within the community and in building a foundation for support systems in times of disaster or emergency.

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Connecting Adolescent Girls through Collaborative Digital Storytelling

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Abstract. Digital storytelling is a powerful educational tool for young people to express their ideas, develop critical thinking, represent their identities, and encourage social engagement through digital media. However, adolescent girls often face limitations due to gender gaps and traditional norms, restricting their access to online information and social services. This study explores how digital storytelling can empower girls and enhance cross-cultural collaboration. Using Participatory Action Research and the DSSM framework, fifty-six adolescents from different countries participated in an eight-session program. The girls demonstrated positive engagement and adaptability and took active roles, transforming their narratives from struggles to ones of strength and advocacy.

Keywords: Cross-cultural collaboration, Digital storytelling, Girls empowerment

Introduction

Digital storytelling is a powerful educational tool for young people to express their ideas, develop critical thinking, represent their identities, and encourage social engagement through digital media (Grant & Bolin, 2016; Hung et al., 2012; Gilhooly & Lee, 2014; Yang & Wu, 2012). Nonetheless, adolescent girls face limitations in accessing information and social services online due to gender gaps and traditional norms (Clark-Parsons, 2017). These limitations deny them the ability to make decisions, collaborate with others, and navigate new experiences to improve their lives. This study examines how digital storytelling can empower girls and enhance cross-cultural collaboration. Fifty-six adolescents participated in an eight-session program from January to March 2023. Using Participatory Action Research, adolescents actively contributed to the research process, addressing their concerns and building social connections (Ferrell, 2014; Gilhooly & Lee, 2017). The DSSM framework was used to analyze their digital storytelling experiences and outcomes.

Theoretical framework

Digital Storytelling

Digital Storytelling (DS) is a tool and method that combines the art of telling stories with digital media. These stories generally last 2 to 10 minutes and are shared through digital platforms (Alonso et al., 2013; Jenkins & Gravestock, 2014). Robin (2006) categorizes DS into three types: 1) personal narratives, 2) historical documentaries, and 3) stories that inform or instruct. Young people utilize DS to create content in their own words, represent themselves creatively, and increase their confidence (Grant & Bolin, 2016).

DS has been widely introduced in education as an innovative tool to foster digital, technological, informational, and visual literacies (Robin, 2008). It also promotes self-reflection and meaning-making from students' experiences (Brooke & Lambert, 2017; Rossiter & García, 2010). DS serves as an inclusive assessment tool for exploring personal and social issues, especially among underrepresented populations, and drives positive changes in their lives (Jenkins & Gravestock, 2014; Polk, 2010).

Empowering girls through digital storytelling

Girls' empowerment is a dynamic process that involves lifelong learning skills, critical thinking, and awareness of gender and power issues. It is not a one-time achievement but an ongoing journey (Bergsma, 2004). Empowering girls means equipping them with competencies to address personal and communal challenges, helping them fulfill their potential, shape their identities, and contribute to creating a better world (Castro-Romero, 2024).

In this sense, digital storytelling (DS) is an effective tool for girls' empowerment (Moutafidou & Bratitsis, 2018), as it allows them to create self-generated content, build new social connections, and develop new identities

from self-representation, self-disclosure, and collective identity (Castro-Romero, 2024). Telling stories becomes an act of trust (Wilson, 2021) as girls align their values with others who share similar interests, beliefs, and dreams.

In order to guide this research, the following questions are proposed

1. What are the lived experiences of adolescent girls that contributed to their digital storytelling projects?
2. How do adolescent girls collaborate with peers to address personal growth and social change?

Research Design & Methods

The Global Girls Meeting (GGM) program was implemented from January to March 2013 and gathered fifty-six adolescents from different countries. Participants were mostly girls (77%), with a median age of 15 years. Most were in high school (59%, followed by middle school 32%, university 5%, and elementary 1.7%), and English was mainly their second language. The program aimed to amplify adolescent girls' voices for self-expression, communicating with new friends, and engaging in collaborative digital storytelling projects.

The DSSM framework allowed girls to find and address personal and collective issues and create action plans and solutions through five phases: story exploration, storytelling and listening, story making, story sharing and reflecting, and advocacy through stories (Castro-Romero, 2024). This framework for girls' empowerment contributes to analyzing girls' social relationships. Data were collected through reflective journals, session transcriptions, digital storytelling outputs, and semi-structured interviews. Analysis was conducted using QDA Miner Lite software through open coding, axial coding, and categorizations (Williams & Moser, 2019).

Results

1) What are the lived experiences of adolescent girls that contributed to their digital storytelling projects?

Girls reflected on their lives, culture, and values and developed empathy. They discussed diverse topics affecting them and their local communities, such as mental health, communication difficulties, girls' risks like violence and discrimination, part-time jobs, workplace gender inequality, gender stereotyping, and environmental issues. Digital storytelling techniques, like the "Tree of Life" and the "Ring of Growth," were used as narrative therapy to help girls express their experiences and emotions. Moreover, they utilized a five-stage story plot based on the Tree of Problem (Haggerty, 2016). It consisted of analyzing and observing the cause of the problem and the main problem, researching the current situation, proposing solutions, and taking actions toward a "bright future" as a metaphor for a better life.

Girls communicated creatively through illustrations, photographs, drawings, and multimedia content. Visuals captured attention while conveying concepts, proposing practical solutions to problems, and tailoring digital presentations. For instance, Mika and Anny, two Japanese high school students, used Google Slides to present a topic on ozone layer depletion. Their project followed a logical structure and sequence, demonstrating academic abilities such as researching, report writing, and presenting (see Figure 1).

Figure 1

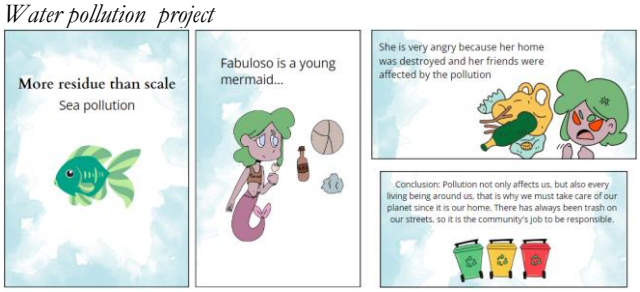
Climate change project

Dewey (2007) emphasizes the link between academic abilities and students' personal experiences, facilitating the exploration of everyday problems. This engagement helps students understand topics and meaning-making and connect them with school subjects (Edutopia, 2008). On the other hand, Ami (a 14-year-old girl, middle school student) and Roberto (a 16-year-old boy, high school student) addressed water pollution using fun characters created in Canva.

Their comic-style presentation raised awareness about the importance of protecting the ecosystems (see Figure 2) in an original, fun, and creative manner.

Figure 2

Water pollution project



(1) How do adolescent girls collaborate with peers to address personal growth and social change?

Collaborating through digital storytelling projects involved girls working in teams as leaders, presenters, researchers, or content creators. The willingness to share their ideas, emotions, and opinions was determined by creating a safe space where they felt heard, valued, and not judged. Breakout rooms facilitated engagement and social connection (Fuller et al., 2021), allowing girls to express themselves in small groups and validate their experiences, knowledge, and skills among peers.

Information exchange also facilitated the development of trust and social connections. However, girls' participation revealed differences in engagement levels. There were two types of active engagement: the stable group and the active group. The stable group is those with prior connections (like Mika and Anny, who were in the same school, the same city, or were close friends) who found a comfort zone. On the other hand, the active group adapted and cooperated despite cultural differences, finding common interests that fostered genuine connections. Collaborative digital storytelling emerged in both groups based on shared social identities, values, and beliefs. Language also plays a vital role in increasing or maintaining engagement, whether in a foreign or native language.

Discussion

Girls were able to amplify their voices with digital storytelling and actively contribute to personal growth and social change by collaborating with their local and global community, enabling them to express their ideas, self-represent their identities, and create social connections. The power of their narratives lies in evoking emotions and persuading an audience by presenting personal struggles and social issues, as well as offering solutions and practical actions. However, storytelling requires a developing language (oral, written, visual) to effectively transmit information and understand cultural contexts (Lindgren, 2018) to develop a complex understanding. Girls can build meaningful connections with their peers, fostering a sense of belonging and perceived value within a group, positively impacting their socio-emotional relationships (Weaver et al., 2022), even with friends from different cultural backgrounds (Sehrawat et al., 2017). A common language can transcend borders through digital media and establish continuity in their relationships.

Conclusion

This study aimed to examine how digital storytelling can empower girls and enhance cross-cultural collaboration. Girls demonstrated positive engagement and adaptability in their social interaction for cross-cultural collaboration and assumed active roles when engaged in conversations with new friends. The willingness to share their ideas, opinions, and personal information is determined by creating a safe space for building trust and self-confidence, transforming their narrative from one of struggles to one of strength and advocacy.

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Utilizing a Performative Approach through the Use of Multimedia to Enhance Achievements to Learn Sports in Athletic Materials

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Abstract
This research focuses on utilizing a performative approach through the use of multimedia to enhance achievements in sports learning. The study is conducted by researchers from the Faculty of Sport Education at Manado State University, Indonesia. The purpose of the research is to develop multimedia on learning materials for Athletic Variations, using the ADDIE multimedia development paradigm. The study aims to improve student learning achievement by making the learning process more interactive and engaging through the use of multimedia. The researchers conducted product trials on small and large groups, and obtained assessments from educators and students. The results showed that the developed multimedia was found to be very feasible and could be used during learning. The study concludes that interactive multimedia in sports learning is declared very feasible and can help students more efficiently receive knowledge.

Keywords: Multimedia, Motivation, Performative Approach

Introduction

Along with the times, the globalization era in the 21st century has presented many new innovations in various aspects. Education is one of the things affected by the development of science and technology. The presence of multimedia as a product of information and communication technology in the world of education is welcomed, because the role of multimedia products can help both teachers and students to achieve the goals of education. According to Husna, et al., (2017) explained that the presence of multimedia learning technology is predicted to improve the routine of education. The purpose of education is to optimize student abilities and can help students develop their abilities perfectly, both in the form of physical, intellectual and emotional aspects.

Multimedia technology has developed rapidly and become an increasingly important tool in various fields, including sports training. Multimedia can be used to increase the effectiveness and efficiency of training, as well as to make the teaching and learning process more interesting and interactive. Multimedia is a powerful tool that can be used to improve the effectiveness and efficiency of sports training. By using multimedia effectively, teachers can help students to achieve their best potential especially in sports learning.

Sports learning not only prioritizes understanding through theoretical, but also prioritizes the ability of students to be skilled and active in practice (Thomson and Mc Lenan, 2015). Interactive multimedia

combines various things such as text, images, video, animation, and audio. The application of interactive media cannot be separated from the application of technology in learning. In addition, the interactive

multimedia will contain examples and practices that must be done by users along with an evaluation of each athletic sub subject matter. The multimedia will assist teachers in teaching as well as students can use independently to learn. With the use of creative and innovative interactive multimedia, it is expected to be able to make the quality of learning both processes and results better.

Sports achievement coaching activities, especially athletics through extracurricular activities, aim to instill the basic techniques of the sport concerned. Likewise, in extracurricular activities in athletics. Sports teachers and athletic trainers should direct the focus of coaching on mastering the motion process of basic athletic techniques. Sports coaches and teachers generally only rely on conventional methods such as the parts and whole method teaching style to teach all sports activities (Wiradiharja, et al, 2017). This is due to the lack of knowledge of the coach or teacher about teaching styles, which is actually an important factor in achieving success. The coach/teacher's efforts to provide basic exercises to students often have difficulty in presenting them, so that the expected results are not in accordance with what is desired.

To teach a type of learning achievement, the use of teaching style is instrumental in determining the success of the teaching and learning process. Therefore, trainers/teachers are required to be skilled in using and choosing teaching styles to achieve the desired goals. In teaching and learning activities, different levels of creativity possessed by students will show different levels of success. This also applies in learning activities for athletic learning achievements, the potential creativity possessed by students is a process of manifesting itself in the form of fluency, flexibility, and originality of thought in doing something activity. Through a performative approach in the use of multimedia in the learning process, it is hoped that it can improve student learning achievement.

Research Design & Methods

In this study, researchers tested the product of this development research, which was carried out by expert evaluation, namely (media experts, learning experts and product evaluation), (media experts, learning experts and material experts). Then the test subjects of the development research, namely game experts, learning experts, media experts, media experts, user experts and 100 students. Type of data are qualitative and quantitative data. data collection techniques, namely observation and questionnaire. Qualitative data was obtained from observations during product trials. While quantitative data is obtained from the results of a questionnaire distributed to 100 students who take part in sports learning. Development research of this educational media development research collects data using a quantitative data analysis approach.

Results

This research aims to develop multimedia on learning materials for Athletic Variations. The research and development procedure is an adaptation of the ADDIE research steps, which consists of five steps Analysis, Design, Development, Implementation, Evaluation. Validation is carried out by media experts, material experts, and linguists whose results will be in the form of assessments, input and suggestions based on the products that have been made.

The results of the assessment of stage I material experts by validator I and validator II obtained results, namely in the aspect of the suitability of the material getting a result of 72.85%, the aspect of the presentation component got a result of 70% So, the average results of the two aspects got a result of 74.66% in the "Worthy" criteria. the results of the validation of the material expert can be seen in table 1.

Table 1. Results of validation by material experts

Assessment Aspect	∑X Per Aspect	Maximum Score	Score Percentage	Average percentage	Criteria
Aspects of	51	70	72,85%		

				74,66 %	Eligible
Aspects of the presentation	35	50	70%		

The results of the assessment of stage II material experts by validator I and validator II obtained results, namely in the aspect of the suitability of the material getting a result of 97.57%, the aspect of the presentation component got a result of 94% So, the average results of the two aspects obtained a result of 95.83 in the "Very Feasible" criteria. To make it easier to see the results of the material expert validation, you can see the following table:

Table 2. Results of validation by material experts

Assessment Aspect	∑X Per Aspect	Maximum Score	Score Percentage	Average percentage	Criteria
Aspects of material suitability	68	70	97,57%	95,83 %	Completely Feasible
Aspects of the presentation	47	50	94%		

The results of the linguist assessment by validators I and II obtained results, namely in the straightforward and communicative aspects getting 85% results, dialogical and interactive aspects getting 90% results, and in the aspect of using language rules, terms, symbols and icons getting 90% results. So, the average result of the three aspects obtained a result of 88%, included in the "Very Feasible" criteria. To make it easier to see the validation results from linguists, you can see the following picture.

Table 3. Results of validation by language experts

Assessment Aspect	∑X Per Aspect	Maximum Score	Score Percentage	Average percentage	Criteria
Straightforward and Communicative	34	40	85%	88 %	Completely Feasible
Dialogical and Interactive	18	20	90 %		
Use of rules	36	40	90 %		

Researchers conducted product trials on small groups, large groups (field tests), and obtained assessments from educators on the media developed. When conducting product tests, researchers explain the contents contained in the learning media. The results of each product trial are as follows:

1. Small Group Trial

The small group trial was conducted by taking a sample of 100 students from and involving educators who teach sports. The results of the educator's response obtained, namely in the aspect of content feasibility 100%, the presentation feasibility aspect got 100%. The results of the small-scale trial assessment on students obtained results, namely in the aspect of content feasibility getting a result of 87.2%, the feasibility aspect of presentation getting a result of 88.5%.

Results of the small group attractiveness test

The results of the attractiveness test are categorized as very interesting from the average of the twoaspects,namely the educators and students, each obtained a percentage of 100% and 87, 90%.

2. Large Group Trial

In the small group trial then the last stage is a large group trial involving 100 students and educators or class teachers. So, the total respondents needed for the large group trial were 45 students and educators. The results of the assessment of the response of educators or pjok teachers obtained results, namely in the aspect of content feasibility getting 100% results, the feasibility aspect of presentation getting 100% results. So, the

average assessment of the educator's response is 100%, included in the "Very Feasible" criteria. The results

of the large-scale trial assessment of students' responses obtained results from the content feasibility aspect getting a result of 90.4%, the presentation feasibility aspect getting a result of 90.44%. So, the average result of the two aspects obtained a result of 90.42%, included in the "Very Interesting" criteria.

Discussion

The final product resulting from this research is Interactive Multimedia. By going through revisions in accordance with the criticisms and suggestions of media experts, material experts, and linguists. The assessment of the media experts received a percentage of 87.36% in the "Very Feasible" criteria, the material expert received a percentage of 95.83% in the "very feasible" criteria and the linguist received a percentage of 88% in the "Very Feasible" criteria. From the test results, it can be seen that the BI Interactive Multimedia developed by researchers received the title "Very Feasible" in all aspects. Thus, Articulate Storyline Interactive learning media can be used as learning media in the teaching and learning process at school. Interactive Multimedia developed by researchers can increase students' motivation and learning achievement (Juhaeni et al., 2021; Setyaningsih et al., 2020), because this learning media has several interesting elements in the media. Especially in this learning media there are videos that are in accordance with the material, and there are various animated images in it. So that it attracts students' learning interest and curiosity.

Conclusion

The conclusion obtained from this research and development can be concluded that interactive multimedia in sports learning is declared Very Feasible. learning media that can help students more efficiently receive knowledge. Based on the author's experience, sports learning is done monotonously. There are even some educators who only use books as the only media in delivering learning materials. At this time, we have entered the industrial revolution 4.0, of course we need to equip students with learning experiences that are relevant to the level of development of the times. It is hoped that the development of Interactive Multimedia can increase motivation for students in the learning process and get a high curiosity and pleasure in learning. The use of learning media is expected to be able to make students more memorable with an interesting learning process.

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Performative Learning as an Innovative Approach A Case of High School Activities outside of School

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Abstract: This presentation reports on high school students engaging in performative learning with local community members and organizations. Research focusing on high schools as a field of study has been rare in Japan, primarily because the rigidity of university entrance exam-focused education left little room for innovative learning practices. However, with the current era's significant demographic decline, there has been a shift This study examines cases where high school students teach SDGs to elementary school children in libraries and collaborate with the elementary school children in Japan primarily because the rigidity of university entrance exam-focused education left little room for innovative learning practices. This study examines cases where high school students teach SDGs to elementary school children in libraries and collaborate with elderly volunteers to thin bamboo groves and create bamboo crafts for sale. conducted outside the school curriculum as voluntary student initiatives, yet they contribute significantly to student development.

Keywords: performative learning, social constructionism, art-based research, high school

Introduction

Except for sociological educational research, researchers in Japan have tended to avoid focusing on high school education as a research subject. I assume that this is the same tendency in other East Asian countries. This is because the major goal of high school education is to prepare students for university entrance examinations, which places difficulty on researchers who would like to introduce innovative learning styles.

In order to pass university entrance examinations, students must thoroughly understand past entrance examinations and develop the ability to solve problems in time. Therefore, high school education focuses on memorizing vast amounts of knowledge and scoring high marks by writing it down at the time of tests. In other words, the high school focus is on teaching students to pass college entrance exams. Teachers have been required to prepare lessons to obtain high scores on tests, and students have been required to attend tutoring sessions after class. Under these circumstances, it is not easy for outside researchers to conduct educational research targeting high schools. From the high school's point of view, researchers were considered to be an obstacle to education, and intervention studies in the classroom were not welcomed.

However, this situation has been changing in recent years. While the number of students has decreased due to the declining birthrate, the number of universities has increased. Currently, the number of universities in Japan exceeds 800, and some universities in rural areas are closing their doors because they are unable to meet their student enrollment capacity. This is because the number of students that universities can accept now exceeds the number of students who wish to enroll.

Under these circumstances, the view of competencies required in education has also changed. The importance of nurturing non-cognitive competencies, rather than the conventional knowledge-intensive education, has come to be shared by many. As a result, "inquiry-based learning" was introduced in high schools, and a direction was sought to cultivate both cognitive and non-cognitive skills by finding problems on one's own and tackling issues for which there are no easy answers. In university entrance examinations, the number of students who enter universities without paper-based examinations, such as AO examinations and recommendation examinations, has come to account for almost half of the total number of students. Thus, it can be said that the nature of high school education has changed in response to changes in society. In the search for new learning styles, such as project-based learning and inquiry-based learning, it has become easier to conduct research to reform the learning style of high schools in cooperation with researchers.

Therefore, in this presentation, we will examine an innovative way of learning in a high school as a case study. This study is ongoing, and this presentation is an interim report.

Case Study: High School Students' Out-of-School Activities

The case is a private high school in Osaka. After entering high school, students are divided into classes according to their career paths, but the majority of students do not take the general entrance examination to enter university. In other words, they do not take entrance examinations based on so-called paper tests. The goal of the students is to grow as individuals through a variety of experiences during their high school years. However, since it is difficult for high school teachers alone to prepare a variety of experiences, it is necessary to collaborate with outside researchers. In fact, this high school has been focusing on cooperation with universities and NPOs, and various outsiders have been cooperating with the high school's activities.

As a member of a non-profit organization, I have been working with this high school to support fieldwork outside of school. In this presentation, I will introduce two activities: (1) SDGs learning in the library and (2) Satoyama conservation activities. Both activities are not part of the regular high school curriculum and are informal activities outside of class, but the students participate voluntarily because they see them as activities that lead to their personal growth.

(1) SDGs Learning in Libraries

Once a month, high school students provide learning about the SDGs to elementary school pupils at the library. The purpose is to deepen the understanding of the SDGs among the participating elementary school students by playing games and making artworks. For example, through making a work of art using toilet paper cores, we aim to nurture an attitude of using carefully what would normally be thrown away immediately, and through the experience of taking apart a cell phone, we aim to promote understanding of the importance of recycling.

Every Monday night, the high school students meet with university students to discuss activities and prepare for the event. The university students give advice on how to realize the proposals made by the high school students and coordinate with the library staff, which makes the activities run smoothly. Under the supervision of the university students, the high school students play the role of instructors, helping the elementary school pupils and supporting their learning.

(2) Satoyama Conservation Activities

In Japan, the price of lumber has been stagnant and cutting trees is not profitable, so forests have become inaccessible, resulting in environmental destruction. Not only planted forests of Japanese cedar and cypress, but also natural forests of broadleaf trees have been neglected, and wild animals such as deer and bears have increased, haunting the countryside and causing agricultural damage. Although forest management is something that must be done on a daily basis, the owners of the forests often live elsewhere, and most of the forests are left untouched and neglected. In order to do something about this situation, a local volunteer group has been working. The high school students go out to the mountains with the volunteer group and carry out conservation activities together. Activities include digging for bamboo shoots, thinning trees, and maintaining hiking trails. They also take the wood and bamboo they cut back to school to make crafts. The crafts are sold to the public at a cultural festival.

Students who participated in these two activities gave the following feedback.

Students participating in the library's SDG study
Student A: "It gives me a sense of accomplishment to think about the content of the activity, prepare it, actually explain it to the elementary school students, have them create a work of art, and have them be pleased with it."
Student B: "I enjoy interacting with elementary school pupils. I want to do it again."

Students participating in satoyama conservation activities
Student C: "When I see elderly people working hard to protect nature, I think we need to work harder too."
Student D: "It is fun to actually go to the mountains and make various things using bamboo and wood that we have taken from the mountains ourselves."
Student E: "I had never thought about forests before, but now that I've actually been in the mountains and thinned the forests, now I understand what's going on in the Satoyama."
Student F: "I brought home the bamboos I cut down in the bamboo grove and made various crafts. We will sell them at the festival and use the income we earn for our future activities."

The students' impressions of these activities were very positive and showed a willingness to continue to actively participate.

discussion

These two activities were not initiated voluntarily by the students, but were proposed by the NPO, and the students were invited to participate in consultation with teachers. Students want to be involved in some kind of social activity, but they do not know exactly what they can do. However, when given an opportunity, students begin to take part in activities on their own initiative. I call the activities discussed in the case study "performative learning" and distinguish it from "traditional learning." In Japan, this type of learning is called "project-based learning" or "inquiry learning. Traditional learning is conducted in preparation for university entrance examinations, but the importance of "informative learning" is gradually being recognized. Particularly, in the case of AO and recommendation entrance examinations, what kind of life students lead in high school is emphasized, and their active involvement in activities to tackle social issues is highly valued.

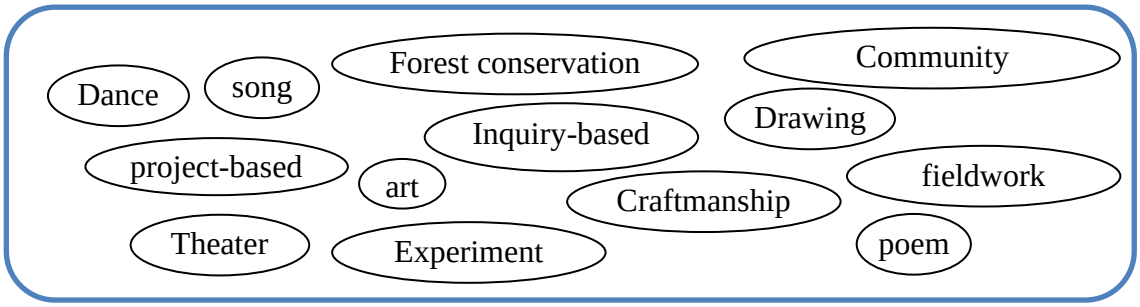

Figure 1: Scope of performative learning

The following table compares traditional and performative learning

Table 1: Comparison between traditional and performative learning

Traditional learning	Performative learning
Inside a classroom	Outside of a school
Compulsory	Voluntary
Same age group	Different age groups
Homogeneity/sameness	Heterogeneity/diversity
One-way (monolog)	Interactive (dialog)
Objective-oriented	Process-oriented
Competition	Collaboration
Assess by test	Reflection
Efficiency	Agency

Traditional learning tends to be centered on classroom-type learning activities and tends to be a one-way flow of knowledge from teacher to student. Performative learning, on the other hand, often takes place outside of the school and is based on students' independent efforts. Students can deepen their learning by engaging in activities not only with their peers but also with people of different ages (Gergen & Gill, 2020).

Conclusion

Performative learning has become increasingly important in recent years. Of course, traditional learning is also important, and it is still required to acquire basic knowledge, and it is important to balance inquiry based learning with traditional learning (Gergen, 2009). Gergen & Gergen (2012) proposed the concept of performative social science as a methodology for studying performative learning. Such research methodology is part of the paradigm of art-based research (Leavy, 2020), which is an effort to integrate formative activities with research methods. In this study, we are still examining how we can use the students' performative activities as the output of the research.

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Learning Open Dialogue with Performative Approach: Potentials of Online Sessions

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Abstract

Open Dialogue for mental illness care has been proven to apply to a variety of care fields, including education, and the need for learning is growing rapidly. Its group dialogue approach brings about healing and empowerment not only to care recipients but also to professionals.

I explain how the performative approach, play and improvisation, can be incorporated into Open Dialogue training. The designed course is an introductory Open Dialogue workshop series done online, intended to give mental-care professionals experience of the principles of Open Dialogue.

I also describe how an improv game facilitates learning and experiencing one of the principles, "tolerating uncertainty," which is considered to be particularly difficult in Japanese culture. The participants' reflections suggest that the improv game helps them to feel their partner's presence while gazing at each other through the computer screen, without hastily jumping to the answer.

Keywords: improvisation, online effects, Open Dialogue, performative approach, tolerance of uncertainty

Introduction

The performative approach helps mental-care professionals learn Open Dialogue's principles

Open Dialogue, which was developed in Finland in the 1980s for the treatment and care of mental illness, has proven to be applicable to a variety of other care service areas (Iba 2017, Ishihara & Saito eds. 2022, Hosokawa et al. 2020), such as supporting *hikikomori* in Japan. Group dialogues reactivate the inherent human nature to stay together in the "here and now." This applies not only to care recipients, but also to mental-care professionals who can experience healing and empowerment (Seikkula & Arnkil 2014).

I have designed and conducted introductory Open Dialogue workshops incorporating the performative approach so that mental-care professionals can learn the key principles of Open Dialogue.

From my research into introductory training courses and guidelines, it appears that the positioning of improvisation and its important role in learning Open Dialogue has not yet been a topic of research.

In this presentation, I focus on learning one of the dialogue principles, "tolerating uncertainty," and report on how an improv game is used for that purpose. Although "tolerating uncertainty" is considered particularly difficult for Japanese people, the improv game seems to facilitate participants' learning in a relatively short period. I will also show what kinds of reflections participants make and discuss potential online learning in line with improv and Open Dialogue.

Research Design & Method

This study

This study reports on an introductory Open Dialogue training program designed and implemented using the performative approach. This study was part of a doctoral dissertation project. The training was conducted in the form of a workshop and delivered online to NPO staff who provided interpersonal support. Each session lasted for approximately two hours. In some cases, the number of sessions was increased from four to five.

How it all began to develop

This training had an original pre-stage in which it was developed. In April 2021, during the COVID-19 pandemic, Dr. Nobuhiko Itani, who specializes in clinical education, and I designed a four-part series of workshops combining dialogue and improvisation and had conducted nine series by October 2022. We developed this workshop series so that participants could learn the important elements of Open Dialogue through improvisation. I was in charge of the dialogue, and Dr. Itani was in charge of the improvisation. The title of the series was "Dialogue and Improvisation Series," and each session lasted about two hours. The number of sessions was four or five depending on the time. The maximum number of participants was 12 and the minimum was 4.

Table 1

Overview of the "Open Dialogue and Improvisation" workshop series

Period	Title (theme)	Schedule	# of sessions	# of participants	Day 1 title	Day 2 title	Day 3 title	Day 4 title	Day 5 title
1st	Introduction to Open Dialogue and improvisation	2021 4/3, 10, 17, 24	4	8	Dialogue & Improvisation 1: Playing with improvisation	Dialogue & Improvisation 2: Dialogue, reflection, resonance	Dialogue & Improvisation 3: Learning improvisation	Dialogue & Improvisation 4: Polyphony and collaboration	
2nd	The joys and difficulties of Open Dialogue	6/5, 12, 19, 26	4	11	Open Dialogue 1: Experiencing and sharing	Improvisation 1: Putting on and taking off the armor of authority	Improvisation 2: Accepting each other's "voices"	Open Dialogue 2: Conflict and co-creation	
3rd	Emotions and empathy in Open Dialogue	8/7, 14, 21, 28, 9/4	5	12	Open Dialogue 1: Unraveling the emotions	Improvisation Game 1: Emotions and "Always rising after a fall"	Improvisation Game 2: Empathy and reflection	Open Dialogue 2: Relying on the emotions	Dialogues for reflections
4th	Tolerating and playing with uncertainty	10/2, 9, 16, 23, 30	5	10	What is "tolerance of Uncertainty"?	Playing with uncertainty (part 1)	Playing with uncertainty (part 2)	Polyphony of tolerance to uncertainty	Dialogic reflection
5th	Dialogue and polyphony	12/4, 11, 18, 2022 1/8, 22	5	5	What is "voice" in Open Dialogue?	Poetry and polyphony	Improvisation and polyphony	Polyphony of inner dialogues	Dialogical reflection
6th	Space and anxiety	2022 2/19, 26, 3/5, 12, 19	5	5	Inner dialogue & reflection	Space and anxiety	NA	Worries and seeds of anxiety	Open Dialogue & reflection
7th	NA	5/14, 21, 28, 6/4	4	4	What is Open Dialogue?	NA	Things that are not words	Open Dialogue & reflection	
8th	NA	7/16, 23, 30, 8/6	4	3	NA	NA	NA	Open Dialogue & reflection	
9th	Inner dialogue and physicality to see change	9/3, 10, 24, 10/1	4	4	NA	NA	NA	Open Dialogue & reflection	

Current research

I adopted the above format and am now conducting Open Dialogue training for NPO staff as part of my doctoral dissertation. The training was held online four times in May and June 2024, with a follow-up session scheduled for September. The participants were staff members of an NPO that provided interpersonal support. The author was the

facilitator and there were nine participants, although some were absent at times. The fourth session was designed to teach how to "tolerate uncertainty" in an Open Dialogue.

The actual workshop and the participants' reflections

The fourth session was held in June 2024 with seven participants. After a short lecture with six slides on the importance of the principle of "tolerating uncertainty," an improv game was introduced as a practical learning session.

The improv game used is called the "gift-giving game." In this game, participants are paired: one person makes a gesture of handing a gift to their partner, and the partner makes a gesture of receiving it. The directions of the game are as follows:

1. Before giving the gift, look closely at your partner and feel until you think of the gift you would like to give.
2. When giving the gift, express the feeling of holding the object in your hand, its shape, weight, and texture by gesture.
3. The recipient feels what the gift is like, and even if they do not know what it is specifically, says "thank you" and continues the conversation. For example, if you guess that the gift is big from the gesture, you can say "thank you for such a big gift."
4. After the conversation continues, the facilitator looks at the timing, gives a signal to end the game, and asks the person who gave the gift to say what the gift was. They are asked to explain how they felt when they gave it and why they did so that way.
5. The person who received it is asked to talk about what they thought the gift was and how they felt about it.

After the session, the participants were asked to write their reflections using text on the group LINE used to contact each other, and four people responded. (Normally, all sessions were recorded, but this time, I forgot to press the record button, so this is how it turned out.) Table 1 summarizes these observations.

Table 2

Reflections of the participants

Participant	Reflection
A	"In the gift-giving game [where one person makes a gesture of giving a gift and the other person tries to guess what the gift is], the recipient said thank you, but I could see their facial expressions convey their confusion [about the uncertain gifts], which was **interesting**." "I thought it would be better if I, the receiver, could accept the sender's feelings without any judgment!"
B	I realized that it's important to try and "**feel**" what the "gift" is from the other person's impression, rather than what the gift [being gestured] is.
C	"In the gift-giving game, it was **fun** to synchronize (our breathing) through the screen. It was like enjoying the slow process of something uncertain becoming certain. It's good to get the answer right, but I thought it was also good to just **enjoy the moment** even if you don't know the answer. Receiving and giving: this is what you exchange in dialogue."
D	It wasn't a simple gesture game, but the exchanges filled with emotions were **heartwarming**. In this training, just watching the exchanges of people made me feel **happy**. With my personality, I tend to rush to conclusions, so normally I wouldn't be able to have this **warm feeling**.

Holzman (2016) sees improv "(a) as a tool-and-result activity, in which the creating of the scene and the scene come into existence simultaneously; (b) as a bridging of the cognitive–emotive divide with its simultaneity of action and reflection and socially produced and shared thinking-and-feeling."

The participants' reflections suggest that the improv game helped them feel their partner's presence while observing each other and creating a gift-giving scene. There were also comments about people being more conscious of the process of observing another person's facial expressions and trying to sense their feelings rather than correctly guessing what gift they were presenting. Some comments stated that they found learning to "tolerate uncertainty" through this "play" to be interesting and enjoyable.

Conclusion

The principle of "tolerating uncertainty" in Open Dialogue emphasizes the importance of not giving "correct" answers and advice to clients. This seems difficult for novices, because they tend to give advice immediately out of good intentions. According to Hofstede's six-dimensional model (Miyamori & Miyabayashi 2019), a framework for intercultural understanding, Japanese culture has many rules and customs because of its strong tendency to avoid uncertainty. It is thus considered very difficult to learn the principle of "tolerating uncertainty" in Japanese society.

However, in the improv games, the workshop participants seemed to be able to learn to "tolerate uncertainty" in a relatively short period. In games, uncertainty enhances creativity and mutual support among participants. It can be said

that accepting uncertainty through positive experiences in "play" makes it easier to control the habit of giving "correct" answers and advice in the practice of Open Dialogue.

Finally, I will discuss the potential of online sessions. Before the COVID-19 pandemic, online Open Dialogue sessions were considered impossible. However, even online, there can be moments when participants feel a sense of unity in the "here and now." The characteristics of online sessions, including their limitations, can become positive depending on how they are conducted.

1. Because the face is in the center of the screen, it is easy to closely observe facial expressions.
2. As only one person can speak at a time, participants can use their talk turns to express their reflections. By encouraging participants to verbalize their feelings, especially subtle changes in sensations at the physical level, they can share aspects that have been taken for granted and not spoken about.

The implications need to be discussed in future studies.

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Manga as Performance in English Language at a Japanese University

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At a Japanese art school students in an EFL course studied American comics and Japanese manga, identifying themes, discussing character origin stories, deepening their understanding of historical context and influences on design, and gaining new language. Students presented on Golden Age American comics they analyzed from large online databases and completed a mid-term evaluation that assessed their retention of the lectures. Students read from a large selection of Japanese manga translated into English and completed an assignment task. As a final performance students wrote their own 14-page manga in English and shared them on social media.

Keywords: Comics, Content Based Instruction, Manga

Introduction

Comics give insight to the language and culture at critical times in history, as art is a window into the concerns of society. Manga is "inextricably tied to social and political discourses" (Suzuki & Stewart, 2023, p.107) A student who writes their own manga is performing culture, a student who reads manga is performing another act of culture. This paper will explain the course design of a content-based instruction course with the theme of manga and comics, at a Japanese art university. Manga and comics were chosen because in CBI subject of interest to the students is a main consideration (British Council, n.d.). Manga is often read alone, from an early age, and often introduced to the reader by a friend (Ingulsrud & Allen, 2009). In the first part of the course, students attended lectures about the Golden and Silver Age of American comics, accessing public domain data bases of Golden Age comics, attending lectures, giving presentations, and holding discussions about American comics. In the second part of the course, students read Japanese manga in English, completing reflective worksheets about what they had read - reading performance, or "the capacity to use and reflect on written texts in order to achieve goals, develop knowledge and potential, and participate in society" (OECD, 2018). Throughout the course students also illustrated semi-weekly original manga assignments. As a final project, students wrote and illustrated their own 14-page manga. A requirement of the final project was for students to show their work in a public forum.

Background

The Golden Age of American comics books is generally seen as having been from 1938, starting with the first appearance of Superman in Action Comics #1 to the mid 1950s and ending with the [U.S] Senate Judiciary Subcommittee on Juvenile Delinquency and the introduction of the Comic Code Authority. (Center for Legislative Archives n.d.; Gonzalez, 2022). Enduring characters from the Golden Age include Superman, Batman, Wonder Woman and Captain America. In Action Comics 1, Jerry Siegel and Joe Shuster, two Jewish boyhood friends, created Superman inspired by biblical stories like Moses the prophet (Ip, 2017). Wonder-Woman was created to be a feminist icon from the beginning. Depicted breaking her chains was part of most of her stories - a deliberate choice to symbolize casting off the shackles of male-dominated society (Lepore, 2015). Superman, Wonder Woman along with Captain America served as a soft propaganda that rallied citizens and soldiers alike for the war effort. Issues of Superman were shipped to American troops to support the war effort (Gordon, 2017). Many of these super-heroes fought racist, dehumanizing caricatures of America's enemies, particularly the Japanese. These dehumanizing, racist depictions may have enabled the "justifiable" use of the atomic bomb against Japan (Chun, 2017). Some comics warned of the dangers of atomic energy, more were fascinated with it. After the bomb, the concern with atomic power was evident in comics from the Golden Age, with names like *Atomic Comics, Atomic Thunderbolt, Atomic Man, Atoman, Atom Wizard*, and even *Atom the Cat* and *Atomic Rabbit*. Atomic as a buzzword was harnessed to sell comics (Szasz, 2012). In the 1952, Japanese manga legend Osamu Tezuka would even deploy this tactic with *Tetsuwan Atomu (*The Might Atom). However, the true brutality and destruction of the bomb would not be accurately depicted in manga or comics until works like 1973's Barefoot Gen by Keiji Nakazawa, survivor of Hiroshima. Some Golden Age comics did feature graphic violence. Horror and crime comics began outselling super-hero comics after the war. Images of hanged men, severed heads, drug use along with a crusade by psychiatrist Fredric Wertham prompted a U.S Congressional hearing to discuss the effects of comics on American youth. The Comics Code Authority (CCA) was created in response. The CCA, although not a government agency effectively censored comics by giving editorial guidance that is said to have created a bottleneck where only superhero comics survived. Comics produced after the introduction of the Code until the early 1970s fall under the banner of the Silver Age. Hero comics began to become more complex. In the Silver Age, heroes still had tremendous powers, but their flaws were now important. Iron Man was modeled after billionaire aviation and military industrialist Howard Hughes (Batchelor, 2017) but he had a fatal heart defect. The Hulk was out of control

and possessed by rage, inspiration for the design of The Hulk came from Jekyll and Hyde and Frankenstein's monster (Hiatt, 2015). Even Captain America, who was re-introduced in the Silver Age, began to reflect on failed missions and question his orders (Thomas, 2017). The stories of crime, murder and espionage gradually were reintroduced, only now they were told in the super-hero genre. In a story that is said to have ended the Silver Age and weakened the CCA, Spider-man's best friend was shown addicted to hard drugs. Marvel had published this issue without the seal of approval of the CCA and the Silver Age ended. Meanwhile, manga in post-war Japan during the manga boom didn't face the same scrutiny as was leveled by the CCA. Many argue that manga developed so diversely because of this fact. Graphic sex and violence have historically been more common in young adult and adult manga than in American comics (Ingulsrud & Allen, 2009). However, manga has faced censorship and restrictions since at least the Edo era. In the 21st century, Barefoot Gen has been repeatedly targeted for removal from school libraries (Suzuki& Steward, 2023). There have been ongoing movements against and legislation to control manga and its depictions of indecency, sadism, and its alleged harmful effects since 1965 that peaked again in the 1990s (Kinsella, 2000). Due to time limitations, instead of lecturing on the history of manga in Japan, students were provided with a selection of diverse and culturally important Japanese manga from Showa era to the present day. These manga had been translated into English. Students worked in class, selecting what manga to analyze, and completing in-class assignment tasks in which students reflected on their reading.

Participants, Course Design, & Methods

Participants in this research were 22 intermediate level students of English as a foreign language. The students gave written consent for their work to be included in the research and informed that course evaluation and participation in the research were separate, that participation would not influence their course outcomes. The students were enrolled in a faculty of interdisciplinary research and design. The students were not in the faculty of painting, or illustration. The first week, students were surveyed about their opinions on manga and the researcher led a discussion about manga and literacy. Survey points were based on a course by R. Rusca at Meiji University. The second and third classes focused on the Golden age of comics. After the third week of the course, students accessed websites which contain over 43,000 digitized public domain comics. Participants chose, read, analyzed, and gave a presentation on their reading. The fifth week featured Horror, Adult Gag, and Crime Comics. The sixth focused on US Congressional hearings and the establishment of the CCA. The Seventh and eighth weeks were dedicated to the Silver Age and the new types of heroes that developed. As a mid-term review, students completed a 3-page open note review task. Students were allowed to discuss their answers with each other and consult lecture notes. This midterm assignment included an image analysis of Golden Age comics featuring violent covers modeled on educational material developed by the U.S. National Archives (National Archives, n.d.). Weeks nine through twelve, students read English translations of Japanese manga. To evaluate reading performance and comprehension, students completed. Students chose from a selection of approximately 30 manga titles. There was no required number of pages and students were asked only to analyze the stories they read in one class period. Throughout the course, students were writing and illustrating semi-weekly original manga assignments that included the themes like "Your Day Today", "My Origin Story", and "My Darkest Hour". In week 9, students interacted via Zoom with professional comic author Zach Davisson. The course leader participated in critiques with the students helping them to correct grammar errors, clarify their writing and develop conceptual points in their manga. The final project the course was to complete a 14-page illustrated manga in English that was to be shared in public. Students were given the choice of displaying their work on social media, at a manga convention, or in a local gallery. The requirement that the art be shared in public was based on coursework developed by K. Morikawa in an undergraduate seminar at Meiji University's School of Global Japanese Studies.

Results

Survey, Presentation and Mid-term Results

40% of students strongly agreed, and 28% agreed that manga was a useful educational tool for helping students learn to read. However, 48% "slightly agreed" and 8% agreed with the statement "If a child sees violence in a manga, they will probably try to copy it in real life". 100% of the students agreed (56% strongly) that manga and comics were useful for sparking interest in "deeper" intellectual pursuits such as science, history, ethics, or literature. Students were asked to comment about Barefoot Gen being restricted educational material. One student commented the material contained "too much personal ideology" to be educational. Two students suggested the material was too difficult for elementary school but appropriate for high school. The other 21 students opposed removing the material, some recalling their own first time reading it, and one student disclosed their hometown was Nagasaki and respected the manga's importance. However, they emphasized the need for an adult to explain the comic but were opposed to its banning. After the term Golden Age Comics was defined, and the years explained, students were asked if they knew any "Golden Age" heroes. Zero students answered correctly, instead naming Silver Age heroes they were familiar with. After attending lectures on the Golden Age of comics, students gave presentations on comics they accessed through large public domain databases. Students were able to identify attitudes that differed from today. For example, one student wrote "the comic reflects the varied roles and aspirations of women in the 1950s…the humor style in the 1950s

portrayed women as stupid". Students commented on the advertisements reflecting consumer trends of the era, like schemes to get rich or lose weight in no-time. One student commented "I have no idea why women want to lose their weight in every era". One student read a comic that warned of the dangers of atomic energy, commenting "this book is designed to discourage the misuse of nuclear testing". One student identified an anti-slavery themed sci-fi manga from 1950 which they believed was influenced by the 1948 Universal Declaration of Human Rights. By the mid-term assignment, 89% of the students correctly identified 90% or more of Golden Age versus Silver Age characters. 75% of students were able to identify specific cultural influences 21% referred to these influences in general terms. When analyzing an image from a Gag comic book cover that showed a boy blowing up a train set, resulting in a mushroom cloud, 37% of students felt the image was simply violent, 37% described it as harmless humor while 17% responded that although it was meant to be funny, they didn't find it to be. For example, "I think comic was made to make a humorous social commentary but…it is a violent and disturbing scene…we feel mocked for portraying such a serious event in a humorous way".

Original Manga Semi-Weekly Assignments

Students collectively produced approximately 160 pages of manga before the final assignment. On assignment "Your Day Today", 92% of students wrote about the heavy rain and their struggle to attend class. For the assignment "A story from your childhood" 20% wrote about some kind of trauma, 21% wrote about the positive effect manga had on their life and 33% wrote about the importance of perseverance. One student wrote about how they were introduced to manga by a friend. For the assignment "My Origin Story" 25% of students based their stories in the real world and the remainder incorporated fantasy elements. For the assignment "Horror, Sex and Crime" students were asked to submit both rough sketches and final black and white 2-4-page stories. 38% only uploaded one version of their story. For the cover art homage, students were asked to design a full-color homage to a classic comic cover and include English lettering. The type of homage was open to interpretation. 38% created new covers using licensed characters from existing intellectual property. 62% created new characters for their homage. During discussions with professional Zach Davisson, students discussed character design. When asked "What makes a compelling villain?", he answered "The best villain 100% believes they are the hero". When asked "How do you write a good story?" he replied "Find your character's motivation and build a story around it. The Hulk just wants to be left alone, so the story is someone bothering him". Students participated in critiques with the instructor who suggested grammar and artistic direction. Asked about a candy-themed character's origin story, the student suggested "god" bestowed the powers. The instructor helped the student research the Japanese god of confectionaries, honored by candy companies. In another case, two characters looked similar diminishing readability. After discussion, the artist gave one character a distinctive hairstyle.

Reading Manga in English

When in performance of reading Japanese manga in English, during the second part of the course, students were given assignment tasks. In these tasks they were asked to identify any new words or phrases they learned. The wide range of phrases and words included idiomatic expressions: *never mind, the night is young*, onomatopoeic: *retch!*, *thud*, academic: *miserable, fingerprint* and slang: *dim, dummy*. Students collectively encountered and wrote English language definitions for 96 words and phrases that were new to them. A few of the many societal themes encountered and identified included: satire of the patriarchal system and narrow communities in postwar Japan in *Sazae-san*, women heroes reflecting the changing roles of women in society in *Sailor Moon*, the Japanese government propagandizing its' own citizens in *Barefoot Gen*, "disdain for one's own gender" in *The Rose of Versailles*, and changing acceptable educational practices from when the manga was written – such as forcing a child to stand in a corner-in *Doraemon*.

Final Project Results

For the final projects, students completed manga that were 14 pages. These manga are available in the printed form at the ICoME conference. All students chose to upload their final work on one of 3 popular social media sites. No students elected to enter a comic circle and display at a comic convention or display their work at a gallery. Themes in their final projects included personal stories of trauma or success, heroes and heroines, sports, horror and crime, and fantasy. Two examples include: a recollection of time spent in the Korean army and a candy-based super-villain who thinks they are a hero. The tones ranged from dark to deeply personal to light and humorous.

Discussion

Students largely saw manga as possessing educational value, despite being reading and discussing the many criticisms of both comics and manga. Because only one student suggested that manga was not educational, it can be understood that the students valued the themes and outcomes of the course. The course was conducted at an art university, so it may be that students placed more value on artistic endeavors such as manga and comics than other schools. However, none of the students were enrolled in a painting or illustration major, and manga is widely read through Japan. Therefore, it is likely that a similarly structured CBI course would work with some refinement in other educational contexts in Japan. While engaging in reading performance and reporting on it through presentations and assignment tasks, students recorded new knowledge on society and history, reflected on written texts to create their original manga,

developed their potential through critiques and discussions and participated in society by uploading their original works to social media. Many students naturally gravitated towards discussing the manga with each other. Because reading manga is often done alone, they may have enjoyed this opportunity to discuss with their peers. Many students chose to read manga in English that they had read when they were children, revisiting old favorites. When creating original manga, as a performance through semi-weekly assignments and final projects, students incorporated design and content themes they researched throughout the course. By engaging in discussions with peers, professionals and the course instructor students developed their manga continuously throughout the semester. There were several limitations to the study and ways that the course could be improved in the future. For example, in an informal discussion with students, the researcher learned that three had never drawn a complete manga before. It would be interesting to survey the students before the class if any had previously drawn manga, especially in a foreign language. The final project was introduced mid-way through the course. This left little time for students to enroll in a manga circle and register for a large convention to show their work. In the future, the final project should be introduced in the first week and more support should be given to students considering displaying their work at a manga convention. The researcher was at times inconsistent about the methods to collect original work. For the first four weeks, all original work was collected and in the later half all work was uploaded to an online platform and reviewed. In the future, all work should be collected via an online platform and reviewed, allowing students to retain all their original drawings.

Conclusion

This course was a success in terms of student performance. Students were highly engaged in the content of the course throughout the semester as evidenced by the high quality of written responses on assignment tasks, presentations, semi-weekly manga assignments, and final project quality. These results indicate that reading manga as performance and the performance of writing original manga are worthy of additional research in the second language classroom and can produce captivating, deeply personal narratives, fantastic stories, humor, satire, suspense, and horror that allow the students to communicate their grasp of the target language. In some cases, in a way that they never had before.

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The potential of “laughter” as a message: Analyzing a university dialogue workshop

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This presentation examines student learning observed in a manzai workshop conducted with a guest lecturers in a university undergraduate language course that the presenter was in charge of called "Media Japanese." First, after reviewing Kimura's (2010) model of the process of generating "laughter" and Suzuki's (2005) along with other concepts of media literacy, an overview of the manzai workshop is presented. Course comments submitted by students were examined as the target data and coded using SCAT to provide a theoretical description. The results of the analysis showed that students experienced 1) a sense of satisfaction from creating a story collaboratively, 2) the joy of generating laughter, and 3) an awareness of the possibilities of a communicative language (other than Japanese) for manzai through workshop activities in which they created and performed an exchange (manzai material) that included "laughter" (manzai neta).

Keywords: Manzai workshop, Laughter, Improvisational collaborative learning, SCAT

Generation of "laughter" and its educational implications

While the media has deeply permeated all of our lives, and information now easily crosses national borders and personal boundaries, making it possible to access material every moment on the planet, there is a need for education that enhances psychological openness and empathy in relation to the individual's mind, growth, and communication through direct connections. One such vehicle is the use of laughter.

According to Oshima (2010), humorous conversation in Japanese involve the creation of laughter by both participants in the conversation, as the listener aids, asks questions, laughs, or says a few words in response to the speaker's experiences. Both manzai and rakugo are forms of storytelling that take advantage of this conversational development. It could even be said that communication that includes laughter can increase psychological openness and empathy.

Kimura (2010) proposed "the unified theory hypothesis of laughter" based on the work of Spencer and Freud. Normally, when people process information from the outside world, they activate their own schemas to understand it. However, when the amount of energy required changes (e.g., when a partner suddenly slips up) in relation to the load energy that has been anticipated and stored for understanding the partner's story, the surplus energy is "discharged" into the kinetic system, which causes laughter. When laughter occurs, the instantaneous release of surplus energy produces "joyous nothingness" in the conscious areas of the brain. Laughter and humor have the ability to deconstruct the receiver and free him/her from the constraints of meaning and thought, as well as to "liberate the psyche from the burden of failure and suffering, from the fear of lack and persecution" (Kimura 2010: 1-20). Research on laughter has been conducted in many fields, including brain science, communication research, literature, and medicine.

Manzai experience-based initiatives have recently been on the rise as educational practices that utilize laughter (e.g., Ito and Tabata 2017, Sekiguchi and Spain 2020, Suzuki and Shimaoka 2022). In all of these practices, the participating learners create and perform a manzai piece, which is then shared with all participants on site. As outcomes of the practice, Ito et al. (2017) found an improvement in the participants' "communication skills," a smoothing of relationships among learners, an increase in spontaneous comments in class, and a revitalization of the class atmosphere, while Sekiguchi et al. (2020) noted enhancement in "the ability to communicate," "the ability to express," as well as "over-the-top nonverbal expressions" and "conversational pauses. In Suzuki et al. (2022), participants' comments mention the fun of the manzai experience and their awareness of the potential of manzai to effectively convey messages. Thus, although there were reports of many learning outcomes from the hands-on practice of manzai, the number of cases is still limited, and a more detailed analysis is needed.

Current Concept of Media Literacy

This manzai workshop was conducted as part of the undergraduate language course "Media Japanese: Media and Messages.” In this class, the concept of media was broadly considered, and media was defined as "a means by which a sender transmits information to a receiver (the medium acting as an intermediary between the two), and

influences the thoughts and actions of those who receive the information. To define media literacy (ML), which is essential when considering media, we based our definition on NAMLE's (2017) "(ML) as the ability to access, analyze, evaluate, create, and act on all forms of communication." Also, we adopted Suzuki's (2005) conception of media literacy as "the ability of citizens to critically analyze and evaluate the media in a social context, access the media, and create various forms of communication" and "efforts to acquire such ability." These were based on the recognition of the importance of not only analyzing messages and media, but also creating, expressing, and communicating in today's knowledge-based and knowledge-creating society.

Manzai Workshop in the "Media Japanese: Media and Messages" Class

Outline of the Manzai Workshop

In the course "Media Japanese: Media and Messages," taught by the Faculty of Global Japanese Studies, TUFS, undergraduate students (native and non-native Japanese language students) are asked to check and briefly analyze the current media situation and the characteristics of information (messages) from both the transmitting and receiving party's perspectives. In the class, "Manzai Workshop" is positioned as an activity for learners to create, transmit, and share messages by themselves; and then, a guest lecturer is invited every year to conduct the workshop (Suzuki & Shimaoka 2022; 2024).

The fall semester 2023 Manzai workshop consisted of two 90-minute classes that included a mini-lecture, pairwork to create a manzai story, and a presentation. The first session was conducted online via Zoom, and the second session was in a face-to-face format (see Table 1). The setting was intended to encourage participants to relax, learn about manzai, and actively enjoy themselves with others.

The class objectives were 1) to experience and feel the fun of manzai through the manzai workshop, and 2) to use the workshop as an opportunity to think about manzai as a way of conveying messages (Suzuki and Shimaoka 2022; 2024).

Manzai Workshop (2nd; face-to-face)

Based on the activities of the first workshop, the mini-lecture of the second workshop introduced the structure of manzai material (deochi, (foreshadowing) recovery, san-dan-ochi, kabuse), differences in expression by region (Kanto/Kansai), and variations of manzai material in languages other than Japanese (English, French, Italian, etc.) were also introduced. The manzai neta below shows an example of a san-dan(three-step) ochi (Suzuki and Shimaoka 2024).

Following the mini lecture, the 46 students in the 2023 cohort were paired up, and the pairs decided on their own kombi (combo) names. The pairings were randomly assigned pairs of native Japanese-speaking and non-native Japanese-speaking students. The time allotted for pairwork to create manzai neta was 13 minutes. The neta was created utilizing what the students had learned in the mini lecture on manzai techniques; some pairs featured similarities in sound and/or gaps in logical development.

Demonstration example of san-dan-ochi in mini-lecture:

A: 日本のスポーツは何が好き？Nihon no supootsu wa naniga suki? (Which Japanese sport do you like ?)
B: うーん　柔道かな。　Uun Judo kana. (Um, I guess Judo.)
A: 他には？　Hoka niwa? (What else?)
B: うーん　剣道かな。　Uun Kendo kana. (Hmmm, Kendo, maybe.)
A: 他には？　Hoka niwa? (What else?)
B: うーん　極道かな。　Uun Gokudo kana. (Hmmm, wicked.)
A: ずいぶん道を外れたね。　Zuibun michi wo hazuretane. (You've deviated quite a bit from the path.)

Manzai neta from student combos

コンビ名 Konbimei (combo name): チュロス Churosu (Churros)

A: 最近寒くなってきたねー。Saikin samukunattekitanee. (It's getting colder these days.)
B: そうだねー。　Soodanee. (That's right.)
A: もうすぐクリスマスだし、この近くで ショートケーキ売ってる所あるかな？
Moosugu kurisumasu dashi konochikaku de shootokeeki utterutoko aru kana.
(It will soon be Christmas, and I wonder if there is a place near here that sells *shootokeeki* (shortcake).
B: 駅前の薬局でしょうー。　Ekimae no yakkyoku deshoo. (It's probably at the pharmacy in front of the station.)
A: 薬局、、、？　Yakkyoku…? (Pharmacy, huh?)
それは消毒液でしょ、もうええわ。Sore wa shoodokueki desho, moo eewa. (That's disinfectant, isn't it. Enough.)
AB: どうも、ありがとうございましたー。Doomo arigatoogozaimasitaa. (Thank you very much.)

コンビ名 Konbimei (combo name): 日韓首都 Nikkanshuto (Japan-Korea Capital)

A: いらっしゃいませ〜 Irasshaimase. (Welcome!)
B: すいません、骨なしキッチンください。 Suimasen, honenashi kitchin kudasai. (Excuse me, boneless kitchen, please.)
A: ああ骨なしチキンですね。レンチンしますか？ Aa, honenashichikin desune. renchin shimasuka.
(Oh, boneless chicken. Would you like to microwave it?)
B: うーん骨なしキッチン、ランチで。 Uun, honenashikitchin, lanchi de. (Umm, Boneless kitchen, for lunch.)
A: なんでやねん。骨なしチキンをレ・ン・チ・ンで？Nandeyanen. Honenashi chikin wo re-n-chi-n de?
(Why not? Boneless chicken with *le-n-chi-n* [microwave it]?)
B: ああ、じゃあ骨なしチキン、リンチで Aa, jaa honenashi chikin rinchi de (Oh, well boneless chicken, lynch).
A: もうええわ。 Moo eewa. (That's enough.)
AB: どうもありがとうございました。 Doomo arigatoogozaimashita. (Thank you very much.)

Student learning from the workshop, analysis of class comments

This study used the Steps for Coding and Theorization (SCAT; Otani 2019) methodology to conduct a qualitative analysis of class comments obtained from 40 students who attended the second class of the Manzai Workshop in the fall semester of 2023. The purpose of the analysis was to uncover how the students felt and what they learned during and after the workshop. The SCAT for this project involved four steps of coding the data to be analyzed: coding of 1) words and phrases to focus on in the data, 2) concepts to paraphrase words and phrases from step 1), 3) concepts to explain the paraphrased concepts of step 2), and 4) themes and constructs that emerged from the concepts of step 3). The themes and constructs from the step 4) were then weaved together to create a "storyline," followed by a "theory writing" process. SCAT has been applied to analyzing interview utterances, but it is also considered to be applicable to the qualitative analysis of open-ended questionnaire surveys and has been used that way in several studies.

In the fourth step of the SCAT procedure, "Emerging Themes/Constitutive Concepts" coding produced 78 items. Using all of these 78 items, a "storyline" was created that exemplified student learning through the manzai workshop. Based upon the storyline, "theoretical descriptions" were developed. Due to paper space limitations, six of the 17 theoretical descriptions obtained are presented below.

Theoretical Writing:

The workshop is an introduction to the basics of manzai in multiple languages and simple Japanese, given by an expert.

In the mini-lecture, during the first half of the workshop, the instructor explains the techniques with examples and clarifies the types of manzai, which helps students become aware of the types of material and gain interest in the similarities between what is learned in this process and everyday terminology.

Participants are able to make use of their experience of learning a second language and the characteristics of the language to create improvised comedic skits. In other words, they are able to make use of the misuse of the language, the pronunciation of the target language, the misunderstandings caused by word breaks, and the differences between languages.

Some students feel anxious about creating jokes and some have difficulty finding funny ideas that they can share with the other students.

As a result of the pair-based work, most students experience satisfaction in creating stories through collaborative creation and a deepening of friendships through such collaborations. It is possible that some first-time pairs may experience difficulties with collaborative improvisational creative activities. This may be an issue for any workshop that takes the form of improvisational collaborative learning.

After the story-making time, each pair presents their original comic story to the whole class, using all the ingenuity they can muster for the delivery, which leads to a feeling of joy having made the class laugh. In addition, they receive warm feedback and highly positive comments on their creative material from the experts.

Discussion

Through qualitative analysis using the SCAT method, we have presented an overall picture of learning through the manzai workshop, including a few small points raised by the students. An analysis of class comments revealed that students gained a sense of "satisfaction from creating stories through collaboration," "joy from making people laugh," "awareness of the possibility of a communicative language (other than Japanese) for manzai," and appreciation of "learning with a relaxing effect." The creation and performance of manzai, including misalignments,

caused the listeners to experience "a pleasant nothingness" (Kimura 2010), which freed their thinking from preconceived notions. Since some participants, on the other hand, felt "a sense of difficulty" in collaborative improvisational creative activities as first-time pairs, we would like to consider measures for improvement, such as distinguishing between activities that are possible only because they are "improvisational creative activities" and those that could be more leisurely thought out, with a little more time in advance.

Table 1

Flow of the second manzai workshop

Class activities	Time (minutes)
① Mini-lecture: variations of manzai + pairing	20
② Determination of the pair name	7
③ Introduction of each student pair + mini-lecture: introduction of material (san-dan-ochi, etc.)	25
④ Creation of mini-manzai	13
⑤ Presentation of mini-manzai and comments	20
⑥ Class-related announcements	5

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Trial Comparisons between YouTube's Audience Retentions and Viewers' Affective Evaluations

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Following a typical video production flow, students were divided into several groups in a university class, and each group produced a promotional video for the university. After those videos were uploaded on YouTube as unlisted videos, the students individually watched them one another and picked up six scenes that they felt were positive or negative as an affective evaluation. In addition, viewer's retention rate of each video, one of the YouTube analytics data which were automatically generated by YouTube Studio, were obtained and compared to the students' affective evaluation. The results revealed the possibility of a certain relationship between YouTube's audience retentions and viewers' affective evaluation.

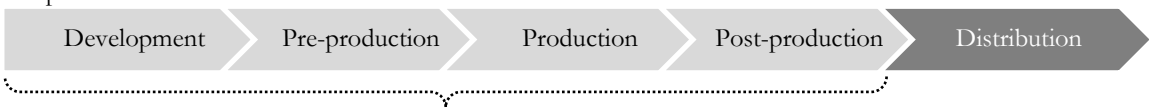
Keywords: Affective Evaluations, Audience Retention, Media Information Literacy, Video Production

Introduction

The low cost of video production equipment and the global spread of video-sharing websites have made it possible for anyone to become a creator of video content. UNESCO (2013) provided 12 competencies of media information literacy (MIL) and one of them is "Monitor the impact of created and distributed information, media content and knowledge as well as use existing media and other information providers." (p. 59). However, most of the conventional research conducted through practical video production activities ends in the post-production phase of the video production flow (Figure 1), and there are few cases where the video is actually released, and the results are monitored and utilized in the next video production.
Therefore, in this paper, the relationship between the audience retentions as viewing data after releasing a video on YouTube and viewers' affective evaluations of the video is examined.

Figure 1

Video production flow



Research Design & Methods

In the "Broadcast Program Production" class at the university where the author works, 35 students were divided into six groups, A through F, and each group was asked to produce a university's promotional video up to three minutes. Following the general video production flow (Figure 1), one week was spent for planning and preparation, one hour for filming, and one week for editing.
After the students submitted the final version of each video, they were uploaded and shown on the author's YouTube channel as unlisted videos shared with only the students. The students watched these videos one another individually on YouTube during the 90-minute class and answered to a Google Form asking six scenes (Table 1) that they felt positively or negatively about with their starting time and reasons as affective evaluations.
The viewers' retention rate of each video was automatically generated by YouTube Studio when the students watched those videos, and they were utilized as the viewing data for this research. In a YouTube's audience retention, there are two key moments called spikes and dips. According to Google (n.d.), "Spikes are moments in your video that were rewatched or shared." and "Dips highlight moments in your video that were either skipped or moments where viewers stopped watching your video completely." In Figure 2, the YouTube's audience retentions (reference date 2024.06.14)

and the number of comments for the six scenes based on each starting time about Video A (length: 2:09), Video B (length: 1:54), and Video C (length: 2:52) were shown graphically and compared.

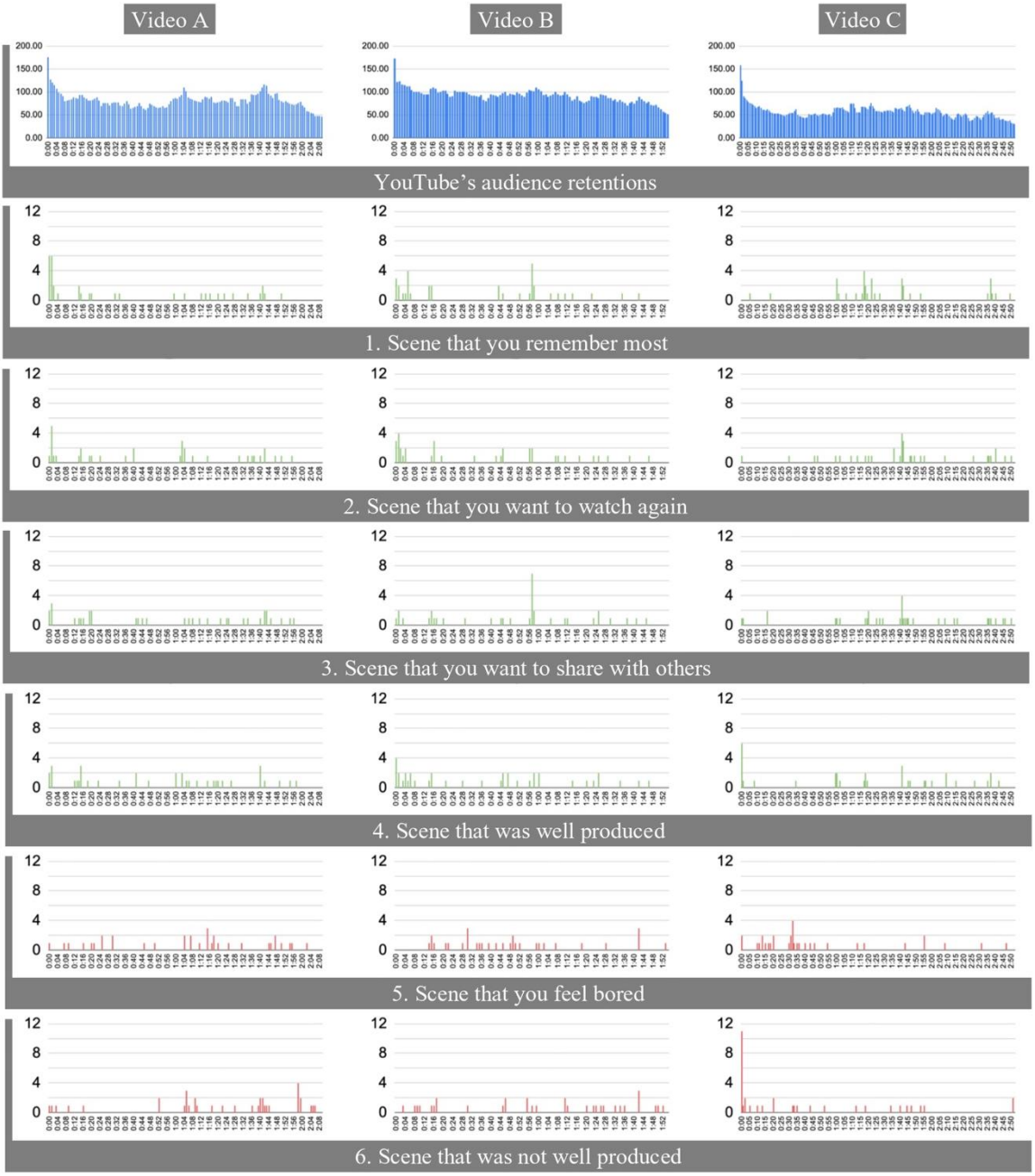
Table 1

Six scenes that were asked on Google Form

Positive	1. Scene that you remember most
	2. Scene that you want to watch again
	3. Scene that you want to share with others
	4. Scene that was well produced
Negative	5. Scene that you feel bored
	6. Scene that was not well produced

Figure 2

Comparison between YouTube's audience retentions and viewers' affective evaluations of each video



Results

For all videos, the audience retention was highest at 0:00, the beginning of the videos. This can be because YouTube misrecognized that the timing 0:00 of the video was repeatedly watched by the viewers, since the playback always starts from the top when the video is refreshed or automatically restarted. In addition, as the videos approached their endings, the audience retention dropped gradually for all videos. Many viewers might leave the videos when they seemed there was no more content.

In Video A, two significant spikes were at 110.34% at 1:04 and 117.24% at 1:42. Comments by starting time for positive scenes were mostly noted around 0:01, 0:15, 1:04 and 1:42, while comments by starting time for negative scenes were mostly noted around 1:05, 1:15 and 1:58.

In Video B, 109.78% at 0:16, 109.78% at 0:59, 94.57% at 1:26, and 89.13% at 1:42 showed moderate spikes. Comments by starting time for positive scenes were mostly noted around 0:01, 0:16, and 0:58, while comments by starting time for negative scenes were mostly noted around 0:15, 0:30, 0:49, and 1:42.

In Video C, fine spikes were found at 63.33% at 0:35, 75.00% at 1:10, 71.67% at 1:46, 65.00% at 2:03, 58.33% at 2:35, and so on. Comments by starting time for positive scenes were mostly noted around 1:00, 1:17, 1:41, and 2:37, while comments by starting time for negative scenes were mostly noted around 0:00, 0:20, and 0:32.

Discussion

Around the spikes of the audience retentions, there was an increase in the number of comments referring to the positive scene. They decreased around the dips of audience retention, and conversely, the number of comments referring to the negative scene increased.

However, although an increase in the number of comments referring to the negative scene was observed around 1:42 of Video B and around 0:32 of Video C, spikes in the audience retentions increased as well. One possible reason for this is that when students were asked to find a timing of a negative scene as a class assignment, they inevitably paused and rewatched that moment many times, and as a result, YouTube might misidentify that specific part of the video as a high audience retention timing.

Conclusion

In this paper, YouTube's audience retentions and viewers' affective evaluations were compared through the production of a promotional video for the university. While there is a possibility of a significant relationship between the two, the way of the research needed to be improved to obtain more accurate results. In the future, viewers' affective evaluations should be examined not only based on starting time but also as one whole video to deepen the research.

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Linking an English Language Test(GTELP Junior) to the CEFR: Embracing Foundational Teaching in the Age of AI

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This study aimed to align the G-telp Junior English Language Proficiency Test with the Common European Framework of Reference for Languages (CEFR) using the modified Angoff method. The research involved a diverse panel of experts, including educators and textbook authors, who conducted a rigorous level-setting process to categorize test results into CEFR's A1 to C2 levels. The study validated the level-setting through procedural, internal, and external criteria, ensuring robust and consistent split scores. The results demonstrated high classification accuracy and internal consistency, with the majority of test takers achieving B1 level. The study underscores the significance of linking language tests to CEFR for enhancing global language proficiency standards and educational policies.

Keywords: Validity, CEFR, GTELP Junior, English Language Test

Introduction

Purpose of research

This study aims to align the G-telp Junior exam with the CEFR, using the modified Angoff method to calculate split scores across CEFR's A1 to C2 scale and validate them based on procedural, internal, and external criteria. It builds on methods like those used by the Korea Institute of Curriculum and Evaluation and references to validity studies by Messick and Kane. The CEFR's role in objectively assessing and enhancing foreign language proficiency is highlighted, alongside comparisons with TOEFL iBT, TOEIC, and IELTS. This approach supports the development and implementation of educational policies and the improvement of language proficiency standards globally.

Theoretical background

The Common European Framework of Reference for Languages (CEFR) is widely used to measure foreign language proficiency in education. In the 1990s, intuitive, qualitative, and quantitative methods were all used to develop the levels and skills for each level of the Common European Framework of Reference for Languages.

Level-setting involves defining split scores to categorize test results into CEFR standards, employing methods like the modified Angoff method to ensure validity and balance. This process, supported by quantitative measures and panel consensus, plays a critical role in significant educational decision-making.

Level-setting in language assessments combines intuitive, qualitative, and quantitative methods to categorize test results into ability levels using the Angoff method. Validity is ensured through rigorous evaluation of intrinsic, extrinsic, and procedural aspects, emphasizing consistency, realistic appropriateness, and systematic procedures throughout the process.

Research Design & Methods

This study focused on level-setting for the G-telp Junor exam using the modified Angoff method, aligned with the CEFR standards. A diverse expert panel, including learners, textbook authors, and educational professionals, participated in the rigorous process to ensure a balanced evaluation of English language proficiency across six CEFR levels. The level-setting was conducted over three weeks, employing a detailed pre-orientation to familiarize panel members with the CEFR and the specific methodology used. The panel utilized various materials, including a manual on linking tests to the CEFR and a collection of questions categorized by CEFR levels, to aid their understanding and judgments.

The process involved multiple rounds of assessments where the panel members defined and re-evaluated the minimum ability required at each CEFR level using the modified Angoff method. Feedback after each round included statistical analyses of split scores, aiding in refining the levels. The study also incorporated the Bookmark method as an additional validation technique to review test results from multiple perspectives.

Table 1
Descriptive Statistics

Domain	Number of Questions	Number of Test Takers	Average	Standard Deviation	Skewness	Kurtosis	Minimum Value	Maximum Value
G-telp Junior	80	4627	46.3	9.87	0.23	-0.82	15	91

Table 2
Characteristics of Level Setting Panel

Category		Frequency	Percentage(%)	
Gender	Male	6	60%	
	Female	4	40%	
Nationality	South Korea	3	30%	
	USA	5	50%	
	UK	1	10%	
	Pakistan, USA	1	10%	
Mother Tongue	Korean	3	30%	
	English	5	50%	
	English, Chinese	1	10%	
	Pakistani	1	10%	
Experience in Level Setting	Yes	2	20%	
	No	8	80%	
Experience (Years)	Average	Standard Deviation	Minimum	Maximum
English Education	7.2	5.3	0	15
English Assessment	4.5	3.5	1	10

To ensure the validity of the level-setting results, internal metrics like Cohen's Kappa coefficient and classification accuracy coefficient were calculated using item response theory. External validity was assessed by comparing the distribution of test takers by CEFR level based on the final split scores. Procedural validity was verified through comprehensive reviews of the process and feedback from panel members, ensuring confidence in the final outcomes. The study ultimately aimed to establish robust, evidence-based language proficiency standards through a methodical and collaborative approach.

Results

The G-telp Junior test underwent a detailed level-setting process using the modified Angoff method, resulting in converged and consistent split scores across four rounds of evaluation, as confirmed by internal validity assessments. Panel members, guided by expert consensus and iterative feedback, determined clear split scores for CEFR levels from A1 to C2. External validity was assessed by comparing these results with those from the Bookmark method, showing minor differences that decreased over successive rounds. Distribution analysis of test takers revealed a majority achieving B1. Surveys indicated strong participant satisfaction with the preparatory materials and clarity of instructions, with significant influence from professional experience and minimum ability definitions on their judgments. Confidence varied among levels, with higher certainty in A1 and B2 scores. Overall, classification consistency and accuracy were robust, demonstrating the reliability of the level-setting outcomes in aligning G-telp Junior with CEFR standards.

Table 3
Results of Level Setting Based on the Modified Angoff Method

	CEFR	Round 1 Average(SD)	Round2 Average(SD)	Round 3 Average(SD)	Round 4 Average(SD)
Modified Angoff	A1	-	-	24.91(4.69)	**24.69(3.60)**
	A2	43.36(6.85)	**42.85(5.33)**	-	-
	B1	-	-	56.53(5.98)	**54.87(4.96)**
	B1+	-	-	74.88(10.12)	**73.16(9.97)**
	B2	87.50(9.81)	84.71(7.87)	-	-
	B2+	93.54(5.27)	94.01(4.10)	-	-
	C1	-	-		-

Table 4
Classification Agreement and Classification Accuracy Coefficients for Split Scores in Each Round

		Round 1	Round 2	Round 3	Round 4
Modified Angoff	Classification Agreement	0.554	0.581	0.532	0.543
	Classification Accuracy	0.812	0.830	0.792	0.802

Conclusion

This study successfully linked the US ITSC's G-telp Junior English Proficiency Test to the CEFR scale using the modified Angoff method, yielding division scores for all six CEFR levels. The process demonstrated strong internal consistency and accuracy, with split scores showing decreasing standard deviations and high classification agreement. Externally, test taker distribution aligned well with CEFR levels, indicating a valid level setting. Comparisons with the Bookmark method revealed higher scores but affirmed the Angoff method's consistency. The findings suggest G-telp Junior can effectively discriminate between CEFR levels, enhancing its comparability with other English tests and supporting its use in evaluating sociolinguistic competencies.

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From Mistakes to Mastery: Understanding Workshop Design through University Students' Experience

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This research aims to identify university students' learning process about workshop design from a misperformance perspective. Misperformance is the concept that highlights how (un)planned mistakes, errors, and even disasters may befall those who perform. Previous workshop research has focused on the design model or the workshop's effectiveness. However, this research focused on not only the result of the workshop but also the misperformance . Specifically, the study identifies how students who work in designing workshops reflect on their misperformances in their practice. As a result of the analysis, it was found that students reflected that their misperformance came from impatience and the inability to balance freedom and restrictions effectively.

Keywords: Workshop, Design, Misperformance, Art-Based Research (ABR)

Introduction

Workshops have been studied mainly in educational technology research. The Japan Journal of Educational Technology published 14 studies on workshops in the past ten years. According to the meta-analysis, the trends of the workshop research can be categorized as follows. One is studies on the development of workshop models. Initially, workshops emerged within community development and art activities and were eventually integrated into educational settings. Some workshop model frameworks have been developed based on Kolb's (1999) experiential learning model and Anderson and Lebiere's (1998) ACT-R model and introduced to enable schoolteachers and others to implement these workshops effectively (Anzai, 2021). The second is studies on workshop effectiveness. The studies investigate whether workshops, incorporated from the perspective of educational objectives, are practical. The last one is research on the development of facilitators who conduct workshops. This research focuses on enhancing the skills and competencies of workshop facilitators. It includes studies on facilitators' challenges and strategies to overcome them (Anzai & Aoki, 2018) and investigations into facilitators' practical knowledge (Anzai & Tonan, 2020).

Thus, studies on workshops done within educational technology mainly aim to generalize and model workshops, promoting their broader adoption. These efforts are significant as they democratize access to workshop-based learning. However, since the workshop is usually implemented in complex and diverse settings, it is necessary to perceive the dynamic of constantly transforming workshops. In other words, workshops should be portrayed as something in the process of being created, not something inherently created. Due to their complexity and diversity, workshops are often unpredictable. Therefore, it is essential to improvise and design the place together with the participants.

It is necessary to capture the process and experience of facilitators improvising and creating activities with participants in complex and diverse settings and study from a first-person perspective. From a third-person point of view, it is impossible to reveal what the workshop facilitators experience on the spot and how they improvise and reshape the environment in interaction with the participants. Nevertheless, most of the studies on the workshop are conducted from a third-person view (Anzai & Aoki, 2018).

Furthermore, the complexity and diversity of workshops need to be adequately portrayed. Since it has been reported that students exchange their various opinions and ideas in the workshop (Mori, 2015), these discussions focus primarily on cognitive awareness, with little mention of the physical or emotional aspects. Even when they are in the same place and participating in the same activities, the reality of the respective person's experience is different, and this is closely related to their cultures, values, and beliefs. The dynamics of the place created through creation and expression in such different and diverse realities need to be portrayed holistically, not just in terms of cognitive aspects.

Considering these issues, this study will focus on the workshop facilitator's experience from a first-person perspective to capture the learning process holistically. Specifically, it will investigate how facilitators perceive and respond to the diverse and complex dynamics within workshop settings, including unexpected events and challenges.

Research Design & Methods

This study aims to clarify workshop designers' developmental process from the first-person view of misperformance. Misperformance is the concept that highlights how (un)planned mistakes, errors, and even disasters may befall those who perform (Prendergast & Bellive, 2017). The reason for focusing on misperformance is that mistakes are important in the process of mastering workshop design and are likely to occur precisely because of the diverse and complex dynamic interactions. By analyzing experiences from the perspective of misperformance, we can better understand the students' mastery as workshop designers as well as the complexity and diversity of the environment.

In this paper, the authors focus on six university students studying workshop design at X seminar of a university in Tokyo. The students develop various kinds of workshops as art-based research (ABR). The primary data for this study are narratives as their reflection. Students conduct podcasts as a reflection of their activities. The authors analyzed narratives posted in podcasts using the qualitative research software MAXQDA.

Results & Discussion

The analysis found that students reflected that their misperformance came from impatience and the inability to balance freedom and restrictions effectively.

First, as to impatience, it was mentioned that participants needed to understand the explanations as expected, causing a gradual misalignment between the objectives and activities. When participants deviated from the intended path, facilitators corrected them and guided them back on track. However, in reality, this deviation led to the emergence of diverse ideas and methods. As a result, they realized the importance of not immediately correcting deviations from their expectations but instead patiently creating the path together with participants.

The inability to balance freedom and restrictions effectively concerns how much freedom participants should have to alter the methods. During the workshop design phase, the flow and methods align with the objectives, but this approach only sometimes works well with diverse participants. In such cases, saying "You can do it freely" leads to a lack of cohesion, while giving detailed instructions hinders participants' creativity, causing facilitators to feel conflicted. Therefore, they realized the necessity of designing the workshop so that while sharing the goals with the participants, they also allowed modifications to suit their needs and preferences to some extent.

In this study, the authors clarified misperformance from a first-person perspective, explored the diverse and complex workshop settings, and the process of mastering as a workshop designer. As a future direction of this research, the authors will focus on the expertise, cultural, and historical backgrounds that influenced what was learned from mispeformance.

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Transforming volunteer students' perceptions and their process through the art creative activity

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Abstract Volunteering has been actively promoted in various domains and encouraged for educational reasons in universities. However, there are epistemological critiques, especially research that discusses how volunteer studies implicitly reproduce inequalities between volunteers and beneficiaries. To overcome this issue, volunteers should change their perceptions of beneficiaries through alternative interactions with them as part of their volunteering learning. Therefore, this study aims to clarify how the student's perception regarding the beneficiaries, especially children in poor communities, changed through an art creation activity conducted by volunteer students with the author in a squatter community where people had lost their houses and items for living and studying due to a fire. The author interviewed two students who participated in the activity and found that the students perceived the children by "recognizing the children as recipients" and "recognizing the children as entities lacking in activeness" because the environmental factor forms students' perception before the activity and the action. However, they change their perception through observing actions and interacting with the children in the art creation activity. The art creation activity can potentially change the volunteer students' perceptions and encourage the children's agency.

Keywords: Volunteer Students, Perceptions, Art Creation Activity, Display, Inequality, Qualitative Data Analysis

Introduction

Student volunteering is promoted in various forms, such as service learning (e.g., Jacoby, 2015) in higher education. Sydnor et al. (2014) qualitatively examined the learning outcomes of students who participated in volunteer activities as alternative break programs at universities and arrived at three themes that emerged: (1) appreciation, (2) empathy, and (3) learning about self. Haski-Leventhal et al. (2020) found in their literature review that the benefits to students who participated in volunteer activities included (1) improving employability, (2) gaining valuable life skills, such as leadership ability, critical thinking skills, self-confidence, conflict resolution skills, interpersonal communication skills, and self-efficacy, (3) having learning outcomes, (4) developing positive citizenship, and (5) developing empathy.

Although volunteering has been actively promoted in various domains and encouraged for educational reasons in universities, there are epistemological critiques. Hustinx et al. (2022) argue that volunteer studies implicitly reproduce inequalities and discuss existing research from the view of "resources," "interactions," "governmentalities," and "epistemologies." Their primary concern is the perception of scholars engaged in volunteering research. However, this point of view can transfer to perceptions of participants in volunteer activities and the relationship between participants and beneficiaries. In other words, volunteers and beneficiaries are differentiated by whether they have resources, and the interactions in volunteerism reproduce the inequality between volunteers and beneficiaries. In addition, the critical examination of such a premise is insufficient. Thus, the students who join volunteer activities should be aware that beneficiaries were labeled as "beneficiaries" due to a lack of resources and change their perception of beneficiaries through alternative interactions with them as part of their learning through volunteering.

Therefore, this study aims to clarify how the student's perception regarding the beneficiaries, especially children in poor communities, changed through an art creation activity conducted by volunteer students with the author in a squatter community where people had lost their houses and items for living and studying due to a fire. From this case study, the author proposes an alternative way of volunteering.

Theoretical Framework and Design of the Case Study

Human actions are generated by his/her interaction with the environment, which includes various artifacts and their configuration. Despite this fact, our abilities were defined as individual acquisition.

McDermott (1993) discussed how Adam, the child who has a "learning disability," is displayed and labeled as a "learning disability" in his everyday life. Adam presents himself differently in everyday life, cooking club, classroom

lessons, and test sessions. He works well without any problems in everyday life and cooking clubs if he has help from his friend who can assist well. On the other hand, in classroom lessons, testing sessions, and cooking clubs where he has no friends who can help well, Adam has many problems and emerged as a child with a "learning disability." Although Adam can drive various resources and have help in everyday life settings, he is isolated from the environment in classroom lessons and testing sessions. Thus, even though Adam himself has not undergone any change and only his appearances emerged differently in different situations, Adam is labeled as having a "learning disability" without any concern regarding environmental and situational factors. In other words, the learning disability is a social display rather than an individual ability.

Adam's case can be applied to displaying beneficiaries as "recipients" in volunteering and resulting in the formation of the volunteer's perception of them. Although the beneficiaries have the potential to work actively and can emerge their agency depending on the environment (Callon, 2004), they are forced to act as a passive presence that is fed as a recipient in a volunteering situation that lacks various resources and requires behavior as a "recipient." The display of passive acts allows the volunteers to see beneficiaries as recipients. Therefore, we should create opportunities for beneficiaries to act proactively in different environments, as Adam sometimes did, and display their active presence to volunteers to change their perceptions.

Based on the above ideas, the author and the students collaboratively designed and implemented an art creation activity for the children living in a squatter community that lost its houses due to a fire. This squatter community experienced a large-scale fire at the end of December 2023, and its residents lost their houses and household goods. The purpose of this art creation activity was to set the opportunity to work with fun for children living in the community, who were required to act as the recipients of assistance due to the limited environment and to generate active actions. Specifically, we planned an activity in which students and children collaborated to create art by combining objects seen as debris and trash from the fire with paints and drawing paper brought in by the students. The students are studying a Japanese university and working with a local NPO to develop accessories and confectionery as job creations for single mothers and others living in the squatter areas.

Nine students traveled to the community to conduct art creation activity with the cooperation of a local NPO in March 2024. On the event day, the students first provided a feeding activity (giving lunch packs and school supplies) for the community members, then implemented the art creation activity. We had planned to use debris and other objects seen as garbage. However, we decided to have the students and children paint freely with paints and drawing paper that the students brought due to safety reasons for the children. The original plan accepted 20 children to participate, but the number of requests exceeded the limit, and more than 30 children joined the activity. The children freely and actively completed various artworks. Photo 1 shows some of their works.

Photo 1
The works of the children and the students at the art creation activity

Result

In this study, two students actively involved in the planning phase of the activity were interviewed, and collected data were analyzed using qualitative research methods (Nochi, 2011). The results of the analysis revealed that the students' perceptions of children's agency had changed. The details are discussed below.

Students' perception before the activity and a factor in their formation

Based on their experience working with community people, the students have planned this art creation activity. They planned "providing an opportunity for children to demonstrate their agency" and "art creation activity as an opportunity collaboratively working together for demonstrating their agency." On the other hand, the students were "recognizing the children as recipients" and "recognizing the children as entities lacking in activeness." Therefore, the author has strongly intervened during the planning phase as an organizer member.

One factor that affected the students' perception of the children as recipients and passive entities is "the environment of the site, which has completely changed by a fire." The students observed the condition of the community before and on the day of the activity and felt shocked and a sense of loss in comparison to the previous landscape. This environment displays the children as recipients and passive entities; the students have formed these perceptions.

Students' perception after the activity and factors promoting its change

The students have changed their perception of the children as "entities with the potential to become active if the environment is organized" through the activity. They also came to have feelings of "respecting children who act proactively even in a limited environment." The author found that it was brought about by observing "children's actions" and experiencing "interactions with children," which promoted a change in perception during the activity.

Moreover, the students have constructed a new perception regarding the agency. That is, agency is not understood as an ability or a readiness that an individual has, but rather, "environment encourages emerging the individual agency." It includes an analytical view that the art creation activity can make the children living in this community active rather than several people such as Japanese students who are in a different environment from them can be encouraged to lead active behavior.

Perspectives after the activity

The students' reconstructed perceptions regarding children's agency expand their perspectives about the nature of their future volunteer activities. For example, they had the "motivation to create an environment continuously" where the children can perform actively based on their agency, and they felt the need to "design for help with a clear vision."

Discussion

This study examined how the transformation of students' perceptions of beneficiaries occurs through the art creation activity as a case study to overcome the inequality in position between volunteers and beneficiaries and suggest an alternative way of action. The analysis revealed that the student's perception of the beneficiaries, specifically the children in the squatter community in Cebu, Philippines, has been formed by the environment in which the children exist. The author also found that this perception could be altered by the actions and interactions between the students and the children during the art creation activity, which were quite different from what the students had predicted.

Children must work actively through art creation activities for such transformation to occur. Thus, it is important to design an environment in which children can actively take action away from their everyday environment, which directs passive behavior. The art creation activity can bring the children to different situations and seems to allow them to perform proactively.

However, as the student mentioned, whether the art creation activity can be an opportunity for beneficiaries to encourage their agency or not depends on the situation in which beneficiaries live. Therefore, the author believes in the potential of the art creation activity; it is crucial to take the perspective of designing activities that are appropriate for the specific beneficiaries rather than overgeneralizing the value of the activity.

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Loss and Damage: Creative Approaches to Educating Climate Change Impacts in the Philippines

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Abstract: The United Nations Environment Programme highlights "loss and damage" as irreversible climate crisis impacts, disproportionately affecting vulnerable countries like the Philippines despite their minimal contributions to greenhouse gas emissions. Traditional approaches often overlook intangible losses such as cultural heritage, sense of place, and displacement. This research explores the transformative potential of arts, media, and culture in documenting these overlooked dimensions. Collaborating with experts from the University of the Philippines Cebu and the University of the Philippines Open University, the study inquires about their creative methodologies, including drone imagery, interactive museum exhibits, and campus permaculture gardens. Through interviews with UP artists, scientists, and researchers, the study examines how they engage diverse stakeholders, bridging artistic expression and scientific inquiry. By showcasing these creative approaches, the research aims to illuminate the nuanced dimensions of climate-induced loss and damage, advocating for holistic solutions.

Keywords: Loss and Damage, Climate Change, Creative Pedagogy

Introduction

Loss and Damage

The concept of Loss and Damage (L&D) has its origins in significant international frameworks such as the Hyogo Framework for Action (HFA) and the United Nations Framework Convention on Climate Change (UNFCCC) (Suarez et al., n.d.). It gained prominence during UNFCCC negotiations, particularly at COP19 in Warsaw, where developing nations, especially small island developing states and least developed countries, called for compensation from developed countries. Understanding and addressing L&D is increasingly crucial in a changing climate. However, communicating the complexity of climate change and its associated concepts—such as extreme weather, probability, uncertainty, and attribution—poses significant challenges. Traditional communication approaches have often fallen short in conveying the multifaceted nature of climate change, particularly to local communities directly impacted by it. According to CRED (2009), these approaches have failed to effectively engage these communities. Mere dissemination of scientific evidence is insufficient; there is a growing need for dialogue that includes diverse perspectives and acknowledges the political dimensions of climate change.

Given the highly technical nature of scientific discourse, there is a disconnect between scientific evidence and public understanding. While extreme weather events can be attributed to scientific phenomena through climate model simulations, this technical explanation alone does not resonate emotionally or sensorially with the public. Consequently, changing behavior based solely on scientific evidence is challenging. However, persuasion through emotional appeal alone is also inadequate without a scientific basis.

Efforts at documenting loss and damage in the Philippines have been gaining traction. In Cebu, for instance, Jay Nathan Jore, a faculty member of the College of Communication, Art, and Design of the University of the Philippines Cebu, curated the "Duyan ang Kadagatan (Cradled by the Sea): Cebuano Culture and the Heritage of the Sea" exhibit. Together with his research team members Virla Jeaeve Castillanes, Abigail Eugenio, and Alyssa Selanova, the exhibit opened on May 11, 2023, at the Kabilin Center. Funded by the Ramon Aboitiz Foundation and led by Heidee Palapar, the exhibition highlights the fishing culture of four small islands in Cebu: Zaragoza Islet in Badian, Olango, Camotes, and Hilotongan in Bantayan. It covers boat-building traditions, fishing methods and implements, intangible knowledge such as sea routes, fishing seasons, ethnoastronomy, and the faith and belief systems of the local communities.

Dr. Jabez Joshua Flores, an environmental scientist, permaculture expert and senior lecturer at the Faculty of Management and Development Studies (FMDS) of the University of the Philippines Open University (UPOU), played a pivotal role in developing the Perma G.A.R.D.E.N. (Growing Appreciation toward Resilience, Development,

Entrepreneurship, and Nutrition) at the UPOU campus. Opened in March 2023 by FMDS, this interactive, natural laboratory demonstrates to communities how to build home gardens using various strategies to achieve sustainable food production and consumption. For Dr. Flores, permaculture gardens are highly effective in teaching environmental stewardship by modeling sustainable practices and principles that mimic natural ecosystems. This hands-on approach to learning empowers individuals and communities to adopt sustainable practices that mitigate climate change impacts while promoting a deeper understanding of and connection to the natural world.

Research Design & Methods

The researchers interviewed two key informants, Jay Nathan Jore, an artist from UP Cebu who curated "Duyan ang Kadagatan," and Dr. Jabez Flores, an environmental scientist, drone pilot, GIS specialist from UPOU who designed the school's permaculture garden. Complementing the interviews were the visual materials like photos, videos, and exhibit objects and tools examined for their visual components that communicate powerful messages and capacity to arouse emotions captivating the audience. The interviews were transcribed and coded according to the responses of key informants to the research questions. Using Braun and Clarke's (2006) six-phase thematic analysis method, the researchers identified patterns and themes within the qualitative data to understand creative approaches in documenting loss and damage. The six phases are data familiarization, initial codes generation, themes identification, themes review, themes definition, and write-up (Braun and Clarke, 2006).

Results

The results below pertain to the primary research question on how an artist and a scientist employ the arts, media, and culture as creative ways in educating the people about loss and damage due to climate change. Specifically, the results focus on Jore's "Duyan ang Kadagatan" and Dr. Flores' permaculture practice and use of mapping and drone technology.

A. Duyan ang Kadagatan in Cebu

Artist-curator Jore and his team spent one year for their archival research on "Duyan ang Kadagatan." This method involved tracing pre-colonial practices and beliefs among the sea people in four small islands in Cebu, through their stories of fishing and life in the sea.

Indigenous Knowledge Systems:

Jore's archival research reaffirmed the historical accounts of the Visayans' profound connection to the sea, which significantly influenced their way of life and worldview. According to Jore, the early Visayans developed indigenous knowledge systems related to the sea during the pre-colonial era. Furthermore, his study of various fishing implements and fishing methods illustrates how changing sea conditions have compelled fisherfolk to innovate tools and strategies to adapt. This adaptation can be linked to climate change impacts, affecting fishing practices, daily life, and fishing strategies.

Exhibit Contents:

The exhibit prominently features tangible artifacts of fishing culture, including fishing tools, boats, and related objects. Additionally, it highlights the intangible knowledge passed down through generations of fisherfolk, showcasing the evolution of fishing techniques in response to changing sea conditions. Originally documented as two methods ("mamasol" and "mamukot" by Alcina SJ), these techniques have diversified over time.

Innovative Practices:

A key aspect of the exhibit is its portrayal of the fishers' ingenuity. Examples include the adaptation of boats with flippers, the creation of fishing boats from discarded materials like cardboard and styrofoam, and the development of "bote bote" floaters for storing catches. This shows the craftsmanship involved in assembling, weaving, and repairing these materials, telling us about the resilience and adaptive capacity of the sea people.

B. Permaculture Garden in UPOU: A Performative Approach to Teaching the Community about Alternative Ways for Food Production and Consumption

Dr. Flores, a drone mapper, permaculture designer, and GIS specialist, aims to communicate his ideas about sustainable design in the most beautiful and effective way possible. He uses drones and mapping because he believes fear tactics

in addressing climate change often overwhelm people with the extent of the damage, leading to feelings of powerlessness. Instead, he emphasizes showing people the scale of where they are and what actions they can take at that scale, with permaculture playing a key role.

Addressing diverse audiences with varying interests and educational backgrounds, Dr. Flores employs the first principle of permaculture: "observe and interact." For him, observing and interacting with nature is an effective approach to teaching about climate change, as it revives the inherent Filipino association of outdoor experiences with specific events or occurrences. Using food as a starting point for conservation, Dr. Flores introduces the concept of beauty in nature into the conversation. He observes that many people take numerous pictures and appreciate natural beauty, yet often do little to conserve it. Encouraging appreciation and fostering interaction with nature serves as another entry point for conversation.

Creative Methodologies in Teaching the Science of Climate Change

Dr. Flores combines art and science in his teaching by using mapping and the art of cartography to make maps visually appealing and engaging. According to him, these images often elicit a "wow" reaction, especially when multiple datasets are overlaid. For instance, in a project for the Department of Science and Technology, he identified hotspots of lead contamination and overlaid this data onto river networks, revealing many contaminated sites near rivers. These insights, which are not apparent from spreadsheets or text alone, are incredibly powerful. Dr. Flores finds maps more impactful than written publications because effective cartography ensures that the message is understood at first glance without needing extensive interpretation. This is where the artistic aspect comes into play on how well the message is conveyed visually. He notes that those who lack an appreciation for the artistic side of mapping might miss out on its full impact.

To visually communicate research findings, Dr. Flores extensively utilizes drones, which offer real-time visualizations of environmental conditions and the impacts of climate change. Unlike static images from tools like Google Maps or Google Earth, which can be outdated, drones provide immediate monitoring and observations of landscapes. This capability is crucial because environmental changes, especially those caused by human activity, can occur rapidly. Drones capture these changes dynamically, painting a vivid picture that's not typically visible from ground level.

Dr. Flores added that this aerial perspective challenges our usual human-centric view and enhances our understanding of our surroundings within a larger context. For instance, he discovered that some people in Laguna mistakenly perceive Laguna Lake as a sea due to its vastness. In Los Baños Laguna, where UP Open University is located, many were unaware that Laguna Lake is just a kilometer away from campus until they saw it from the drones. This aerial view provides a new dimension to spatial awareness and helps people appreciate their geographic reality more fully.

Discussion
Integrating Science and Art in Documenting Loss and Damage Due to Climate Change

Artist-Curator Jore and Dr. Flores present compelling approaches to documenting and educating about climate change through the integration of science and art. Both of them aim to make the nuances of loss and damage caused by climate change more relatable and comprehensible to the public, but their methods and focus areas differ, providing a multifaceted view of the issue.

Compelling Aspects of Art in Educating About Climate Change

Jore s exhibit *Duyan ng Kadagatan* underscores the loss of tangible aspects of life and displacement due to climate change. His approach is deeply rooted in the historical and cultural contexts of the Visayans, emphasizing the changes in traditional fishing practices and the resulting socioeconomic impacts. By tracing pre-colonial practices and beliefs of the sea people through the stories of fisherfolk, Jore highlights how climate change has disrupted their way of life. For instance, changes in fishing implements and methods indicate a significant decline in fish populations, linked to warmer waters and coral bleaching. This not only affects the livelihoods of fishermen but also threatens food security and public health as dietary patterns change.

Jore s project connects the past and present, making the scientific aspects of climate change understandable through cultural education. His work reveals the intertwined nature of environmental and societal changes, demonstrating that the loss experienced by these communities is both tangible and intangible. By doing so, Jore aims to inspire a strong commitment to responding to climate change through informed behavior and attitudes, highlighting the urgent need for action.

Dr. Flores, on the other hand, emphasizes the importance of offering solutions alongside highlighting the problems caused by climate change. He believes that presenting the scale of the problem can be overwhelming, and instead, focuses on showing people what actions they can take at a local level. His work in permaculture is a blend of science and art, designed to mimic the natural world, which inherently possesses beauty. This approach allows for creativity and adaptability, recognizing that each permaculture design is unique and context-dependent.

From Dr. Flores' work, we learn that mapping and the art of cartography can foster engagement from the audience. This tells us that visual representations, such as maps created with drone technology, can powerfully communicate environmental changes and their impacts. This visual approach helps make complex scientific data accessible and compelling, emphasizing the urgent need for action guided by scientific understanding. By integrating technology with nature, Dr. Flores demonstrates how modern tools can enhance rather than detract from our connection to the natural world.

Conclusion

Both Artist-curator Jore and Dr. Flores illustrate that the intersection of art and science can create powerful educational tools to address climate change, particularly in conveying the concepts of loss and damage. Jore's cultural and historical approach brings to light the human stories behind environmental changes, making the scientific data more relatable and emotionally impactful. His exhibit, *Duyan ng Kadagatan*, emphasizes the tangible and intangible losses experienced by coastal communities due to climate change. Dr. Flores' emphasis on visual and real-time data presentation underscores the importance of immediate and actionable insights. His use of mapping and drone technology to document environmental changes provides a compelling visual representation of the damage caused by climate change. By making these connections visually accessible, Dr. Flores helps the public understand the scale and urgency of the crisis.

Together, their work demonstrates that addressing climate change requires a multidisciplinary approach that highlights both the loss and damage incurred and the possible solutions. By combining the emotional and cultural resonance of art with the empirical rigor of science, they provide a holistic view that can inspire and inform diverse audiences. Through their creative methodologies, they contribute to a more informed and engaged public leading to their action to address the climate crisis in their own ways.

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The Effectiveness of the 360-degree Camera as a Learning Tool - From its Application in Workshops

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This study explores the effectiveness of the 360-degree camera as a learning tool through workshops to a diverse range of age groups and delineates the progression of their application. In today's information society, it is necessary to develop media literacy in response to new visual media. Unlike conventional cameras, 360-degree cameras can record positional information in all directions, and such images provide viewers with an immersive experience. The media literacy necessary to fully understand and effectively utilize the characteristics of these images has yet to be acquired by users. Therefore, this study implemented the workshop in which 360-degree cameras were used to capture and share images, and conducted qualitative study there. As a result, that the 360-degree camera as a learning tool is effective in enhancing media literacy to understand the three-dimensional space recorded in 360-degree images.

Keywords: 360-degree camera, learning tool, workshop, media literacy

Introduction

In today's information society, visual media literacy skills are crucial. It is essential to develop media literacy skills compatible with innovative visual media. Unlike traditional cameras, 360-degree cameras record information about a location in all directions, providing a sense of presence and immersion to the viewer of the image.

Since 360-degree video-based content has become widely available online and we have become familiar with this content through smartphone apps, computers, and Virtual Reality (thereafter, VR). In terms of web content, since 2008, Google Maps' Street View has been providing 360-degree images accessible at specific locations, integrated with map information. This feature allows users to obtain comprehensive visual information about a place without having been there, making the content widely usable. In Japan, research has explored the use of 360-degree images in various educational contexts, including peace education (Setozaki et al. 2017), science education (Imai et al. 2020), and environmental learning (Kobayashi et al. 2021). Other studies have evaluated the practicality of 360-degree images for simulated experience activities (Imai 2021). Universities have been incorporating these materials in nursing education (Yamaguchi et al. 2023) and developing instructional systems for teaching methods (Miyazaki et al. 2019). Beyond educational materials for children and students, VR content is utilized in social education within museums and art galleries in Japan. These institutions use VR in exhibitions and distribute it as teaching materials via online.

On the other hand, personal involvement with 360-degree cameras shooting and the images themselves is relatively small compared to standard smartphone photography and videography. In our daily lives, 360-degree cameras are installed in various places as media devices to record locations and situations, such as security cameras and in-car cameras functioning as drive recorders. However, these recordings are primarily intended for reviewing extraordinary events and are not meant or personal uses, thus offering limited opportunities to see 360-degree videos

that include oneself as a subject. Additionally, while we often recognize ourselves as the subject of photos or videos taken with smartphones, we have very little experience recognizing ourselves in 360-degree recorded images.
Currently, it can be said that we have mastered the media literacy required to accept 360-degree videos provided by VR systems and content. However, due to the limited opportunities to voluntarily use 360-degree cameras, it is challenging to assert that people have developed the media literacy required to understand the characteristics of 360-degree images, thoroughly analyze their functions, and utilize them effectively.

There are few opportunities to interact with 360-degree images that include ourselves as subjects. It is difficult to affirm that we have achieved the media literacy necessary to fully understand the characteristics of these images, analyze their functions, and utilize them effectively. Therefore, it was explored that the actual capturing and sharing of 360-degree images would increase understanding and literacy of 360-degree images. This study explored the effectiveness of 360-degree camera usage as a learning tool through participant observation and interviews across three workshops, involving children, students, researchers and factory workers.

Research Design & Workshop Design

Research Design

In this research, we designed, and conducted workshops in which the participants filmed and shared this immersive media. The workshops were held at three different locations including factory, convention event and gallery. Despite locations, all three workshops shared common elements: the use of a 360-degree camera, tablet terminals and PCs without VR systems, and the collaborative viewing and dialogue facilitated by monitors or projectors. Participants engaged in discussions while manipulating the images on their devices after receiving instructions on filming techniques. The author facilitated the workshop, observed the participants, and recorded videos during its implementation. The author facilitated the workshop, observed the participants, and recorded videos during its implementation. A qualitative study was conducted based on field observations and analysis of the video recordings to examine the dialogue among workshop participants, their engagement with the 360-degree images, and their evolving attitudes toward the 360-degree images.

Workshop Design_ the 1st Workshop

The 1st workshop was conducted on November 23, 2023. It involved filming at Company A's metalworking factory using a 360-degree camera and sharing the footage with the factory staffs, their relatives, and family members. The author and employees set up the camera and filmed for about an hour starting at 10:00 am. The initial video-sharing session occurred during the staff break at noon in the factory cafeteria, where participants could freely manipulate the images using tablet terminals and PCs. These manipulated images were projected for group viewing. Approximately 40 factory staff members participated in this 45-minute session. Following this, a session for the family members of the factory staffs included five families with around 16 participants: three preschoolers, five elementary school students, one junior high school student, and seven adults. The 360-degree images inside the factory were presented alongside the preview monitor of the 360-degree camera.

Workshop Design_ the 2nd Workshop

The 2nd workshop was held on March 10, 2024, as part of the INSTeM Convention 2024 Spring at the University of Tokyo. This workshop catered to students, graduate students, and researchers interested in media literacy

and media practices. The convention focused on media literacy for adults and featured exhibitions, demonstrations, workshops, and talks. The 45-minute workshop had eight participants and was facilitated by the author.

Workshop Design_ the 3rd Workshop

The 3rd workshop took place on March 19, 2024, at the K's printing factory. The filming, supported by a senior factory staff, captured the printing process. A 15-minute video-sharing session followed with the senior staff and the company president. Subsequently, the participants moved to a community gallery and shared the 360-degree video with the gallery owner, a gallery supporter, and a gallery visitor. The session included explanations of the 360-degree video shooting mechanism, factory A's 360-degree video, and the K's printing factory 360-degree video.

Results

Analysis of the three workshops revealed three commonalities.

First, many participants do not have daily experience with 360-degree cameras. In the first workshop, three adult participants and two family members of the factory staffs (mother and preschooler) had never filmed with a 360-degree camera before and it was their first time operating a tablet device for this purpose. One child mentioned using a 360-degree camera at school, but none of the participants in the second workshop, despite being aware of such cameras, had ever filmed with one. Similarly, all participants in the third workshop indicated that they had never taken a 360-degree video before.

Next, all workshops demonstrated 360-degree camera filming, and the filmed images were immediately shared on a tablet device. Participants quickly realized that they themselves would be reflected in the images as they were being filmed. This process allowed participants to recognize that the 360-degree video captures both the environment and the photographer, making them subjects of the video. The family members of factory staff in the first workshop, participants in the second workshop, and gallery staff in the third workshop were all amused by the distorted view of their surroundings as they previewed the screen on their tablet devices during filming. They engaged with the content by swiping and positioning themselves on the screen, pinching in and out to adjust the size of the subject in the frame, and showing the results to those around them. The participants were highly interested in the images of themselves as subjects, both in demonstration videos and videos of their factory work, and they actively reframed the scenes and locations where they appeared. In other words, it was clear that participants can identify the three-dimensional content in the 360-degree image displayed on the screen and appropriately present the necessary information on the terminal screen by repeatedly interacting with the tablet device.

Third, it was found that after the demonstration of video recording, active understanding was promoted by viewing and sharing the recorded content with multiple people, even if the viewer was not the subject of the 360-degree video. However, obtaining information solely from the video was challenging for users, necessitating the photographer's explanation of the location. Providing multilayered and polyphonic information for interpreting the video images was essential for a deeper understanding of the content.

Discussion

The results show that using the tablet device alone, without a VR system, improved participants' ability to understand the attributes of the 360-degree camera and interpret the 360-degree image. Specifically, participants identify and reconstruct the three-dimensional content within the 360-degree image. The shooters noted that they were depicted as subjects in the 360-degree images, especially in workshops that involved shooting. In contrast to

conventional filming, where the camera and the shooter's point of view coincide, in 360-degree images these viewpoints are decoupled, and the surrounding situation is recorded autonomously with the camera at the center. This separation emphasizes the presence of the shooter, which is hidden in conventional images. In addition, the high design quality and novel visual expression of the camera were highly evaluated, and its wider use and sharing were recommended. It can be concluded that the 360-degree camera as a learning tool can be effective in enhancing media literacy to understand the three-dimensional space while three-dimensional images become popular.

In the past, taking a photograph was a deliberate act, leading to a heightened awareness of being photographed. Today, due to the ubiquitous camera apps on smartphones, photography has become routine and internalized. Consequently, in everyday photography, we capture what we see, and viewers interpret this as the photographer's perspective. It can be said that literacy in these visual media has already been mastered. However, 360-degree images differ from traditional photographs that "cut out" a specific field of vision. Instead, they uniformly record all visual information from the photographer's location. This results in images that appear distorted even when viewed through a viewfinder or viewer, providing a novel visual experience for the photographer, subject, and viewer.

New video technologies offer an opportunity to reconfigure the routine and internalized use of cameras and understanding of images, allowing individuals to experience the fascination and wonder of reality captured in images that differ from their own vision. This helps develop the literacy needed to interpret images. It can be said that the experience of filming and viewing differentiated by new technology will heighten awareness of recording and being recorded with visual media.

However, the amount of information provided by 360-degree video can be overwhelming. Simply providing the images with tablet devices is insufficient to develop the ability to accurately interpret these images, leading to potential misinterpretations during the sharing process. To address this, multilayered and polyphonic communication, including facilitated discussions about the images, is necessary. In the future, this study aims to conduct further research on the nature of communication, including dialogue and facilitation, in workshops involving multiple viewers using 360-degree video.

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COIL Collaboration with Five Universities across the Pacific: English Education Perspectives

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Abstract The purpose of this study is to examine the instructional design of Collaborative Online International Learning (COIL) and to clarify the effectiveness of COIL from the perspective of English education at a university in Japan. The faculty members from Tokyo University of Foreign Studies (TUFS), International Christian University (ICU), the University of California, Irvine (UCI), Aoyama Gakuin University (AGU), and the University of the Philippines-Open University (UPOU) collaborated in the second semester of 2023. This study focused on bilingual Japanese and EFL students in this international environment. As a result, it was found that bilingual students are likely to serve as good role models for EFL students, which may enable EFL students to engage in learning activities within their zone of proximal development (ZDP).

Keywords: COIL, Constructivism, ZDP, Affective Filter Hypothesis

Introduction

COIL

The purpose of this study is to examine the instructional design of Collaborative Online International Learning (COIL) and clarify COIL's effectiveness from the perspective of English education at a university. There is growing interest in COIL for authentic language learning in Japanese English education at universities. Anzai and Shimizu (2022) conducted Action Research on COIL in Japanese and American university language classes. Shimoyama et al. (2022) held a symposium on future online international exchange at an international conference. These are some of the studies related to COIL.

Among various COIL projects, Transpacific COIL (TP-COIL) was a global-scale project granted funding by the Ministry of Education, Culture, Sports, Science, and Technology in Japan from 2018 – 2022. In 2023, the year after TP-COIL was completed, faculty members from Tokyo University of Foreign Studies (TUFS), International Christian University (ICU), the University of California, Irvine (UCI), Aoyama Gakuin University (AGU) and the University of the Philippines-Open University (UPOU), whose classes had participated in the previous year, voluntarily collaborated in the new COIL project as an extension of TP-COIL. All the faculty members of this team specialized in Education. They coordinated their syllabi and conducted COIL as a part of their classes.

Under this TP-COIL, this study focused on Japanese students who are bilingual and taking Media class where English was used as a medium of instruction and those who were taking academic English as EFL learners. The study seeks to answer the following questions. First, what are the differences and similarities of the effects of COIL between bilingual students and EFL learners? Secondly, what are the Japanese students' learning about intercultural communication through COIL?

Action Research (Nunan, 1993) was used to answer the questions. Nunan maintained that there are six steps to conducting Action Research: problem Identification, Preliminary Investigation, Hypothesis, Plan Intervention, Outcome, and Reporting.

1. **Problem Identification.** In this TP-COIL, the students from TUFS, UCI, and UPOU were generally native speakers or speakers who use English as a second language. They were studying their specialized fields using English. In contrast, the classes at Aoyama Gakuin University consisted of two types of courses: one for EFL students learning English and another for returnees and international students studying media communication.

Consequently, in a global environment such as COIL, there was an issue that made Japanese EFL students hesitant to participate in a global learning community.

2. **Preliminary Investigation.** Since this COIL has been ongoing for several years, the instructional design was developed based on the instructors' previous COIL experiences.

3. **Research questions**. First, what are the differences and similarities of the effects of COIL between bilingual students and EFL language learners? Secondly, what are the Japanese students learning about intercultural communication through COIL?

4. **Plan Intervention.** The period of the implementation was from September to November 2023. Over Two hundred UCI, AGU, UPOU, TUFS, and ICU students participated in the project. This COIL project was a content-based, collaborative learning experience in which all participants used English as a communication tool, and the environment became more like studying abroad. It consisted mainly of two phases. The first phase was an asynchronous COIL using Flip. First, a short 10-second self-introduction videos were created and uploaded to Flip, and the students from five universities commented on each other's videos. Next, the project moved from individual work to group work. Each group created a five to six-minute video introducing "on and off-campus life" and engaged in online interaction on Flip. The first phase took place between September 23 to November 16, 2023. In the second phase, the project moved from asynchronous to synchronous COIL, and the students carried out synchronous COIL using ZOOM to have more spontaneous interactions. The ZOOM session took place on November 17, 2023.

5. Outcome.

5-1. What are the similarities and differences in the effects of COIL between bilingual students and EFL students?

What are the similarities and differences in the effects of COIL between bilingual students and EFL students?

Similarities

・I felt closer to others when they showed me a smile or when we had something in common.

・Every student was very friendly. I was so happy and relaxed by their friendliness.

・I think it is OK to have a Japanese accent in my English. When we use English as a lingua franca, the most important thing is to be able to communicate with each other, no matter how we have different accents.

・I feel closer to others when they speak in a way I can understand… I want to help foreigners kindly by using easy English and body language.

As the students' comments showed, both bilingual and English learners had similar impressions that interactive and technology-enhanced learnings significantly boost their engagement. They particularly highlighted the importance of nonverbal communication in addition to verbal communication, which may serve as immediate feedback to the other participants. This feedback aligns with the principles of Constructivist Learning Theory (Vygotsky, 1978), which emphasizes active, student-centered learning where learners construct their understanding and knowledge through experience.

Differences

Bilingual students	EFL students
・・In the ZOOM session, Japanese students tend to be shyer or not share their opinions as freely as the other students. It was mainly me and the other Filipino university students who spoke more freely about our thoughts on the video-making processes.	・I was so nervous to talk with other university students in English because all the students without me spoke English fluently. Japanese was only me. In my ZOOM group, almost all students turned on the video, but only one did not. I did not feel good about it.
・ It seemed that many people enjoyed the synchronous Zoom session since we could see the other students and faculty and communicate with them in real-time compared to the asynchronous form on Flip.	・I thought it was still difficult for us to speak in front of everyone, even online. I studied abroad in Australia for one year but am nervous about speaking English. I need to solve this problem.
・I found the most significant difference between asynchronous and synchronous to be the degree of isolation. The fact that we can participate and communicate simultaneously makes me feel closer to my classmates.	
・I thought COIL was the new style of an online class and was the start of a new education style. I was able to feel confident	
・When we were in a breakout room, we got to talk with just four people, and it was comfortable. Miku was in the same group, and she was smiling and giving back-channel feedback.	

・. I found out that when we use asynchronous, we can take time to write back comments. In synchronous media, it is not possible. On the other hand, in the Zoom session, I felt that I belonged to the course, and I was thrilled and encouraged that my opinions were embraced. Talking to my peers directly in the breakup session made me very comfortable.	

In summary, regarding nervousness and shyness, bilingual students pointed out the general shyness of Japanese students. They also mentioned that they felt confident in new online educational styles like COIL. On the other hand, EFL students felt nervous speaking English among fluent speakers and were conscious of being the only Japanese student when it happened. They mentioned that they need to overcome the issue of their anxiety. Furthermore, regarding the benefits and challenges of synchronous sessions, bilingual students enjoyed real-time communication more than asynchronous sessions, while the opposite is true for EFL students. They found it challenging to speak in front of everyone and felt uncomfortable when some participants did not turn on the video. Krashen's Affective Filter Hypothesis suggests that a learner's emotions can affect their ability to acquire language, and high anxiety may serve as a filter that impedes language acquisition (Krashen, 1986). According to the theory, motivation, self-confidence, and anxiety are three variables that play a role in second language acquisition. In this sense, asynchronous communication may serve as a better communication system for EFL students than a synchronous communication environment such as ZOOM.

5-2. What are the Japanese students' learning about intercultural communication through COIL?

Below are the comments from the bilingual and EFL students regarding the similarities and differences.

・Even at Zoom, I felt a cultural difference. The moderator was an American student, and a few Japanese did not show their faces. None of the Filipino students showed their faces either. I was surprised when one of the Filipino students said, "I am shy and do not want to show my face."

・There were also cultural differences in the self-introduction video. Some American students filmed outside, while many Japanese did inside their homes. Also, some Filipino students did not show their faces.

・Between the countries, the social problems or ways of thinking are very different. My friend and I discussed the problems with trash in Japan in my project. This problem is widespread in Japan, and it is our daily mission. However, some students from the Philippines did not realize it, even though they had the same problem in their country…This problem is widespread worldwide, but the way they capture it is very different, and I feel we should be more concerned about our environment.

・I found cultural differences, which cannot be learned in the asynchronous part. Students from different countries, such as the U.S. and the Philippines, were speaking up more. They were not hesitating to speak up at all. Also, I realized that students from the Philippines were reacting with heart on Zoom so often. I do not often see Japanese students using reactions. It was interesting. I could imagine that students from the Philippines value reaction.

In summary, cultural differences were evident during COIL. For example, the Japanese students and Filipino students were different in how they communicated, such as whether they turned it on or off, how they shot the videos, or how they reacted to the communication. Furthermore, they recognized the difference in social problems, such as how they treat trash. These are meaningful, authentic learning experiences about intercultural communication.

These observations align with constructivist and sociocultural theories. Constructivism emphasizes learning through active engagement and social interaction (Vygotsky, 1978), which would foster global competencies and digital literacy. Furthermore, bilingual students confidently express themselves on international platforms where diverse races come together. Therefore, bilingual students are likely to serve as good role models for EFL students. Good role models can enable EFL students to engage in learning activities within their zone of proximal development (ZDP), which is expected to enhance their learning outcomes.

6. Reporting. This study will be reported at iCoME 2024, and the results will be shared with the participants at the concurrent session.

Acknowledgment

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Effectiveness of discussion technologies for cross-cultural understanding
− Video Conferencing and Virtual Reality −

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This study examined aspects of various formats of online discussion for cross-cultural understanding and language learning between Japanese students and overseas partner-university students. Discussions were conducted through three formats in order to investigate whether different forms of video conferencing influence the structure of communication: 1) VC-intergroup connection; 2) VC-individual connection; and 3) VR (a metaverse platform). After the VC discussions, VR discussions were conducted. Analysis focused on turn-taking and non-verbal communication such as body language, gesturing, and eye-contact. Focus group interview and questionnaire data was also collected and analyzed. The various discussion forms significantly influenced discourse aspects such as turn-taking and participant attitudes. These findings indicate that VR interaction was smoother than VC. The results of this study could suggest improved forms of distance communication for educational contexts.

Keywords: COIL, Cross-cultural Understanding, Metaverse, Videoconferencing, Virtual Reality

Introduction

Background

Since the Covid-19 pandemic, communication through video chat and video conference has become widely used in our lives. Distance communication which uses such tools has already become one of the formats of education, on par with face-to-face communication in educational settings. In addition, with the evolution of technology, we can communicate not only in real life, but also in virtual reality. Are there any differences between these new forms of communication? This study examined aspects of various formats of online of discussion for cross-cultural understanding and language learning between Japanese students and overseas university students.

Video conferencing for cross-cultural understanding

For more than a decade, long before the Covid-19 pandemic, we have been engaged in education through collaborative remote learning such as the recent COIL (Collaborative Online International Learning) (e.g. Suematsu et al. 2019) in Japanese higher education settings, between Kanazawa University, Japan, and Çanakkale Onsekiz Mart University, Turkey.
This educational practice aims to deepen students' understanding about their own and each other's societies and cultures. Students exchange their thoughts and opinions about various aspects of the societies (social problems in each country, global issues) in the Japanese language. The objective is to examine learning effects (the effects on students' cross-cultural understanding, communication skills, and autogenous growth). Another significant feature of this practice is that the discussion is conducted in the Japanese language, though most of the educational practice which is carried out through COIL uses English. The participants of the video conferencing (hereinafter: VC) discussion are Japanese language learners who are studying Japanese as a foreign language at overseas universities. This educational

practice also aims to provide occasion for JFL learners to improve their communication skills in Japanese and deepen their understanding of Japan and Japanese people.
We have conducted this educational practice through various video conferencing platforms, so we call it "video conferencing discussion for cross-cultural understanding," or "VC discussion."
This educational practice consists of discussion through video conferencing, and tasks on an LMS. VC discussion is carried out several times. During the VC discussions, students prepare for the next discussion on the LMS (Moodle or Google Classroom) and communicate with each other between VC discussions. We have conducted VC discussion through video conferencing systems such as Polycom and video conferencing applications such as Skype and Zoom. Since 2023, we have also conducted these educational practices on Metaverse.
Through these educational practices and research, we have noticed that different forms of VC discussion influence the aspects and structure of communication (Fukagawa & Kawamoto 2022). In this presentation, we describe the results of a quantitative study of the effects of various forms of VC discussion on the aspects of communication.

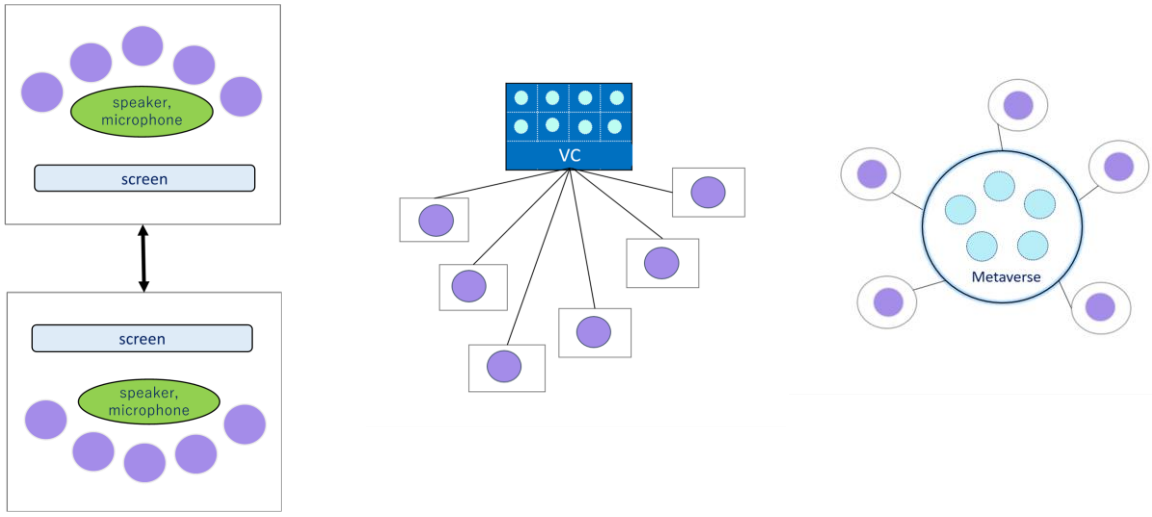
Research Design & Methods

Settings

Forms of VC discussion Discussions were conducted through three formats in order to investigate whether different forms of video conferencing influence the structure of communication (Figure 1): 1) Students gathered in classrooms at each university and connected through Skype or Zoom (VC-intergroup connection); 2) Students connected from places of their individual convenience via Zoom (VC-individual connection); and 3) Students connected from places of their individual convenience through Horizon Workrooms, a virtual reality (VR) metaverse platform.
Before the Covid-19 pandemic, students met up in classrooms of each university, and we connected these classrooms through the VC system or Skype (Intergroup connection). However, during the Covid-19 pandemic, both universities implemented distance learning, so students couldn't meet up in the classrooms and had to connect from wherever they were via Zoom. (Individual connection). In this study, we compared the two formats of VC-intergroup connection in 2019 and VC-individual connection in 2020. Discussions were conducted as courses at each university, and this educational practice was carried out over 2 months, during which VC discussions were held three times. The duration of each VC discussions was 40-50 minutes.
As for the VR discussion, Japanese students connected from different rooms on the campus, while Turkish students connected from places of their individual convenience, because their university had been locked down due to an earthquake which had occurred in 2023. These VR discussions were held three times over the course of a month. The duration of each VR discussion was 30-40 minutes. After the VC discussions, VR discussions were conducted among three Turkish students and three Japanese students, all of whom had experienced VC discussions. A pilot discussion was conducted prior to the main experiment to check the VR environment, including internet connection condition, the layout of the meeting room in the metaverse, and operation of the VR headset.

Figure1

Format of each discussion



VC-intergroup VC- individual VR

Participants For VC discussions, approximately 10 Turkish students and 5 Japanese students were placed in each group. The Japanese students were undergraduates from various faculties and grades. The Turkish students were 3rd-year students from the Faculty of Japanese Language Education. They had been studying the Japanese language more than three years, and taken basic-level Japanese language courses since they entered their university. Most students had communication skills at the CEFR B1 level or above.

Topics of VC discussion Theme and delivery of the discussion activities were constant throughout each discussion form. Discussions were either about social problems in the students' respective societies/countries (e.g., job-hunting for university students, education, gender problems of each society), or global issues (e.g., AI), and were conducted in Japanese. Before each VC discussion, students sent messages through the LMS to discuss and decide about topics. In the VC discussion, teachers were involved only as facilitators.

Method

To examine the learning effects, the discourse structures during the video conferencing discussions were examined, individual student reports and questionnaires were analyzed, and interviews were conducted. Analysis focused on turn-taking and non-verbal communication such as body language, gesturing, and eye-contact. Focus group interviews and questionnaire data collected after the VR stage were also analyzed.

Results

Discussions in all formats (VC-intergroup, VC-individual, and VR) were successful in stimulating deep understanding and learning among students. We then focused our research on aspects of the discussions, through analysis of the discussion videos, focus-group interviews and questionnaires to students. Different discussion forms significantly influenced the discourse structures of communication.

Aspect of turn-taking and pauses

To compare the aspects of turn-taking, we timed how long it took to change turns among speakers. We extracted 20-minute scenes from each session. Table 1 shows the frequency of turn-taking and duration of pauses averaged over three discussions for each format. A one-way analysis of variance (ANOVA) was conducted to compare the pauses between turn-taking among the three groups. The results of the ANOVA showed that there was a statistically significant difference between groups, $F(2, 385) = 19.572$, $p < .001$. Because the ANOVA results were significant, a post hoc comparison using the Tukey HSD test was performed to determine which groups were different from each other. The results indicated that VR and VC-individual were significantly different from each other ($p < .001$), as were VR and VC-intergroup ($p < .001$). As we can see on Table 1, VR demonstrated shorter pauses between turn-taking than either VC-individual or VC-intergroup. The turn-taking in VR was smoother than in other formats. In VR discussion, speech overlapping and spontaneous interruptions, as observed in face-to-face interaction, occurred more often.

Table 1

Frequency of turn-taking and duration of pauses for each discussion format

Discussion Format	Frequency of turn-taking (average)	Average of pause between turn-taking (sec.)	Maximum of pause between turn-taking (sec.)
VC-intergroup	108.33	2.16	8.0
VC-individual	66.33	2.42	9.0
VR	127.00	1.29	4.1

Aspect of non-verbal communication

In a conversation, speakers try to get cues for when to take their turn by looking at other peoples' faces, in addition to listening to phonological features such as intonation and speed. In VC discussion, participants could see other people's faces through the monitor and speaker, but it was sometimes difficult to recognize the current speaker's face, especially in VC-individual. Our analysis suggests that speakers' faces are more easily recognized during VC-intergroup than VC-individual, because participants watch the other side's participants on a large monitor/screen together in the same

room. It was possible to communicate smoothly, barring problems with Internet communication conditions. VC-intergroup displayed more laughter than VC-individual. However, we did observe some interactions in which participants tried to take turns but their comments overlapped, interrupting the conversation.
On the other hand, in VR discussion, all the participants turned their bodies toward the speaker and watched the speaker's facial expressions. Besides, in VR space, participants were able to move their bodies, albeit through avatars. They could move their arms and head while they were talking. Because of that, movements such as back-channeling with nodding (*aizuchi*) were often observed in VR discussion. In addition, in the VR space (Horizon Workrooms) we used for this examination, the closer a speaker is to a listener, the easier it is to hear them, so speakers could hear other people's back-channeling (*aizuchi*) such as "*aa,*" "*un,*" "*hee*" (In English: "I see," "really?" etc.). These differences might contribute to speakers and listeners finding the appropriate timing to take their turns.
This analysis aligns with the comments of the participants. The focus group interview suggested that it was easier to communicate through VR than VC-individual. In the interview and questionnaire for VC-individual, participants said they felt some difficulties taking turns. Some of the Japanese students said that they had a hard time "reading the atmosphere" (In Japanese: "*kuuki o yomu*") to know the right moment to talk. However, the participants said they felt it was easier to talk in VR than VC-individual (Zoom), because the avatars allowed them to see the other speakers' faces and gestures as they spoke, and it felt as if they were exchanging eye contact with the other speakers. The participants also indicated that they felt as if they were talking in the same classroom. Such a sense of unity may have made it easier for them to interact with each other, and discussions were livelier. From these findings, we realized that when we communicate with others, we use various information channels besides language itself, and how different in-person communication and indirect communication using VC platforms are, even though we can hear our speaking partners' voices and see their faces.

Discussion

These findings indicate that VR interaction was smoother than VC. This means VR could be another option of format for education. As for the merit of VR, it could become a solution to the problems of distance and transportation cost of collaborative learning in distance education. In addition, it is meaningful to be able to interact with others in learning activities such as these, and the immersiveness of VR offers a sense of unity and intimacy in the environment. On the other hand, some physical and technical issues, such as the restrictions and cost burdens of having to use specific equipment such as VR headsets, as well as the physical burden of wearing VR headsets, such as the weight of the VR headset itself and fatigue from wearing it for long periods of time, were also recognized.

Conclusion

The results of this study could suggest improved forms of distance communication for educational contexts. Future research will examine reasons for difficulty/comfortability through VR and other formats, including face-to-face, elucidating what we rely on to communicate smoothly with others.

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The Success Case Method: Impact Analysis for Global Biomanufacturing Training Program

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This study evaluates the impact of the "Hands-on Training for Upstream Process in Vaccine Manufacturing" program, aimed at strengthening Africa's biomanufacturing capabilities. Using the Success Case Method, the research analyzed survey data from 18 participants and interviews with 5 high performers. Results indicate significant improvements in participants' knowledge and skills, with 94.4% finding the program highly beneficial. Key themes emerged: knowledge utilization, networking, and process enhancement. While the program effectively enhanced job competencies and initiated organizational innovations, implementation challenges were identified, including inadequate infrastructure and resource constraints. Recommendations include refining the balanced approach of didactic and hands-on training, facilitating more networking opportunities, and implementing support mechanisms. The study underscores the program's potential to advance Africa's biomanufacturing sector while highlighting areas for future improvement.

Keywords: Impact Analysis, Hands-on Training Program, Success Case Method

Introduction

The "Hands-on Training for Upstream Process in Vaccine Manufacturing" program, initiated through a collaboration between the Kenya Medical Research Institute (KEMRI)-Wellcome Trust Research Programme, the International Vaccine Institute (IVI), and the Korea Bio-Pharmaceutical CMO Center, aims to fortify Africa's biomanufacturing capabilities. Launched in 2023, the program addresses a significant gap in local vaccine manufacturing expertise by providing African scientists and industry workers with essential skills for upstream processes in vaccine production. Amid a transforming global health landscape, the urgency for local vaccine manufacturing capabilities has intensified. The COVID-19 pandemic has highlighted the vulnerability of regions reliant on external sources for vaccines, underscoring the need for self-reliance and robust healthcare infrastructure. This training program, therefore, is a vital component of a broader strategy to ensure the sustainability and resilience of Africa's biomanufacturing sector.

The primary objective of this research project is to conduct a comprehensive impact analysis to assess the program's effectiveness in enhancing participant learning outcomes, fostering behavioral changes in

professional practices, and generating broader organizational and sectoral impacts. This analysis is critical for identifying areas of improvement, optimizing training delivery, and contributing to the advancement of Africa's biomanufacturing sector.

Research Design & Methods

This study has adopted the Success Case Method (SCM)(Brinkerhoff, 2003) to evaluate the impact of the training program. SCM is utilized to identify and document specific examples of where training has been successfully applied, enabling an exploration of key success stories and the factors contributing to these achievements.

First of all, success indicators were developed across four domains: Job Competencies Enhancement, Job Performance Improvement, Professional Engagement, and Organizational Innovations, and the indicators were validated by subject matter experts(SMEs) to ensure their relevance and accuracy. Second, the survey and the interview questionnaire were developed with the four success indicators. Third, the survey was conducted among 18 participants from the training program. 5 interviewees were chosen based on the survey result based on the selection criteria. Fourth, semi-structured interviews were conducted with each selected interviewee to gather detailed insights into the training program's impact. Finally, both quantitative and qualitative data were analyzed to identify the factors that contribute to the success cases.

Results

The program's impact was evaluated by surveying all eighteen participants and interviewing five selected high performers. The results of these analyses are as follows:

Survey Analysis Results

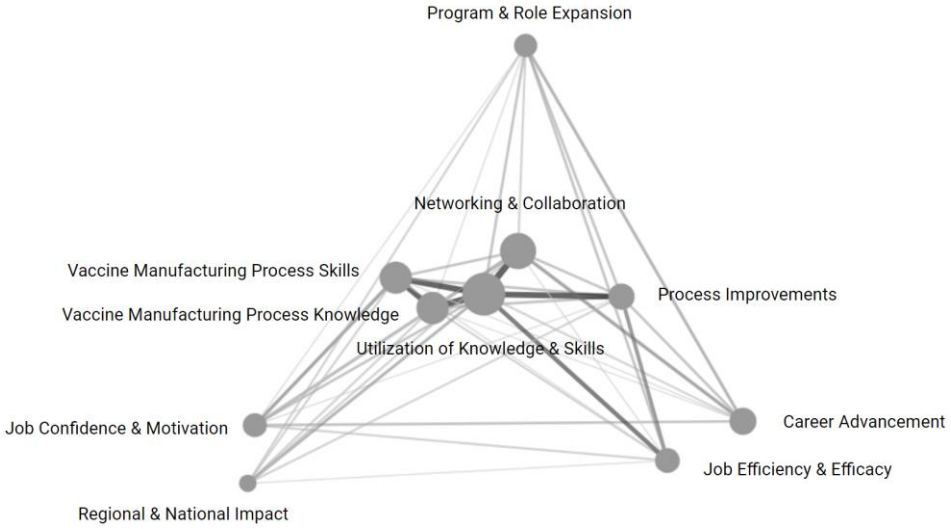
Post-training survey results indicate that the KWTRP training program significantly impacted participants. The program effectively improved knowledge and skills in vaccine manufacturing, with 94.4% finding it highly beneficial, and participants rated their knowledge and skills acquisition at 88 and 92 out of 100, respectively. Key areas of improvement include Vaccine Upstream Process development, GMP, and biosafety basics, despite limited exposure to downstream processing. Participants reported enhanced job performance, rating the training content's applicability at 3.67 out of 4.00, with frequent application of GMP, Good Documentation Practices, and Good Laboratory Practices. Additionally, 94.4% felt the course enhanced their efficiency in USP processes. The training also provided them with better engagement, networking, and career growth, with private sector participants reporting higher career advancement than their public sector counterparts, which is assumed to be due to cultural differences. After the training, the participants looked forward to improving organizational SOPs and quality systems, with immediate changes observed and longer-term results expected. Overall, the KWTRP effectively enhanced job competencies, performance, professional engagement, and initiated organizational innovations, showing significant long-term potential in vaccine manufacturing.

Interview Analysis Results

A code co-occurrence analysis of interviews with high-performing participants, integrated with foundational program data and survey results, revealed the primary themes in order of significance: Knowledge and Skill Utilization, Networking and Collaboration, Process Enhancement, and Occupational Efficiency and Efficacy(Fig 1).

Figure 1

Code co-occurrence analysis graph of trainee interviewee response data



The paramount effect of the educational program is the utilization of knowledge and skills. This aligns with the program's structure, which emphasizes the application of acquired knowledge and skills through practical training that precedes theoretical instruction.

Networking and collaboration were identified as the second most critical factor. Interviewees emphasized the significance of cooperation with other experts, laboratories, corporations, and nations in applying their knowledge and skills. Numerous learners experienced the importance of networking during the training program, which continued to exert influence upon their return to their home countries.

Process enhancement and occupational efficiency showed lower than expected correlation with knowledge and skill utilization. The analysis identified key implementation challenges:

1. Non-responsive supervisors impeding change initiatives.
2. Inadequate vaccine manufacturing infrastructure in trainees' home countries.
3. Insufficient equipment and financial resources, hindering immediate skill application.

These factors collectively obstructed the practical implementation of acquired knowledge and skills.

Discussion

The program effectively enhanced participants' competencies in vaccine manufacturing processes, particularly in upstream processes, GMP, and biosafety. The balanced curriculum of theoretical knowledge and practical skills proved crucial in addressing industry-specific needs. Notably, the utilization of acquired knowledge and skills emerged as a key indicator of success, highlighting the value of hands-on training approaches. The program fostered networking and collaboration, creating a strong community among participants that facilitated ongoing knowledge exchange. While participants initiated organizational changes, particularly in SOPs and quality systems, they faced challenges in implementing these changes due to institutional constraints and insufficient support systems. The analysis also highlighted the importance of targeted participant selection to maximize training effectiveness. These findings underscore the program's potential to contribute significantly to the advancement of Africa's biomanufacturing sector, while also revealing areas for improvement in future iterations.

Conclusion

The Success Case Method analysis provides valuable insights for enhancing global biomanufacturing training programs. Key recommendations include maintaining and refining the balanced approach of didactic and hands-on training, with continuous updates to reflect industry advancements. Facilitating more networking opportunities and collaborative projects is crucial for fostering innovation and professional growth. Implementing regular follow-up and support mechanisms, such as mentorship programs and resource libraries, will ensure participants can effectively apply their knowledge post-training. The participant selection process should prioritize individuals directly involved with

relevant technologies to maximize impact. Future impact analyses should adopt a pre-post evaluation design and engage more deeply with participants' supervisors to assess broader organizational and sectoral impacts. Continuous evaluation and feedback integration from all stakeholders is essential for maintaining program relevance. Broadening the evaluation scope to consider long-term career progression and regional impacts will provide a more comprehensive understanding of the program's effects. These improvements aim to consolidate gains and address challenges, contributing to a resilient, innovative, and self-sufficient biomanufacturing sector in Africa.

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Readiness of Current University Students for Taking Online "Negotiation" Class

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The purpose of our research is to find the effects of drawing image of "negotiation" in the online "negotiation" class offered for the university students. In this class, the contents were delivered by not only lecturing but also role play, group discussion, and the analysis of case studies. To capture how far the students understood the contents, drawing image of "negotiation" was conducted by using the whiteboard of zoom in the middle of the semester. As a results, drawing image of "negotiation" was effective on facilitating group discussion, checking the process of negotiation and capturing the importance of nonverbal cues. Especially the enrolled number of the students is large, it will be efficient method.

Keywords: Drawing, Negotiation class, Nonverbal cues, Online, University students

Introduction

There are six ways to deal with conflicts: avoidance, negotiation, mediation, arbitration, litigation, and fight (Suzuki, 2004). Among them, arbitration is a traditional Japanese method of conflict management in which a third party intervenes and offers a proposed solution. As the first study, four role plays were conducted online with two professional mediators and four undergraduate students and recorded with Zoom in 2022. In the role play, the undergraduate students took the role of mediation and analyzed their abilities of mediation to find out their readiness. As a results, the four un-trained students demonstrated arbitration to solve the conflicts. Therefore, the researchers realized the necessity of training of negotiation skills for the university students based on "OECD Future of Education and Skills 2030."

Negotiation is a way to resolve disagreements and conflicts. Conflicts include things ranging from familiar everyday disputes, such as between parents and children or between superiors and subordinates, to national-level disputes and wars. Therefore, the ability to negotiate to resolve conflicts must be acquired not only as knowledge, but also as an everyday practical skill.

In Japan, students learn academic writing when they enter university. Last ten years. in most of the cases, the subject of academic writing is offered to the freshman and the writing center is established to support the students (Tokito, 2022). At the academic writing class, students learn how to write reports and thesis by citing various references and logically constructing opinions with evidence. To acquire negotiation skills, students are required to have such logical thinking as well as practical skills that can be put into action at the same time. Therefore, this study proposes that there is merit in checking the understanding of negotiation skills not only in writing but also in drawing in online university classes.

Research Design & Methods

The purpose of our research is to find the effects of drawing image of "negotiation" in the online "negotiation" class held for the university students. The research question is "What is the university students' image of "negotiation"? To investigate the research questions, one questionnaire at the beginning of the semester was conducted and drawing image of negotiation was conducted in the middle of the semester (after 7 classes). At the end of the semester, another questionnaire that is the same content of the first one will be conducted in order to measure the change of individual knowledge about negotiation. However, the results of the second questionnaire are not focused in this paper.

In the first questionnaire, the following four questions are asked besides some attribute such as name, age, and gender.

1) & 3) Raise five words associated to the word “negotiation” and “third-party intervention” respectively.
2) & 4) Please write your own definition of the word “negotiation and “third-party intervention.”

The target class is called “negotiation” class hold in Spring semester 2024 at one university. In April 2024. 96 students are enrolled. This class is conducted online using zoom once in a week. The class will proceed through interactive lectures and group work. The cases discussed are "the story of orange” (Fisher & Ury, 1991) “my paid vacation" (Suzuki, 2017), "A Chairy Tale" (McLaren, 1957), and "the LOHAS mother" (Suzuki original), all of which begin with a conflict of opinion between two characters. However, they use examples in which consensus can be reached by exploring each other's interests and creating a proposal that realizes both interests.

Results

Questionnaires 1
In April, 96 questionnaires were distributed to the enrolled students in the “negotiation” class and 90 questionnaires were collected. Among them, 89 were used for analysis. It was found the gender differences regarding the readiness of “negotiation”. The 59 female students’ image of “negotiation” is communication, discussion, be influenced, compromise, transaction, and business. The 30 male students’ image of “negotiation” is communication, beat down the prices, compete, inter-personal, and sales. The female image of “third-party intervention” is intermediate, arbitration, help, quarrel, and prevent. The male image of “third-party intervention” is intermediate, objective, oppose, outsider, and stop. In total, the female image is more harmonious while the male image is more business oriented.

Image drawings
June 3rd Image drawings about “negotiation” and its explanation in words are conducted by 18 groups which consists of 3 to 6 classmates. Based on the results of the first questionnaire, each group was grouped with mix number of boys and girls. For drawing, white board of zoom is used and 20 to 25 minutes was spent. 18 image drawings done by 18 groups which consists of 3 to 6 classmates were analyzed.
Figure 1 shows some examples of the drawings. The left picture shows the process of cooperative approach, while the right picture shows the result and the process of cooperative approach. Out of 18 groups, 8 groups drew the scene of cooperative approach only while 10 drew cooperative approach, competitive approach and others. 9 groups focused the results of negotiation while 4 focused the process of negotiation, 3 focused the results and the process, 1 focused the process of brainstorming and 1 is other. Sixteen groups drew two persons, and 1 group drew four persons and 1 is other.

Regarding the contents taught in the class, the results as follows: dual-concern model (6), a chairy tale" (4), the story of orange (3), my paid vacation (2) etc.
Table 1 shows the summary of expression of image of building consensus. 10 groups out of 14 groups drew smile face, and 7 groups drew shaking hands. Since white board with zoom is used, the stamps of heart, star etc. is available. Thus, the students use these stamps to show the positive feeling, and the number of the stamps are the same for both sides when it is cooperative approach. Table 2 shows the process of cooperative approach and it is represented by the usage of symbol (⇔、→←) as two way communication, and the speech bubbles. In addition, two opponents stand at the end of the same table. On the other hand, the process of competitive approach (table 3) is represented by asymmetrical body postures, and sweat or tears on the loser's face. The facial expression is different, one is smile and the other is dissatisfied face. The amount of speech is different. Marker of anger such as  is used on one side. The students knows that  shows the anger because this is one of signs used in manga.

Figure 1
Examples of image drawings

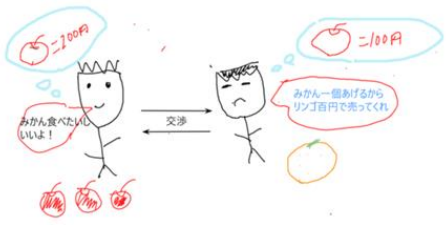

Table 1

The image of building consensus

image of building consensus	simile	shaking hands	positive usage of stamps	the same number of the stamps	holding hands	crown	Libra	thumb up	equal symbol (=)
14	*10*	*7*	*5*	*3*	*2*	*1*	*1*	*1*	*1*

Table 2

The process of Cooperative approach

the process of Cooperative approach	usages of symbol (⇔、→←) as two way communication	speech bubble	stand on both sides of the table	holding hands	facial expression (smile vs dissatisfied face)	contrasting figures
7	*4*	*4*	*3*	*1*	*1*	*1*

Table 3

The process of competitive approach

the process of competitive approach	contrasting movement	sweator tears on the loser's face	facial expression (smile vs dissatisfied face)	marker of anger	different amount of speech	contrasting figures	usages of symbol (⇔) as conflict	anger faces on both sides	grabbing each other	tug of war	difference of power
8	*5*	*4*	*3*	*3*	*3*	*2*	*2*	*1*	*1*	*1*	*1*

Some premise for negotiation was drew in the drawings. One is about the difference of power that was drew by the different height of the steppingstones. Second is the variety of the background by using different colors. Third is different energy and values by the number of heart mark stamps in two figures.

Two drawings show the brainstorming in which many ideas are thrown away. In the class, the students experienced some brainstorming, thus, they know what it is and drew it.

Discussion

The results of the content analysis of the drawings show that all the students drew cooperative approach only or cooperative approach and competitive approach, and none of the students drew the competitive approach only. It means that the students acquire the knowledge of the cooperative approach in relation to competitive approach. In the drawing, some students pick up the cases such as a chairy tale, the story of orange, and my paid vacation. So, the students tried to re-think about negotiation with the concrete examples.

In addition, a half of the students focused on the results of the negotiation. Another half of them focused on the process of the negotiation only (4 group) or the results and the process (3 groups) and others (2 groups). One group focused on the brainstorming. These results are the evidence of the effective way of interactive online teaching in the negotiation class that is the combination of the analysis of case studies, roleplays, group discussion, and the filling individual reflective worksheets after the activities. The students' image of negotiation was changed in the middle of the semester. They focused more on the process of the negotiation.

Drawing the image of negotiation by group of 3 to 6 students is very effective, because to draw it, they need to discuss and decided what to draw. Okumoto (2024) pointed that "since artistic expression requires more original thinking and

sensitivity, creative power, which is the key to conflict transformation, will be developed from a different angle than verbal discussion" (p.112). Therefore, drawing image of negotiation is educationally effective way of capturing what the students understood without using many words. In addition, "it is expected that relationships will evolve as they are shared with their peers, and it appears that many participants will experience the joy of doing so and will gain confidence and a sense of self-affirmation and accomplishment" (Okumoto, 2024, p.112).

Group discussion is known that one of the effective ways of teaching (Mitsui, 2022, Fukui, 2022). In addition, drawing with a group can present the features of negotiation. Especially, nonverbal features such as facial expression, feeling, body movements, power difference, energy etc. within the limited time. It showed that the students understood the importance of nonverbal cues, although the class was conducted online. However, voice features such as tone of voice were not able to draw, thus it should be trained in the role play etc.

One group drew four persons at the table and four speech bubbles. In each speech bubbles the different need were drew. In this case, the writing explanation helped to understand the meaning of the drawing. It was a conversation among for persons.

Conclusion

Without any training, the university students end up practicing arbitration for conflict management. Thus, "negotiation" class was offered as an elective subject in the university. It is offered online; however, the contents were delivered not only lecturing but also role play, group discussion, the analysis of case studies and son on. To capture how far the students understood the contents, drawing image of "negotiation" was conducted in the middle of the semester. As a results, drawing image of "negotiation" was effective on checking the process of negotiation and the importance of nonverbal cues. The students used the white board of zoom and couldn't draw the pictures freely; however, they used the stamps effectively in terms of the shape, colors and the number. In addition, they used the sings of manga to show the person's anger. Thus, it seems that the students did not feel much about the limitation of the function of white board. Instead, they could draw what they learned in the class and highlighted the features of negotiation based on the group discussion. Therefore, drawing image of "negotiation" was one of the effective ways to facilitate the group discussion for the students' side and capture how the students grasp the content for the teacher side. Especially the enrolled number of the students is large, it will be efficient method.

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Analysis Assignments Submission Time of Programming Learners on Informatic Subject in High School

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We conducted a class for learning text programming using our own teaching materials on infomatic subject in a high school . Learners viewed the teaching materials on the LMS, studied programming in the environment, and submitted assignments. The metadata of user IDs and submission dates could be obtained from the submitted assignments, and it was thought that early support by the teacher would be possible by predicting the learning status based on the metadata. We standardized all assignment submission times. The results of a cluster analysis of the submission times as the five assignments showed that the average value of one cluster became slower as the chapters progressed. And this difference could be taken as an indicator of the need for support, which would reveal effective support methods and timing.

Keywords: High school informatics, programming instruction, LMS, educational data, learning analytics

Introduction

In the Courses of Study for high schools that went into effect in 2022, the content of "Information 1" in the subject "Informatics" was substantially revised (Ministry of Education, Culture, Sports, Science and Technology 2018), and the content related to programming in particular was enhanced. In addition, Information 1 will be implemented in the Common University Test from 2025, but the number of class hours is only 2 credits over the three years of high school. So there is a need to improve the effectiveness of instruction through self-adjustable instruction that matches the ability of the students. In a survey of high school Information subject teachers by the nonprofit organization Minna no Code (2023), 82.7% of the respondents answered that they felt that the number of class hours for Information 1 as a whole was insufficient because of the large amount of instructional content.

Okamoto et al.(2023) proposed a learning method in which a sample program prepared by the instructor is distributed to learners on a learning management system (LMS), and learners modify the program to accomplish the assignments on the LMS. In this method, even in a one-to-many instruction format, learners can learn at an individualized pace by referring to supplementary information provided on the LMS. In such cases, learners sometimes stumbled even if they had checked the supplementary information and proceeded with their studies, and teachers provided individual care to such learners. However, it is difficult to detect and care for stumbling blocks unless teachers can find learners in need of care or unless learners self-report their needs. If we could predict learners who do not understand before submitting assignments and provide individualized care for them, we could further improve the effectiveness of instruction. We examined data and analysis methods for predicting learners who need care from metadata obtained by using Google Classroom (Classroom) as a general-purpose LMS. The results suggest that learners who tend to be late in submitting assignments with difficult content or assignments in self-study using the Classroom may not understand simple learning content, and that such learners can be automatically identified. However, since the submission dates of the assignments analyzed in this study were based on the timestamps output from Google Forms and converted to UNIX time, the range of time between each class session may have made it difficult to see learner trends. By standardizing this range, we may be able to grasp learners' detailed tendencies.

In this study, the elapsed time obtained from assignments submission time of the learners was unified and statistically processed in order to see the tendency of the learners toward the task and to indicate the policy of support for the learners.

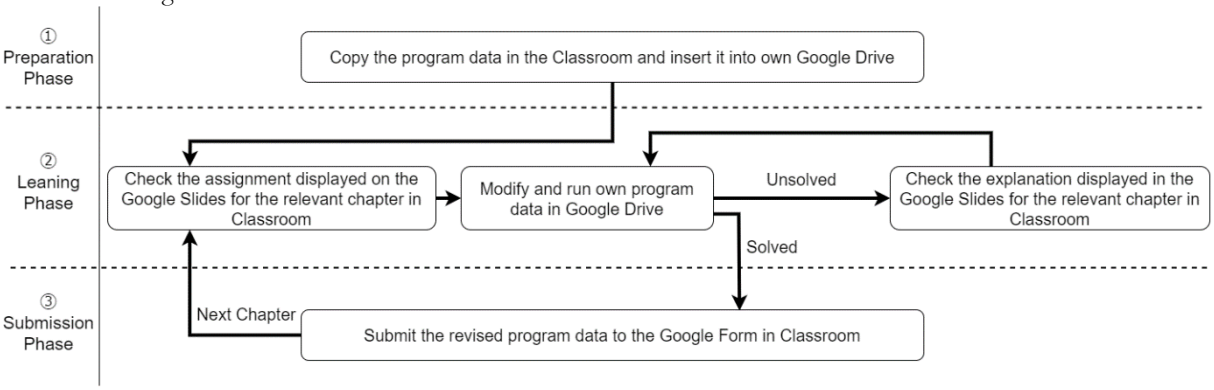
Assignment content and flow of learning activities

Learners modify the provided Google Spreadsheet (Spreadsheet) and the learning program to suit the assignments, execute them, and check the operation. The Spreadsheet is divided into two worksheets, an "Execution Sheet" and a "Problem Sheet. By modifying and executing the Problem Sheet and the program that controls the Spreadsheet,

learners can proceed with the assignment. The programs to be changed are prepared in advance, and the user can proceed with the assignment by changing some of them. The program is a "wordbook program" that, when executed, displays the words and their meanings stored on the question sheet, allowing the user to confirm whether or not to study them again.
The contents of the assignment are Chapter 6 [Find the corresponding variable in the program and change the value of the variable.], Chapter 7 [Locate the corresponding function "Browser.msgBox" in the program and change the argument of the function.], Chapter 8 [Change the Problem Sheet, locating the corresponding function "getRange" in the program, and changing the argument of the function.], Chapter 9 [Change the Problem Sheet, finding the corresponding function "Math.floor(Math.random)" in the program, and changing the argument of the function.], Chapter 10 [Change the Problem Sheet, find the corresponding function "getRange" and the corresponding for statement, and change their arguments.]
The flow of learning activities in the class in this study is shown in Figure 1. Firstly, (1) In the preparation phase, learners copy the sample program in the Classroom to their Google Drive. Secondly, (2) In the learning phase, the learner checks the supplementary explanations of the Google Slides and the assignments in the chapter prepared in the Classroom, modifies and executes the sample program. If the program solves the problem, the students proceed to the submission phase. If not, they check the explanations provided in the Classroom, modify the program, and execute it again. Finally, (3) In the submission phase, the learners submit the program data via Google Forms and proceeds to the next chapter of the study. In this case, we did not set a deadline for the submission of the assignment in order to allow students to learn at their own pace.

Figure 1

Flow of learning activities



Analysis Method

The analysis procedure are (1) Retrieve the user IDs attached to the assignment submissions for each chapter and the date and time of assignment submission obtained from Google Forms for the 6th to 10th chapters, (2) Extract data only from learners who submitted all assignments, (3) Calculate the difference in elapsed time in minutes between the earliest person in the class and the rest of the students for each assignment, (4) Remove the out-of-class time from each class session (if the assignment was submitted outside of class, it was assumed to be one second after the class session before the assignment was submitted), (5) Perform cluster analysis using the time in minutes processed in each session as a variable, (6) Analysis of variance was conducted using the clusters from the cluster analysis as the independent variable and the time in the minute display processed in each session as the dependent variable.

Results

There were 144 learners who submitted all assignments. Cluster analysis was conducted, and the results were classified into three clusters (Table 1). The number of learners in each cluster was 63 for Cluster 1, 71 for Cluster 2, and 10 for Cluster 3. Cluster 1 is the cluster with the earliest submission timing for all clusters. Cluster 2 was the cluster that submitted the assignments early in Chapters 6 and 7, but late from Chapter 8. Cluster 3 is the cluster with the slowest submission timing for all the clusters. The average of all the clusters tends to be significantly delayed in Chapter 8 (Figure 2).

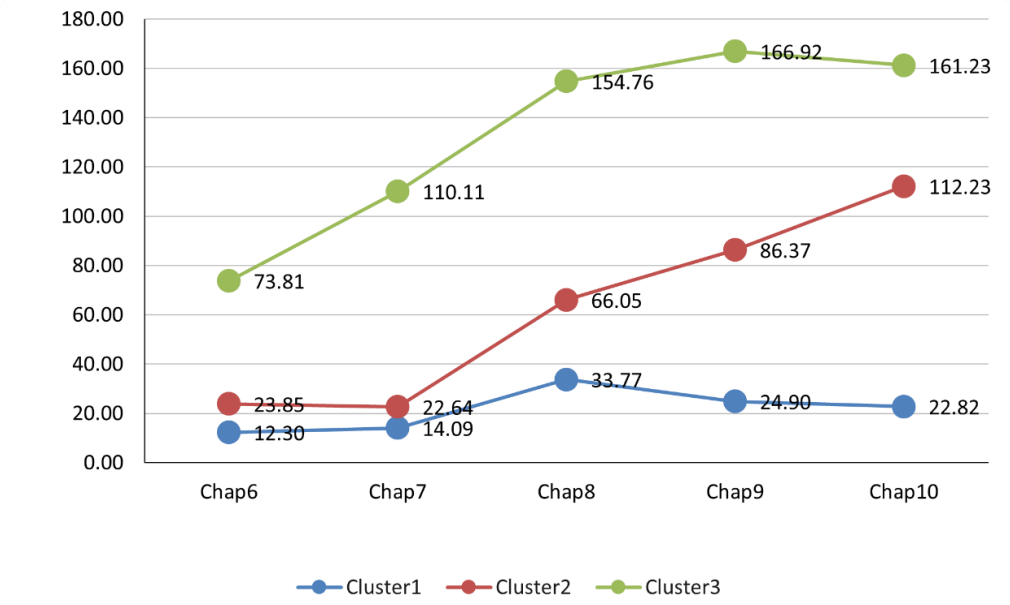
Table 1

Results of Clusters (minutes)

	Chapter6			Chapter7			Chapter8			Chapter9			Chapter10		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Ave.	12.3	23.9	73.8	14.1	22.6	110.1	33.8	66.1	154.8	24.9	86.4	166.9	22.8	112.2	161.2
Std.	(10.8)	(42.1)	(71.2)	(11.4)	(21.0)	(69.9)	(18.2)	(36.1)	(47.4)	(17.0)	(38.0)	(44.3)	(15.8)	(31.4)	(49.4)

Figure 2

Average value in each chapter of each cluster



Discussion

The reason for the delay of Cluster 2 from Chapter 8 is thought to be due to the increased difficulty of the assignments in Chapters 6 and 7. The contents up to Chapter 5 have been explained in the previous chapters. However, the contents up to Chapter 5 are only explanations, and the program operations are to be performed from Chapter 6. Therefore, it will be difficult to solve the assignments without understanding the relationship between the Spreadsheet and the program. The functions and arguments studied in Chapter 8 are represented as getRange(1, 2, 3, 4). The functions are also covered in Chapter 7, but the getRange function in Chapter 8 has four arguments, and it is necessary to understand the meaning of each number in conjunction with its relationship to the Problem Sheet. Thus, the complex operations required in Chapter 8 are more difficult and time-consuming to understand, which may be the reason for the delay. This is also suggested by the tendency for Chapter 8 to lag far behind in the average of all clusters. In addition, Okamoto et al. (2023) also found that the post-test results showed that the students were stumped in Chapter 8. In this study, we created the assignment in Chapter 8 because we believe that the learners need to understand the Spreadsheet and ranges using the function getRange as the order of learning. Based on the results of this study, we believe that in order to improve the teaching materials, it would be better to set up assignments in which learners learn to understand the Spreadsheet step by step.

Conclusion

In this paper, we organized and conducted a cluster analysis of the time for learners to submit their assignments, using unique teaching materials for learning text programming. The cluster analysis resulted in three clusters, with each cluster consisting of a cluster where all the submissions were made early, a cluster where the submissions were made late in the process, and a cluster where all the submissions were made late. In the future, we will analyze the details of these clusters and clarify the detailed contents of correct and incorrect answers to determine when and how to support the learners.

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Scaffolding in Practice: Zones of Proximal Development for Large Programming Classes

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Every educator struggles with the varying skill-levels and backgrounds of their students. This phenomenon is highlighted when teaching large programming classes to students with non-STEM backgrounds. Such students typically range from tech-illiterate to experienced programmers, and they all expect to learn the contents as presented in the same syllabus. This paper focuses on large programming courses at Waseda University to determine key indicators of success and aims to develop best-practice guidelines for diverse scaffolding needs.

Keywords: Flipped-Classroom, Best-practice, Mentoring, Scaffolding, Tutorials

Introduction

Educators often face the challenge of addressing the diverse skill levels and backgrounds of their students, a challenge that becomes particularly pronounced in large programming classes with students from non-STEM fields (Ohman, 2019; Hiippala, 2021; Terroso and Pinto, 2022). These students range from having little to no technical knowledge to being proficient programmers, yet they all anticipate mastering the material outlined in a unified syllabus. Identifying crucial success factors and striving to establish best-practice guidelines for effectively supporting students with varying needs is at the core of successfully retaining students and nurturing them into programmers.

The concept of the "Zone of Proximal Development" (ZPD) describes the difference between what a learner can do without help and what they can achieve with guidance and encouragement (Vygotsky, 1987; Chaiklin, 2003). Vygotsky's ZPD is a fundamental element in understanding educational scaffolding (a concept introduced by Wood et al. 1976), a strategy that involves providing support structures to students based on their specific needs and gradually removing these supports as students develop their independent learning skills. ZPD is particularly relevant for large classes with high variance in student skillsets because it acknowledges that the learning process is not uniform across all students. Scaffolding, then, is the application of ZPD in practice, where instructors and educators play an active role in extending the students' capability to solve problems or understand concepts that they would not be able to handle on their own.

In large and diverse classes, such as those commonly found in programming education for students from non-STEM backgrounds, scaffolding becomes crucial. It allows educators to address the wide range of abilities and prior knowledge in the classroom. By structuring learning activities that provide variable levels of challenge and by adjusting the support provided based on each student's progress, it is possible to guide students through their personal zones of proximal development.

This paper will discuss the teaching, and scaffolding, methods for a large introductory programming course offered at Waseda University School of International Liberal Studies (SILS): Python Programming for Digital Humanities. These teaching methods have been designed with consideration of the varying needs of non-STEM students and offer potential best practices in equipping future employees and scholars with the coding skills needed for a world continuing to digitalize further.

Background

Previous research from Nikula et al. (2011) explores methods to raise the pass rates of programming courses, including the elimination of de-motivators and resolution of "hygiene" problems such as scheduling and access to content, the increase of intrinsic motivators by making it more interesting and useful, and the use of extrinsic motivators to increase the predictability of student behavior. Although the article focused on STEM students, the longitudinal study showed that in terms of intrinsic motivators, the usefulness of the course was paramount in keeping students from failing, the pass rate rising from 36% to 68% over 5 years without changing the actual learning goals of the introductory programming course discussed in their study.

We suggest that programming courses are best balanced by using scaffolding methods to keep students in the zone of proximal development. In practice, this means telling the students the outline of what they are going to learn first to enable independent learning at the students' own pace later, but also providing students with the tools to do their own trouble-shooting and advanced learning. Having multiple different sources of information helps students find the information they need better without the need to separate for learning types. On-demand content also helps with the first point of Nikula et al. (2011) regarding "hygiene" problems as information can be accessed at any time.

Course Structure

The main course examined, Python Programming for Digital Humanities at Waseda University in Japan, is a 4-credit course for undergraduate liberal arts students. The general guideline is 100 minutes per week of contact teaching for every 2 credits. Instead of 200 minutes of contact teaching, however, to facilitate the diverse levels of the students, the course is divided into a weekly on-demand class and a face-to-face class. This allows the students the time they need to absorb the core contents each week at their own pace. Students are provided with extra content that for some helps them understand new content from different perspectives and through different modalities (text, video, podcast, coding tutorial, interactive exercises), and for others helps them understand already familiar concepts in more depth. Providing these extra resources is part of establishing and scaffolding their individual zones of proximal development by utilizing the same materials for different purposes.

A combination of automated checks and flipped classroom is used with an honor-based report system and peer feedback to facilitate 200 students per course while ensuring the students are applying their new skills and staying on track content-wise. In practice, students are asked to complete weekly assignments that help them apply their new program skills to practical problems that might come up in their own studies or internships. Since it is virtually impossible to manually check the code for nearly 200 students each week, besides automated checking, students are asked to check which questions on the assignment they were able to successfully complete. When we meet face-to-face, students are asked to share their solutions when they have marked a question as completed. If they are unable to do so, they get zero points for that week (NB! Students are not penalized for imperfect solutions). This has worked nicely as a deterrent to simply marking all questions as completed and students overall are very honest about their capabilities. When students share their solutions, they are asked to explain their reasoning and justify their code which serves as a flipped classroom model and often leads to active participation from a majority of the class in hunting for optimal solutions together. Additionally, students who were not called upon but who want to share their own unique solution to a programming problem, may do so. We usually have many volunteers who eagerly share their solutions, but also many who share their code when they were not able to solve a particular problem in the hopes of understanding the logic better.

Students are also encouraged to post in the Moodle help forum and get extra credit for helping their peers solve their questions. These questions and their respective explanations often turn into much more in-depth content than is generally covered on the course. And finally, the teaching assistant runs voluntary weekly tutoring sessions that are meant to help students understand the contents better, but also to reassure the struggling students that they too have the ability to learn programming in a relaxed setting with someone they view more as a peer.

The students' level of understanding of core concepts is monitored weekly through anonymous polls while attending the face-to-face class. The course contents are then adjusted, if necessary, based on both summative and formative feedback to ascertain a roughly normal shaped distribution between students who think the content was too easy, just right, and too hard with a large majority of students finding the content just right.

Common topics in the feedback was that the course was useful and enjoyable:

- The links provided were very useful for beginners. The homework assignments were challenging and useful. The class part helped me to understand my mistakes and also learn from others. The professor was very kind and understanding.
- I genuinely enjoyed this course! though it was hard at first, I had fun developing my skills.
- I really enjoyed myself in this semester by learning to code! The satisfaction of getting the correct output really motivated me throughout the semester.
- This course gives SILS students opportunities to learn in-depth about real programming in real society and get the ability to solve some problems using python.

And also about the difficulty of learning programming in general:

- The teacher was very, very understanding. She knew coding was hard to learn at first for beginners.
- It was a lot to take in for someone new to programming. […] The terminology was difficult to understand."

Quantitative Analysis of Feedback

Figure 1 Correlation matrix of course feedback

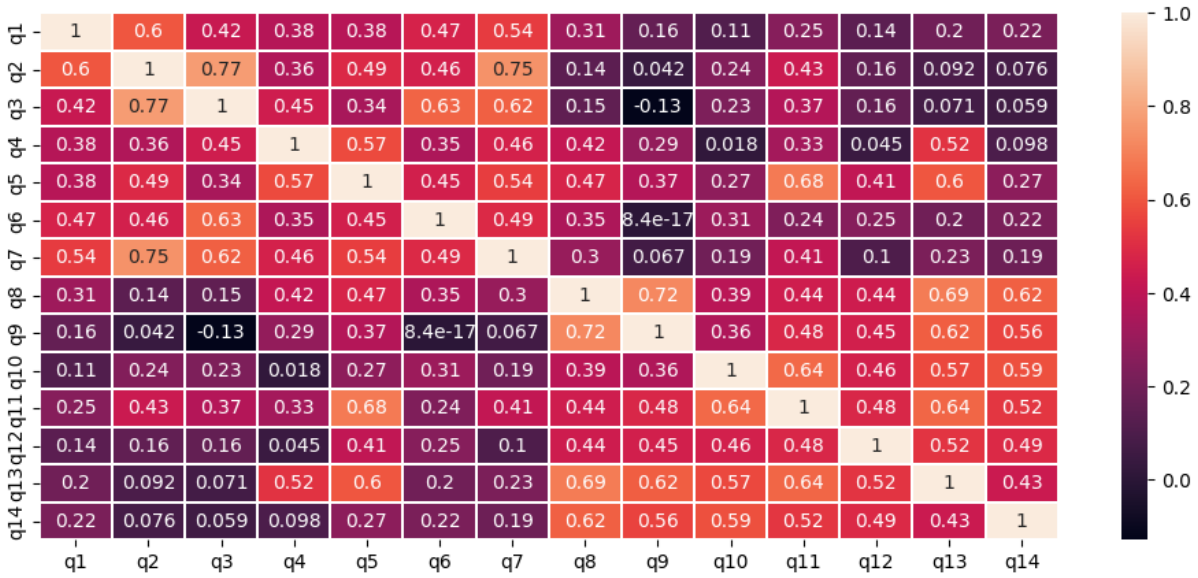

Table 1 *Legend for questions in questionnaire*

q1	Teaching: Overall organization of the course
q2	Teaching: Making it easy for you to take notes
q3	Teaching: The use of visual aids
q4	Teaching: Arousing and maintaining your interest in the subject
q5	Teaching: Encouraging you to be critical
q6	Teaching: Allowing you to ask questions
q7	Teaching: Encouraging you to participate actively in the class
q8	Teaching: Speed of the course
q9	Course content: Was the level of the course appropriate?
q10	Learning: New facts, new concepts?
q11	Learning: How to see the subject matter more clearly?
q12	Learning: How to improve your own study skills?
q13	Learning: How to think analytically, apply theoretical knowledge and do research?
q14	Workload: Was the workload appropriate?

The final course feedback is collected both automatically via the University and independently at the end of the course via Moodle with a more course-specific questionnaire. The questions cover teaching methods, course content, learning, and workload. Examining the feedback holistically and reviewing correlations between specific feedback items (Figure 2) indicates that what really resonates with the students is usefulness as a measure of quality. Students felt they learned more, felt the pace was appropriate, and did better on the course when they felt that the contents of the course were directly useful to their studies. It is hardly surprising that those who find the course level to be appropriate also find the pace appropriate, yet there is a low correlation between the ability to take notes and the speed of the course. The results from the computational analysis provides straight-forward, pedagogically grounded, best-practice suggestions for teaching large diverse student bodies such as giving clear tangible goals, enough time to process new information, use teaching and learning tools that force students to actively participate in class assignments, use engaging visual aid. Overall, as prior studies too have found (Sobral, 2021), students who stay enrolled, pass the course, a fact that is intertwined with the traditionally high drop-out rates of programming courses (Robins et al. 2003; Nikula, 2011).

Concluding Discussion

We suggest that interdisciplinary programming courses are best balanced by using scaffolding methods to keep students in the zone of proximal development. In practice, this means telling the students the outline of what they are going to learn first to enable independent learning at the students' own pace later, but also providing students with the tools to do their own trouble-shooting and advanced learning. Although the theory of different types of learners (kinesthetic, visual etc.) has been debunked by multiple studies (Pashler et al., 2008; Rogowsky et al., 2015), many students find it easier to focus on text over video and vice versa at different points in their studies. It might be easier

to listen to a video while doing something else at the same time or while on public transport, but having a website with the same information is easier to go back to check, for example details on syntax later. Having multiple different sources of information helps students find the information they need faster in their desired modality. On demand content also helps with the first point of Nikula et al. (2011) regarding "hygiene" problems as information can be accessed at any time and learning is not restricted to a specific day of the week or time.

Although students today have had more exposure to technology, technology has become opaquer, and many students (and teachers) have little understanding of how computers let alone code works (Lyon, 2020; Croxall and Warnick, 2018; Kokensparger, 2016). This seems to persist regardless of culture and level of course (undergraduate/graduate). A glossary and thorough explanations of new concepts and words (e.g. iteration, compile, algorithm, edge case) can be an invaluable tool for those who struggle due to unfamiliar terms (Hiippala, 2021). Making any slides available for the students and writing new terms on the whiteboard or similar so the students can look them up can also be very helpful, particularly when the students might not be native speakers of English. Using more lay terms might work in the interim but is counterproductive long term since correct terminology is crucial to troubleshooting and further learning.

As we found in our case study, students who reported that the course was useful were more likely to report positive learning outcomes, such as increased confidence in their ability to apply programming techniques and increased interest in pursuing further study in the field. By emphasizing the practical applications of Python, instructors can help students see the concrete benefits of learning the material, which may improve their overall engagement and motivation. We recommend varied on-demand content (course hygiene as per Nikula et al., 2011) combined with hands-on tutorial sessions for blended learning (Öhman, 2019), with thorough explanations of new terms (Hiippala, 2021). Extrinsic motivators are harder to change and are seldom up to individual instructors, however, as we have shown in this paper the experience of usefulness is probably the most important intrinsic motivator for applied programming and interdisciplinary programming courses.

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Effectiveness Analysis of Peer Review, Teacher Review, and Self-review in Production-based Class

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This study investigated the impact of various review methods on improving student work in a production-based class. In the initial phase, the focus was on peer review. Results indicated a low utilization rate of peer feedback, with only 20% of students incorporating it into their revised work. This result highlighted the need for additional support mechanisms to enhance production quality. Subsequently, teacher review and self-review using a checklist were introduced. The effectiveness of each method was then assessed. Half of the students utilized comments from teacher reviews to refine their work. Self-review proved highly effective, with 84% of students demonstrating improvement after engaging in this process. These findings suggest that while peer review alone may not be sufficient to drive significant improvement in a production-based class, teacher review and self-review can play crucial roles in fostering student growth and development.

Keywords: Peer Review, Teacher Review, Self-review, production-based Class

Introduction

Issues of peer review in production-based classes

Research in production-based classes indicates that teacher and peer reviews can effectively enhance student work (Liu & Carless, 2006). Specifically, feedback provided during peer review has been shown to improve the quality of produced artifacts (Kuwahara, 2010). Additionally, engaging in self-review after peer review can enhance students' self-review skills in performance tasks (Iwata & Taguchi, 2020). These studies showed the effectiveness of peer, teacher, and self-review. However, it is unclear what the characteristics of the three review methods in production-based classes are and how students improved after introducing each review method. Therefore, this study addresses two key questions. First, it seeks to analyze comment trends in peer reviews within a production-based class focused on creating web page teaching materials and to clarify the impact on improving student productions. Second, the study will introduce teacher review and self-review using a checklist to enhance productions further and examine the impact of each review method on this improvement process.

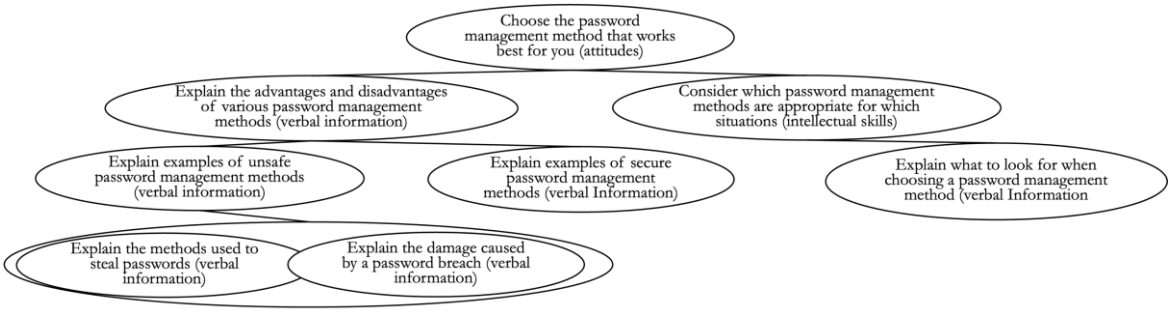
Research Design

Research Subjects and Course Overview

The production-based class selected for analysis was "Digital Literacy in the Information Society," a course offered to 20 first-year students at University H. The course comprised 15 lessons held from April to August 2022. Throughout the course, each student developed teaching materials based on a self-selected theme to foster the acquisition of digital literacy skills essential for the information society. Upon course completion, students were asked to submit reflections on their experiences and insights through a Google Form. For this study, the objects of analysis included the task analysis charts (Figure 1), which students iteratively created and refined during the instructional design process, as well as the written reflections submitted at the end of the course.

Figure 1

Example of a task analysis chart



Creating a Task Analysis Chart

Task analysis, a method for identifying the components and relationships needed for learners to achieve their learning goals (Suzuki, 2002), guided the creation of teaching materials in this study. We used Google Drawing as the tool for constructing task analysis charts. As preparation for the ninth lesson, students viewed an instructional video demonstrating how to use the tool, write learning objectives, and create task analysis charts. In the ninth lesson, students spent 30 minutes working on their charts, and then 15 minutes each in the 11th and 15th lessons, refining them. Students submitted their final task analysis charts after class, regardless of whether they had revised them, and these charts were then graded as part of the overall course assessment.

Methods

Peer Review, Teacher Review, and Self-review

Peer review was conducted in the 11th lesson. Twenty-nine students were divided into nine groups, seven of three members and two of four. Students spent 25 minutes engaged in oral group reviews of each other's work, focusing on four instructional design (ID) perspectives: verbal information, intellectual skills, attitudes, and other relevant factors. Subsequently, students spent 10 minutes providing verbal feedback via a Google Form. These comments were then shared with all students, who used them to revise their analysis charts in the 11th lesson.

The teacher review focused on the analysis charts submitted in the 11th lesson. Review comments were provided to students before the 14th lesson using the feedback function within the Moodle assignment module.

Self-review was conducted to encourage students to reflect on creating and improving their analysis charts. A self-review checklist, consisting of eight items based on the teacher review, was created and implemented in Google Forms. These items included seven elements related to the chart's structure and one element addressing the content of the learning tasks (Table 1). In the 14th lesson, students self-reviewed their analysis charts using this checklist.

Table 1.
Self-review Checklist

Item	Category
Are all learning tasks categorized under appropriate skills (verbal information, intellectual skills, motor skills, and attitudes)?	ID
Are the higher-level objectives assigned to learning tasks other than verbal information, such as intellectual skills, motor skills, and attitudes?	ID
Are learning tasks such as intellectual skills and attitudes hanging below learning tasks for verbal information?	ID
Are the learning tasks behavioral goals, using appropriate verbs?	ID
Are there no lines connecting subordinate goals that hang from different medium-level goals?	ID
Are there a sufficient number of learning tasks based on the theme of the material?	ID
Are the learning tasks arranged so that the learning order is from bottom to top?	ID
Are the learning tasks clear and specific?	Content

Comment Classification

To analyze the trends in each review type, comments and items in peer, teacher, and self-reviews were classified into three categories: "content," "instructional design (ID)," and "others." based on the criteria in Table 2. We performed a chi-square test on the number of peer review comments to identify significant differences. Additionally, we tabulated the number of comments for each category and conducted a residual analysis to examine trends in the content of each review.

Table 2.
Categories and examples of comments

	Category	Example
Strengths	Content (themes, sources, the volume of content)	Describing different hypothetical situations and how to deal with them.
	ID/instructional design (learning objectives, design of learning tasks)	For filter bubbles, I thought it was good to categorize the elements in detail.
	Others (not stating what is good about it).	Easy to understand.
Weaknesses	Content (themes, sources, the volume of content)	There is much information in the teaching materials, such as the types and stages of IoT and the explanation of SOCIETY 5.0, and it would take time to learn everything in depth, so I think it needs to be adjusted.
	ID/instructional design (learning objectives, design of learning tasks)	You could have the history of the left-hand side and the definitions reversed.
	Others (not stating what the problem is).	I thought it could be more detailed.

Analysis of Analysis Chart Improvement

To understand the extent of improvement in the analysis chart after each review, we analyzed changes in the placement of learning objectives, writing style, and terminology in the charts. Improvements aligned with peer feedback were categorized as "improvements following peer reviews," while those aligned with teacher feedback were categorized as "improvements following teacher reviews." Improvements made in areas not explicitly addressed by peers or the teacher were categorized as "improvements after self-review."

Results

Of the 29 respondents, 25 who submitted analysis charts all three times were included in the analysis.

Trends in Review Content

The number of peer review comments was 263. There were 173 comments on strengths, of which 80 were related to content, such as information in the teaching materials, 28 were related to ID, and 65 were related to others. There were 90 comments on weaknesses, of which 35 were related to content, 53 to ID, and 2 to others. A chi-square test on the number of comments on the strengths and weaknesses showed a significant difference ($\chi 2=64.83$, $p<.001$). Residual analysis revealed that comments on others were significantly more frequent at the 0.1% level for the strengths. On the other hand, there were significantly fewer comments on IDs. For weaknesses, there were significantly more comments on IDs at the 0.1% level and significantly fewer comments on others.

Teacher reviews totaled 43 comments, with 25 relating to strengths and 18 (for 13 students) to weaknesses. About weaknesses, 17 comments addressed ID, and one addressed content.

Improvement of Analysis Charts

Students revised their analysis charts based on the feedback received. Of the 25 analyzed students, five (20%) made improvements after peer review, and seven (53.8%) of the 13 who received teacher feedback revised their charts accordingly. Following self-review, 21 students (84%) improved in areas not explicitly addressed by peers or the teacher. Of these, nine improved based on self-review, four solely based on peer review, and eight based on both. While some students adhered to the feedback provided, others modified aspects unrelated to the comments. For instance, the student who created Figure 1 removed one learning objective and repositioned the other despite the

instructor's suggestion to establish them as independent medium-level objectives. It suggests that students may interpret and apply feedback differently, sometimes deviating from the instructor's intended guidance.

Reflection on Peer Review

In reflections on the 11th lesson, where peer review occurred, 18 of the 29 students reported that peer review was "constructive," while seven found it "somewhat helpful." Student comments highlighted the benefits of peer review, such as gaining new perspectives on their work and incorporating diverse ideas to improve and expedite the creation process.

Discussion

In this study, we sequentially introduced peer review, teacher review, and self-review to students creating web page teaching materials within a production-based class. We aimed to examine each review method's impact on improving their work. Following peer review, only 20% of students revised their analysis charts, suggesting that peer review alone may not be sufficient for effective improvement.

However, after introducing teacher review and self-review, 53.8% of students who received teacher feedback improved, and 84% improved after self-reviewing aspects not explicitly mentioned by the teacher. This result indicates that teacher review and self-review may be more effective in encouraging students to refine and enhance their work.

Analyzing the content of each review revealed that peer reviews often highlighted strengths in others and areas for improvement in instructional design (ID), while teacher reviews primarily focused on ID improvements. Interestingly, the most significant improvements were observed after self-review, suggesting that each review method plays a distinct role in the revision process. Furthermore, some students incorporated peer feedback into their self-review process, indicating the potential synergy of combining both review types.

However, some students made changes that deviated from the teacher review, suggesting potential misunderstandings or independent interpretations. Individualized support tailored to students' understanding may be necessary to ensure that teacher feedback is effectively utilized for improvement.

The most notable improvement in analysis charts occurred after self-review. One student commented that the self-review checklist helped them identify areas for improvement, supporting the effectiveness of structured self-reflection in facilitating learning (Terashima & Hayashi, 2006).

Conclusion and Future Issues

In this study, we examined the effect of peer review comments on the improvement of students' work. We introduced teacher review and self-review to address the issue that students often have difficulty improving their work based solely on peer review comments. We then evaluated each method's impact on improving their work. The results showed that both teacher review and self-review significantly contributed to the further enhancement of the students' productions. However, the need to enhance students' literacy to utilize peer review comments effectively was also highlighted. In the future, practical research on specific support measures to effectively cultivate the ability to use peer review comments is required.

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Practical Exercise in Video Production Using a Review Video Comment System

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Abstract:This paper discusses the development of a video comment system and related educational materials for reviewing the works of beginner video producers in video production exercises. With the advancement of smartphones and the spread of video distribution platforms, individual video production has become common, and university education has also started incorporating video production into classes and projects. However, beginners often struggle with creating content from the viewer's perspective and applying the extensive knowledge and skills required for video production. To address these challenges, this study developed a video comment system that allows instructors and peers to provide feedback on student works. This system enables learners to receive clear comments, making it easier for them to revise their works. Additionally, the educational materials linked to the review comments help students address the feedback effectively. Practical implementation in classes at two universities using this system demonstrated that it improved the quality of students' videos, with many students positively evaluating the comment system and educational materials. However, further refinement of the system and materials is necessary to enhance the clarity of comments and the understanding of educational content.

Keywords:Video Production, Beginner, Video Comment System, Educational Materials , Review

Introduction

With the advancement of smartphones, tablet PCs, and the spread of video distribution platforms, individual video production has become common. University education has also started incorporating video production into classes and projects.

Video is a medium that conveys messages by combining images and audio, including not only live-action footage but also subtitles, animations, background music (BGM), sound effects (SE), and narration.
Additionally, since video is a medium with a flow of time, it is necessary to consider an order that makes it easy for viewers to receive information and messages, select the necessary information, and edit it in a way that does not cause discomfort to the viewer(Christopher, B. (2023)).

However, beginners taking video production classes face the following challenges:

1. Their works tend to prioritize their own thoughts and feelings rather than being created with the perspective of other viewers in mind.
2. Their understanding and utilization of the extensive knowledge and skills required for video production are often insufficient.

Regarding point 1, beginners often include footage or interviews unrelated to the production's purpose due to their strong personal attachment, or they may overly condense the content through editing, making the message unclear to the viewers. Regarding point 2, although a comprehensive range of knowledge and skills is taught in lectures, there is a lot to learn, and they often fail to apply these appropriately during the production stages.

To address these issues, this paper discusses educational practices for beginner video producers incorporating review activities, as well as a video comment system and related teaching materials to support these practices. This study focuses on the production of documentaries, informational programs, and interview programs among the various genres of video.

Review Activities

Review activities involve learners providing comments on each other's work or programs to cultivate an objective perspective and improve their work. Support systems have been developed and practiced in document creation(Cho, K. (2007)) and art education(Nakaname, M.(2016)) to facilitate reviews(. In video production exercises, students can benefit from reviews by having specific points of advice tailored to their works, receiving guidance on corrections, and learning necessary knowledge and skills. The authors have also incorporated reviews in the production of final assignments in their classes.

There are two methods for conducting reviews: real-time and on-demand. The former involves watching the video with the creator during class and commenting on the spot, making it easy to communicate feedback. However, it requires time to watch and comment on the videos, so it can be challenging to complete within class time if there are many works. Additionally, verbal instructions may be forgotten by the students. The latter method allows for reviews without the constraints of class time. However, since it relies mainly on text comments, it can be difficult to identify the specific parts being commented on. It requires matching the indicated time codes with the video to understand the specific points being addressed.

Video Comment System

This study proposes a system for efficiently conducting reviews of video works. The system is designed to perform reviews outside of class time and aims to provide clear review comments and their corresponding actions to beginners.

The system interface is shown in Figure 1. This system allows instructors, TAs, and SAs to add comments to review videos on the web. The system consists of a video viewer, comment input section, comment history section, and memo input section.

Figure 1

Interface of the Video Comment System

During the review, the registered video is played, and the reviewer pauses at the point they want to comment on and enters their review comment in the comment field. When entering comments, the reviewer selects a category such as "technical," "content," "software usage," or "other." After entering the comment, pressing the submit button records the time code, category, and comment, which are then displayed in a list in the comment history section. For recording comments, the system uses an API (Stein) that allows Google Spreadsheet to be used as a database.

After the review, students can view the registered review comments in the system. By clicking on the time code of each comment, they can jump to the corresponding point in the video and play it, making it easy to understand which part the comment refers to.

Development of Teaching Materials

To clearly convey to students how to address comments registered in the review system, we develop educational materials designed for this purpose. These educational materials are intended to be used in conjunction with the review system.

These materials compile knowledge and know-how into rules, each focusing on making the content structure of the video clearer or effectively editing visual materials. Additionally, we develop instructional materials that convert points to be checked during shooting and editing into a checklist format.
Each content item is designed to fit on a single page, allowing it to be linked from the comment section of the review system so that students can directly access the relevant material from the comments.

Class Practice Using the System

We conducted a video production class using the developed system. This practice was implemented in the final project of video production exercises offered at two universities where the authors are affiliated, using the review system and educational materials.

In each of these exercises, during the latter half of the course period, each individual or group produces one work. In the final class, a video screening event is held to showcase the produced works. In this course, before the final submission, students submitted a review video, and reviews were conducted using the review system.

In each exercise, University A had each individual (21 students) produce a video. University B had 16 students divided into 7 groups to produce videos. The total number of comments given during the practice and the status of their revisions are shown below. The reviews were conducted by one or two instructors and one TA/SA.

After the practice was completed, a survey regarding the use of the review system and educational materials was conducted among the students. Out of 37 students, 36 responded. The following are the results of the survey.

Table 1

Summary of Reviews and Revision Status

	Total	Revised	Partially revised	Not revised	Difficult to address
Technical	168	91	31	22	24
Content	170	100	34	34	2
Software usage	27	19	5	2	1
Other	8	6	2	0	0

Table 1 shows the breakdown of reviews and the status of revisions. A total of 417 review comments were registered in the system. Of these, 373 were comments suggesting revisions. Approximately 70% to 90% of these comments were revised or partially revised by the final screening session. About 10% to 20% were not revised. Additionally, some comments were difficult to address at the editing stage. Specifically, comments such as "The video is hard to watch due to excessive camera shake" and "It would be better to add this content" required reshooting or additional interviews, making them challenging to revise.

Table 2

Did the work convey the intended message?

Response	Responses
Agree	4
Somewhat agree	27
Neutral	1
Somewhat disagree	4

According to Table 2, more than 80% of the students (31 out of 36) rated the message clarity of their own work positively. One student responded with "neutral," and four students responded with "somewhat disagree."

From the open-ended responses, students who gave positive feedback stated that "we were able to express the message we wanted to convey through the video" and "we received positive feedback from other students during the screening event." On the other hand, students who gave negative feedback mentioned, "we were not able to effectively select the necessary information" and "we included too many interviews." It is considered that these students needed more advice on trimming information during the review process.

In response to the question "How much did you refer to the comments from the review system?", all students answered either "very much" or "somewhat." Additionally, in response to the question "Did you refer to the educational materials when making revisions?", more than 90% (34 out of 37) of the students answered "very much" or "somewhat." There was one response each for "neutral" and "not much."

When asked about the positive aspects and areas for improvement of the comment system, respondents highlighted the clarity of the review comments, such as "there were specific points," and the ease of understanding how to make corrections, such as "the links to the educational materials made it easy to understand how to make corrections." On the other hand, there were comments such as "I followed the advice and made revisions, but it didn't seem to make much difference" and "I would like to have prioritized tasks to complete within the given time."

Regarding the educational materials, students noted that "the materials were easy to understand because they were divided by theme," "the explanations were easy to understand because they included images of real examples," and "the explanations of volume adjustment were clear." There was also feedback stating, "I was able to concretely understand what I had vaguely understood during the class." On the other hand, there were criticisms such as "due to software updates, some methods explained in the materials differed from the actual operations" and "there were many items, so it was difficult to know which ones were important for me."

Discussion

The review activities using the review system and educational materials in this practice are considered to have contributed to the improvement of the quality of the students' works. By combining review comments with educational materials, students were able to understand the knowledge and know-how of video production. On the other hand, there were suggestions to make the contents explained in the materials easier to view in a list format or to make related content more accessible. Additionally, there were opinions that more detailed methods for addressing the comments should be provided, indicating a need for further refinement of the content explained in the materials.

Some students self-evaluated that they could not effectively select necessary information or included too many interviews. For these students, it is necessary to consider how to improve the way comments are given and to add more content to the educational materials.

Further analysis is needed on how works changed before and after the review, and how students' abilities evolved through reviews and teaching materials. Improvements to the review system interface and efficiency of commenting are being considered.

Conclusion

This paper discussed the development of a video comment system and related educational materials to support beginner video producers. Implementation in classes at two universities resulted in improved quality of student videos, with many students giving positive evaluations of the system and materials. However, it was found that further refinement is needed to enhance the clarity of comments and educational content.

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Roundtable Session1

A study of the impact of programming games on programming learning based reflective scaffolding

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Abstract: *Research over the past several years has shown that students using programming games to learn about programming improves students' academic performance to a certain extent. However, due to the entertainment of programming games and their pedagogical nature, it is difficult to reach a balance, and students lack the ability to summarize and reflect on their knowledge, which leads to the proposal of programming games based on reflective scaffolding. Meanwhile, using various metacognitive and metacognitive strategies to monitor and adjust their learning process is also an important process for students' learning. However, there are fewer studies exploring the impact of metacognitive models on students' programming performance in programming gamification contexts. Therefore, this study explores the research on the effects of programming games and metacognitive patterns on students' programming performance, mind stream experience, and metacognitive activity characteristics under reflective scaffolding based. The purpose of this study is to provide educators with guidance on how to utilize programming games to influence elementary school students' programming performance,to improve the efficiency of students' learning using programming games,and to provide a scientific basis and new ideas for the implementation of programming education for elementary school students.*

Keywords: programming game ; metacognition ; program ; reflective scaffolding

Research Design & Methods

A total of 124 sixth-grade students from an elementary school in China were recruited to take a three-month course in python, and they were divided into two groups in this study, the control group (without scaffolding) and the experimental group (with scaffolding).

This study proposes to use classroom-based instruction and programming games in context, where teachers form reflective scaffolding in the classroom by creating a reflective task on a pre-class pre-study sheet; creating a context in the classroom with guiding questions; and creating an e-portfolio at the end of the class, respectively. Students were guided to plan, regulate, and reflect on the learning process. The e-portfolio bag is saved in a timely manner using the screenshot function that comes with the computer, and needs to include code errors encountered, solutions, code knowledge points, etc., and summarized in the form of word to be submitted on time for the teacher's corrections.

Research question: is programming game learning with reflective scaffolding conducive to elementary school students' programming learning compared to unscaffolded programming game learning?

Results

The pre-test scores of the control and experimental groups were tested by independent samples t-test with pre-test significance p=0.446>0.05 (Table 1), pre-test was not significant and there was no significant difference between the two groups. The posttest was tested by non-parametric test, posttest significance p=0.030<0.05 (Table 3), there was a significant difference and the experimental group was better than the control group. Compared with the control group(Mean=53.28, SD=25.522),the experimental group (Mean=62.98, SD=20.173)achieved better grades(Table2). The results show that programming game learning with reflective scaffolding facilitates students' learning of programming compared to programming game learning without reflective scaffolding.

Table 1

Independent Samples Test

	Levene's Test for Equality of Variances	t-test for Equality of Means

									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
grade	Equal variances assumed	.020	.888	-.765	118	.446	-1.662	2.173	-5.965	2.642
	Equal variances not assumed			-.767	114.900	.445	-1.662	2.166	-5.952	2.629

Table 2

Group Statistics

	group	N	Mean	Std. Deviation	Std. Error Mean
grade	AVD	62	62.98	20.173	2.562
	CTRL	58	53.28	25.522	3.351

Table 3

Test Statistics

	grade
Mann-Whitney U	1385.000
Wilcoxon W	3096.000
Z	-2.174
Asymp. Sig. (2-tailed)	.030

Conclusion

Past research has shown that programming gamified learning is much better than non-gamified learning students in terms of academic performance (Tasadduq et al., 2021). However, students tend to get addicted to the game mechanics while playing programming games and neglect to summarize and reflect on their programming knowledge. Therefore, providing reflective scaffolding while playing programming games compensates for this shortcoming, and this study found through analysis that learning programming games with reflective scaffolding exerted a positive influence on students' learning of programming and facilitated their learning of programming. It provides scientific basis and new ideas for the implementation of programming education for primary school students.

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Research on the application and effect of reflection promotion mechanism based on double loop learning theory in digital story creation supported by generative artificial intelligence

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Abstract

In recent years, many new digital tools have been applied to digital stories, but there are problems such as insufficient training of teachers and students, difficulties in integrating tools, and declining student motivation. AI tools enable students to quickly generate the multimodal footage needed for digital stories. However, the teacher's suggestion and guidance are indispensable in GAI creation. Double-loop learning theory emphasizes deep reflection and adjustment in the learning process, which is especially important for students who use GAI for creative writing. Therefore, this study proposes a reflective promotion mechanism based on double-loop learning theory to support GAI in digital story creation. To evaluate its effectiveness, the study employed a quasi-experimental design, recruiting 76 sixth-grade students, with the experimental class using the reflective promotion mechanism based GAI Supported Digital Stories (RTP-GAIDST) method and the control class using the traditional GAI Supported Digital Stories (C-GAIDST) method. The results show that the RTP-GAIDST teaching method can effectively promote students' AI literacy, learning motivation, problem solving ability, critical thinking and creativity. Therefore, the results of this study have implications for the application of digital stories and GAI in education.

Keywords: GAI, digital story creation, two-loop learning, reflective facilitation mechanisms, creativity

Research Design & Methods

2.1 Participants

The study voluntarily recruited 76 students (ages 11-13) from two Grade 6 classes. Both classes are taught by the same experienced and well-trained teacher.

2.2 Methodology

Measurement tools for this study included AI literacy, learning motivation, problem solving, critical thinking and creativity questionnaires, Digital Story Creation (DST) assessment scales, and interviews.

2.2.1 AI literacy

This study refers to the AI literacy questionnaire developed and validated by Davy Tsz Kit Ng et al. (2024), which covers four dimensions of emotion, behavior, cognition, and ethics. The score for each dimension ranges from 1 to 5 points.

2.2.2 learning motivation

The learning motivation questionnaire, developed by Wang and Chen (2010), covers both intrinsic motivation and extrinsic motivation and includes six items in total. The questionnaire used a 5-point Likert scale.

2.2.3 Problem solving and creative thinking

The questionnaires of problem solving tendency and creative thinking tendency refer to Lai and Hwang (2014), which respectively contain six items and adopt 5-point Likert scale.

2.2.4 critical thinking

The questionnaire was adapted by Lin, Hwang, and Hsu (2019) based on the scale proposed by Chai et al. (2015) and consisted of six items.The questionnaire used a 5-point Likert scale.

2.2.5 Digital Story Creation (DST) project evaluation Scale

Reference Via's (2002) assessment criteria for digital story content and technical quality, adapted from Hwang et al. 's (2018) ebook project's assessment scale with six dimensions (structure, accuracy, completeness, appearance, innovation, and interactivity). The score for each dimension ranges from 1 to 5 points.

2.2.6 Interview

The interview outline in this study refers to the studies of (Lin et al. (2021) and Hwang et al.(2009). It contains three questions, aiming to discuss the advantages and disadvantages of GAI tools for digital story creation and the learning effect of the reflection promotion mechanism method from the perspective of students. The interview results provide additional information for interpreting the findings of this study and can be used as a reference for improving digital story creation in the future.

2.3 Experimental Design

A class of 38 students were assigned to the experimental group using the RTP-GAIDST method; Another class of 38 students were assigned to the control group using the C-GAIDST method. They are required to learn GAI tools and digital storytelling, and complete AI literacy, learning motivation, problem solving, critical thinking, and creativity pre-tests. After the equipment operation instruction, the students engaged in two weeks of digital story creation activities. After the intervention, the digital works were presented in video form, and the students' works were scored by experts according to the criteria. Students took a post-test and completed questionnaires on AI literacy, learning motivation, problem solving, critical thinking, and creativity. In addition, eight students from each group were invited to conduct interviews.

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Beyond Play: Harnessing Game Design Activity to Boost AI Literacy and Computational Skills in Education

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Abstract

This study develops an instructional model and strategies for AI-integrated education using game design activities in school settings. Despite increasing AI education in schools, research on leveraging game design for AI learning is limited. This research presents a framework where learners create and share games to enhance AI understanding through hands-on experience. Using a design-based research methodology, the model was validated through literature review, expert feedback, and empirical exploration. The model consists of four stages: 'Preparation,' 'AI-Integrated Game Design,' 'Reflection,' and 'Learning Environment Setup,' supported by 62 instructional strategies. Implementation with 13 middle school students showed significant improvements in AI literacy and computational thinking skills. The results demonstrate the model's effectiveness in enhancing AI literacy and computational skills, offering a structured approach to incorporating game design into AI education.

Keywords: AI in EDucation(AIED), AI-integrated Education, Game-based Learning, Game Designorder)

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Investigating the Relationship Between Gamification, Personality Traits, and Goal Attainment in Online Postsecondary Settings

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Though gamification has been found to improve motivation and achievement (Alsawaier, 2018), it is important to recognize that no intervention influences all learners equally. The need to identify the relationship between learners' personality traits/learning styles and success using gamification has been studied (Buckley & Doyle, 2017), but the relationships between gamification, personality traits, and goal-setting are uncommon within the literature. The objective of this study is to identify the relationships between learners' personality traits, perceived goal attainment, and their perception of badges and leaderboards to explore the effects of these critical influences on higher education online learning. This study's framework is formed around Self Determination Theory (Deci & Ryan, 1985), The Big Five model of personality (Costa & McCrae, 1992), and Goal-Setting Theory (Latham & Locke, 1991) and addresses three critical research questions, RQ1: What relationship exists (if any) between learners' personality traits and their perception of goal attainment using badging and leaderboards? RQ2: What relationship exists (if any) between learners' personality traits and their perception of badging and leaderboards? and RQ3: What relationship exists (if any) between learners' perceived goal attainment and their perceptions of badges and leaderboards?

Accordingly, this study collected data from eighty-nine (n= 89) students through surveys in a higher education online setting. In the initial survey, participants selected a course goal from 12 goal options (Elliot & McGregor, 2001) and completed the Big Five personality test (Johnson, 2014; Rubynor, 2022). Students participated in the course, which implemented the Canvas Badges program for one semester. Participants then completed a post-survey to indicate their perception of the extent to which their goal was achieved on a five-point Likert scale and completed the formative course perception survey (Kwon & Özpolat, 2020). Variables in this study included perceived goal attainment and perceptions of gamification elements (badges and leaderboards) and five personality traits: extraversion, neuroticism, conscientiousness, agreeableness, and openness. Analysis was conducted using Statistical Package for Social Sciences (SPSS). The results showed some significance between the variables goal attainment and conscientiousness, which suggest practical implications for instructional design. These results contribute to the scarce literature that ties all three components (gamification, personality traits, and goal-setting) together. Conclusions drawn from this study may influence future research on instructional design of gamification elements within a course.

Keywords: gamification, goal achievement, online, personality traits, postsecondary

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Employing Artistic Methods to Help Students Create Research Questions: A Case Study of Inquiry-Based Learning in a Japanese High School

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Abstract

Globalization and technological innovation have caused vast and drastic changes in society. This phenomenon is called VUCA, which stands for Volatility, Uncertainty, Complexity, and Ambiguity. These transformations have made it challenging to analyze the situation and anticipate the future. Adapting to an unpredictable and complicated future requires students to "learn to navigate by themselves through unfamiliar contexts and find their direction in a meaningful and responsible way" (OECD, 2019, p.2). In response to this need, inquiry-based learning has drawn attention to equip students with skills to create new value in the changing world.

Revising the Upper Secondary School Curriculum Guideline introduced IBL into Japanese high schools. The guidelines outline the inquiry process as four steps: formulating questions, investigating, analyzing, and presenting opinions. However, the teaching method and curriculum are still being discussed because teachers have yet to experience inquiry- based leaning while they were in school nor been trained to guide it. Therefore, they find encouraging students to formulate research questions challenging. Inaki et al. (2023) examined teachers' difficulties guiding inquiry-based learning. They found that teachers consider question formulation the most difficult of the four steps of the inquiry process. Students also needed help with formulating questions. Mizutani and Terada (2023) investigated what made it challenging for students to formulate questions. Their research showed that the students could not formulate questions because they did not think that the research topic was relevant to them and was intriguing.

To address these problems, the authors developed an educational program of inquiry-based learning that leverages the features of arts-based research (ABR). In the conference presentation, the authors will discuss the ABR practice of formulating questions in inquiry-based learning of the 1st grade at X High School in Osaka, Japan. We analyzed students' reflections to elucidate their understanding of the process of question formulation. We also examined teachers' reflections to determine how this ABR method can enhance their guidance of students' inquiry-based learning. Additionally, as this study is positioned within the practice of arts-based research in high schools, the authors will discuss the potential and challenges associated with implementing arts-based research in high school inquiry-based learning settings.

Keywords

Keywords: Inquiry-based learning, Arts-based research, ABR, High school

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Developing and Evaluating a Learning Model for Improving Graphical Representation Ability

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Abstract

Think Talk Write is a learning model for developing mathematical representation ability. However, it has been suggested that TTW may not be effective for students who lack knowledge of graphical representation. We developed a learning model for the development of graphical representation ability.

Keywords: graphical representation, graphical representation ability, Think-Talk-Write (TTW)

Introduction

In K-12, one of the goals is to cultivate to select, apply, and transform mathematical representations to solve problems (National Council of Teachers of Mathematics, 2000). Student's mathematical representations fall into three forms of representation: symbolic, linguistic, and graphical (Nasrun et al., 2023). The ability to translate identified properties and relationships in mathematical problems into three representations is termed abilities in symbolic, linguistic, and graphical representation (Hwang et al., 2007). However, Nishinaka (2023) noted that secondary school students face challenges when using symbolic, linguistic, and graphical representations to answer descriptive problems. Above all, there needs to be more improvement in the three types of mathematical representation ability during problem-solving.

The Think-Talk-Write (TTW) developed by Huinker and Laughlin (1996) is listed as a learning model to improve these representation abilities. TTW involves an individual reading and contemplating a problem (Think), discussing the thought process within their group (Talk), and finally, writing down the organized solution individually using diagrams and graphs (Write). Ansari et al. (2018) suggested that TTW develops symbolic and linguistic representation abilities, but the lack of knowledge about graphical representation prevents the creation of appropriate diagrams, leading to inadequate improvement of graphical representation ability.

Regarding the development of graphical representation ability, Ayabe et al. (2022) stated that instructions on the features and functions of diagrams, the types of problems in which diagrams are beneficial, and the reasons for constructing diagrams are efficacious. On another note, Ott (2020) mentioned that sharing students' graphical representations, identifying similarities and differences, and scrutinizing them with others can improve their graphical representation abilities. Thus, improving graphical representation ability requires instructions and scrutinizing related to it. the purpose of this study is to develop and evaluate a new learning model for improving graphical representation ability that integrates instructions and scrutinizing related to graphical representation into TTW.

Research Design & Methods

In MTTW, students receive instruction on graphical representation (Instruct) and then engage in activities like those in TTW. During the Instruct phase, students receive guidance on the characteristics of diagrams (line diagrams, tables, graphs, and like), the problems for which these diagrams are efficacious, and how to construct these diagrams. At this stage, students acquire knowledge of graphical representations. Students also engage in activities to examine graphical representations during the Talk phase of TTW. Specifically, students discuss and summarize with other students the similarities, differences, good points, bad points, and reasons why they created such a graphical representation of the answers they produced in the Think phase.

We conducted a lesson based on MTTW for junior high school students in the "Use of Linear Equations" unit. Table 1 shows the concrete flow of the lesson.

Table 1

The concrete flow of the lesson

Stage	Flow of Lesson
Instruct	Receive guidance on the characteristics, utility, and assembly methods of tables and line diagrams, and work on problems at the textbook level.
Think	Individually tackle complex problems related to the use of linear equations and describe the answers using mathematical representations.
Talk	Form groups, discuss the similarities, differences, and points for improvement in the mathematical representations used in each member's written answers, and summarize.
Write	Re-engage individually with the problem tackled in Think and describe the answers using mathematical representations.

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“Regarding the practice of linked improvisation in which music elements are shared mutually, and the communication possibilities between performers as a result”

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Abstract

In the past, a musical performance consisted of one player producing a sound using a single instrument at his or her own will. In a collective improvisational setting, each performer is fully responsible for the sound of the instrument he or she is playing. However, since the late 1980s, with the spread of personal computers, attempts have emerged to explore new possibilities for expression by connecting computers with each other via networks. Furthermore, nowadays where it is easier to handle digital acoustic processing in real time, there are many opportunities to confront digital acoustics in an improvisational manner. In such situations, it becomes possible to create a new kind of performance in which multiple players share musical elements with each other whilst their actions are connected to guide the final sound.

The purpose of this research is to introduce the practice of interconnected performance forms in which multiple people share roles in producing sound, and to portray the uniqueness of the communication between them.

The structure of this presentation is as follows.

1. First, we will refer to the activities of The Hub, a pioneer of network music seen in the late 1980s. Next, we will introduce a composition method that utilizes real-time sound processing that the authors have been using since the early 2000s, and the activities of Mimiz, who endeavors in the creation of original connected improvisation works.

2. We will introduce specific technical examples of Mimiz's improvisations and raise awareness of the issues between the parties involved during the performance. Of the three members, two are responsible for the sound elements of the music, each using analog processing. The remaining member takes those analog sounds and adds digital acoustic processing in real time to modulate the final sound. Through this asymmetrical relationship, the members seek better acoustic results.

3. Finally, what can be seen in these mutually interconnected relationships is a level of consideration that differs from the norm during a performance, and value placed on communication that is cultivated amid relationships that "cannot be completed solely by the intentions of an individual."

Keywords: linked improvisation, network session, improvisation, real-time audio processing

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Development of XR-based content in Art education

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Integrating arts into STEM education to form STEAM aims to develop creative and integrative thinking (Yakman, 2008). Arts courses using 3D or VR systems significantly enhance student interest and achievement compared to traditional media (Henriksen, 2014). Embodied cognition theory supports learning through direct sensory and motor experiences (Wilson, 2002).

This study uses the Design and Development Research (DDR) methodology to create XR-based art education content aimed at enhancing creativity and technical skills. The design process was iterative, ensuring continuous improvement (Richey & Klein, 2007). The instructional design incorporated selected elements of Gagné's Nine Events of Instruction, specifically focusing on gaining attention (motivation), presenting the content, providing learning guidance (guided practice), and eliciting performance (performance) (Gagné et al., 2005).

The XR-based program used advanced tools such as Character Creator 4, Mixamo, iClone, Unity 3D, and MRTK. The Monet avatar provided an engaging learning experience, covering basic color theory, color contrast, saturation, and brightness. Students applied these concepts in an XR environment using virtual tools and received immediate feedback.

The program's blend of play and learning enhanced perceptual and sensory abilities. Challenges include the need for advanced technology and adaptive AI for personalized feedback. Despite these, the program shows potential in improving art education by providing an immersive, interactive learning environment. Future research should evaluate its effectiveness and explore ways to improve accessibility and personalization.

Keywords: Art education, Embodied Cognition Theory, Extended Reality (XR), Interactive Experience, STEAM education

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The Application of Peer Dialogue Strategy Supported by Virtual Human Platform in Primary School Listening and Speaking Teaching

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Abstract: With the increasing maturity of virtual human technology and the continuous development of primary school English teaching, how to effectively improve pupils' English listening and speaking skills has become an urgent problem for education. Combining virtual human platform and peer dialogue strategies, this study evaluated the practical effects of peer dialogue strategies supported by virtual human platform in primary school English listening and speaking teaching by designing teaching experiments, providing innovative teaching methods and theoretical support for primary school English teaching.

Keywords: Virtual human platform, Peer dialogue strategy, Primary English teaching, listening and speaking skills

Introduction

In today's world, English has become one of the main languages in academia, business, technology and international relations. Listening, speaking, reading and writing skills are particularly important in English learning, especially listening and speaking skills. However, in countries where English is an unofficial language, such as China, Japan and South Korea, reading and writing are often valued more than listening and speaking. This is due to the lack of real English context, oral dialogue practice and the limitation of traditional teaching methods, resulting in students are more inclined to avoid interaction and reduce learning motivation.

The application of modern technology in English teaching continues to emerge, and English listening and speaking apps have achieved initial results. These apps restore life-style interactive situations, enrich teaching resources, stimulate learning interest and improve learning efficiency through recording imitation, role playing and human-computer dialogue. However, the conversation content of many apps is specified by the system, limiting interactivity and freedom.

With the development of virtual reality technology, virtual training system has become the mainstream of simulation training. Virtual people are integrated into learning technology, which can enhance learners' immersion and learning effect by using social agent theory. Virtual teachers can imitate the voice and expression of real teachers, conduct personalized dialogues with students, and provide personalized feedback reports, create real situations, and improve learning experience and efficiency.

However, at present, there are few empirical studies on students' English listening and speaking level based on virtual human-supported dialogue learning platform, and no studies have explored the difference between virtual human-supported peer dialogue and real peer dialogue. Therefore, this study aims to compare the effects of these two modes of peer dialogue on students' English listening and speaking skills, and provide references for the future application and research of peer dialogue supported by virtual people in teaching.

Research Design & Methods

This study uses the methods of experiment, questionnaire and interview to explore the impact of peer dialogue learning modes with virtual people in online learning platforms and with real peers on primary school students' English listening and speaking skills. Specific research questions are as follows: What is the difference between peer dialogue with virtual people on online learning platform and real peer dialogue learning mode on the improvement of English listening and speaking skills of primary school students?

The research objects of this paper are 69 students (41 boys and 28 girls) in two parallel classes with the same level of English listening and speaking in grade 5 of A primary school in Wenzhou, including 34 students in class A and 35 students in Class B. The students of both classes have had real peer conversation practice in English class, and can understand and read some simple English texts. Before the experiment, none of the students had received relevant training on the online English learning platform supported by virtual people.

This experiment was carried out in the English listening and speaking course of two classes in Grade 5 of primary school and during the self-study time at night. The experiment lasted for two months from March 2024 to May 2024. Before the experiment, the students were pre-tested, including English skills. Two classes with the same level in all aspects were selected, and irrelevant variables were controlled. Since the two classes had similar English listening and speaking scores, they were randomly assigned to groups: Class 503 was the experimental group (group 1: practicing oral English with virtual people in HiEcho, an online English learning platform), and Class 506 was the control group (Group 2: practicing oral English with their real partners). Before the experiment started, the teacher introduced the Hi Echo learning platform to the students of class A in the experimental group, including the function and use of the platform. Before and after the test, English listening and speaking performance data were collected in the form of test paper, and SPSS software was used to make statistics and analysis of the data, so as to understand whether there were significant differences between the two classes and draw conclusions.

The listening and speaking classes of the two classes all use the same teaching material, are taught by the same teacher, and have the same teaching units, teaching resources and teaching progress. After each listening and speaking class, the students in the experimental group will use the virtual human conversation learning platform on the tablet computer for 5-10 minutes of oral listening practice during the evening self-study and self-study time. After the conversation, the platform will automatically generate an oral evaluation report, including feedback on the dialogue content scoring and correction. Students correct their listening and speaking through feedback reports; After each class, the students in the control group also used the same time of evening self-study to practice oral dialogue with their real partners on the same theme. At the end of the experiment, the two groups of students were tested after the English listening and speaking test.

Results

Independent samples t-test

The analysis results of normal distribution of English listening and speaking scores in the pre-test. Based on Shapiro-Wilk test, the data of English listening and speaking scores in both groups are normally distributed. In pre-test, $p1=0.559$, $p3=0.067$; In post-test, $p1=0.104$, $p2=0.101$, all the data are greater than 0.05.

Table 1

The results of independent sample t-test analysis of English listening and speaking scores in post-test

Independent Samples Test

group	post-test score (M±SD)	t	p
group 1 (N=34)	81.85±7.92	3.475	<.001
group 2 (N=35)	75.83±6.43		

According to Table 1, Levene's test results show that $p=0.291$, greater than 0.05, which meets the condition of homogeneity of variance. According to the results of independent sample t-test, $t=3.47$, $df=67$, and $p<0.001$. Since $p<0.05$, there was a significant difference in the post-test scores of English listening and speaking between the two groups. Compared with the control group (group 2) (Mean=75.83, SD=6.43), the experimental group (group 1) (Mean=81.85, SD=7.92) achieved better scores. It can be concluded that the peer dialogue strategy based on virtual human support is helpful to the improvement of primary school students' English skills.

Discussion

According to the experimental results, although peer dialogue based on virtual human support has a positive effect on the English listening and speaking performance of primary school students. However, there are still some shortcomings and limitations in this study:

(1) Limited teaching time. The experiment period is two months, and the time is relatively compact and the task is heavy.

(2) The number of experimental samples is limited, and the experimental results are not widely representative. Therefore, more extensive samples are needed to study the impact of virtual human-based peer dialogue strategies on primary school students' English listening and speaking skills.

Conclusion

Impact of Hidden Curriculum on Upper Elementary Students' Information Literacy

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Abstract This study clarifies the impact of the hidden curriculum on upper elementary school students' information literacy. To achieve this, a survey was conducted focusing on three perspectives: (1) teacher behavior, (2) teacher instruction, and (3) student behavior, referencing examples from the Information Literacy Framework. The survey revealed significant differences among the perspectives in seven out of 12 questions. These differences suggest that higher-order information literacy skills are not connected to students' behavior through teachers' actions or instruction, that certain skills exists that teachers can easily demonstrate through their behavior, and that skills such as following basic rules when using computers are heavily influenced by teacher instruction.

Keywords: Elementary School, Hidden Curriculum, Information Literacy

Introduction

In Japan, information literacy has been positioned as an essential skill and ability that is nurtured and utilized across all learning domains, similar to language skills. Daily use of ICT influences the development of students' information literacy (e.g. Taizan and Horita 2021). Furthermore, students are thought to learn not only from teachers' instructions but also from teachers' use of devices and learning environments. This kind of student learning can be called a hidden curriculum (Bloom et al. 1982). Regarding research on the hidden curriculum, despite studies on classroom management and subject-specific frameworks, research investigating the impact of the hidden curriculum on students' information literacy is lacking. This study seeks to clarify the impact of the hidden curriculum on upper elementary school students' information literacy. Accordingly, a survey was conducted to examine how information literacy is developed through teachers' instruction and behavior.

Research Design & Methods

Survey Target and Period From late April to early May 2024, cooperation was requested from 132 students in the 4th to 6th grades of five public elementary schools.
Survey Method In creating the questionnaire, we created a questionnaire consisting of 12 items related to information literacy. The items were designed to be answered from three perspectives: teacher behavior, teacher instruction, and student behavior with responses given on a four-point scale.
Analysis Method First, the mean and standard deviation of each item were calculated. Furthermore, to clarify the factors influencing student behavior, multiple comparison analysis was conducted on each questionnaire item for "teacher behavior," "teacher instruction," and "student behavior."

Results & Discussion

Each survey item, the mean and standard deviation of the responses, and the results of the multiple comparisons between items are presented in Table 1. The results revealed significant differences between items in seven out of the 12 questionnaire items. Among the seven items with significant differences, the following four items indicated that "teacher behavior" scores were significantly higher than "student behavior" scores: "Viewing information from multiple perspectives," "Attempting to create information," "Turning researched information into simple drawings or diagrams," and "Consciously expressing information clearly for the audience." These skills are considered relatively advanced within information literacy. Considering the survey period was in late April, the findings suggests that while students are aware of the teachers' behaviors, they have not yet acquired these skills themselves. Additionally, in the following three items, "teacher behavior" scores were significantly higher than "teacher instruction" scores: "Using information in situations where they summarize and present ideas," "Typing using a keyboard," and "Consciously

expressing information clearly for the audience." These skills are easier for teachers to demonstrate through their actions, and teacher behavior appears to have a greater influence on student behavior than verbal instruction.Finally, for "Following basic rules when using a computer," the scores for "teacher instruction" were significantly higher than those for "teacher behavior." This skill is considered a fundamental aspect of handling information devices and suggests that teachers intentionally provide more verbal instruction on this topic.

Conclusion

Many questionnaire items exhibited a ceiling effect. This is likely because the teachers were specialists in information literacy and had participated in professional development workshops on this subject. Future challenges include investigating the hidden curricula in such classes. The specific nature and impact of the hidden curriculum in classes taught by teachers who are specialists in information literacy needs to be investigated. Furthermore, the survey target should be expanded. By broadening the survey target to include a variety of classes with different backgrounds, regardless of the teachers' specialization in information literacy, more generalizable results can be obtained.

Table 1

Results of Students' Awareness of Information Literacy

Teacher Behavior=A1 Teacher Instruction=A2 Children Behavior=A3

		Mean	SD	Multiple Comparisons
1 View information from multiple perspectives	A1	3.58	0.64	(* p<.05)
	A2	3.39	0.77	A1 = A2 n.s. (T=2.043)
	A3	3.20	0.89	A1 > A3 * (T=3.667)
				A2 = A3 n.s. (T=1.726)
2 Creating Information	A1	3.39	0.80	(* p<.05)
	A2	3.14	0.94	A1 = A2 n.s. (T=2.258)
	A3	2.98	0.99	A1 > A3 * (T=3.593)
				A2 = A3 n.s. (T=1.377)
3 Follow basic rules for using computers	A1	3.62	0.67	(* p<.05)
	A2	3.84	0.48	A1 < A2 * (T=3.340)
	A3	3.77	0.53	A1 = A3 n.s. (T=1.994)
				A2 = A3 n.s. (T=1.463)
4 Making use of information and information technology in our daily lives	A1	3.48	0.70	n.s.
	A2	3.47	0.73	
	A3	3.45	0.70	
5 Use of information in summarizing and presenting ideas	A1	3.55	0.75	(* p<.05)
	A2	3.33	0.83	A1 > A2 * (T=2.482)
	A3	3.45	0.85	A1 = A3 n.s. (T=0.799)
				A2 = A3 n.s. (T=1.619)
6 Input text using keyboard, etc.	A1	3.77	0.61	(* p<.05)
	A2	3.49	0.90	A1 > A2 * (T=3.092)
	A3	3.61	0.82	A1 = A3 n.s. (T=1.640)
				A2 = A3 n.s. (T=1.441)
7 Operate apps in your life	A1	3.70	0.63	n.s.
	A2	3.58	0.72	
	A3	3.61	0.67	
8 Use of different applications for different purposes	A1	3.66	0.65	n.s.
	A2	3.52	0.69	
	A3	3.55	0.73	
9 Organize your research into a simple picture or diagram	A1	3.47	0.77	(* p<.05)
	A2	3.33	0.90	A1 = A2 n.s. (T=1.154)
	A3	3.20	0.89	A1 > A3 * (T=2.728)
				A2 = A3 n.s. (T=1.489)
10 Communicate your own ideas from your research	A1	3.61	0.61	(* p<.05)
	A2	3.51	0.68	A1 = A2 n.s. (T=1.333)
	A3	3.43	0.70	A1 = A3 n.s. (T=2.292)
				A2 = A3 n.s. (T=0.975)
11 Reflect on your own use of information	A1	3.37	0.79	(* p<.05)
	A2	3.35	0.86	A1 = A2 n.s. (T=0.172)
	A3	3.15	0.86	A1 = A3 n.s. (T=2.260)
				A2 = A3 n.s. (T=2.249)
12 Be aware of others and try to express yourself in a way that is easy to understand	A1	3.81	0.50	(* p<.05)
	A2	3.58	0.67	A1 > A2 * (T=3.507)
	A3	3.56	0.68	A1 > A3 * (T=3.762)
				A2 = A3 n.s. (T=0.282)

* P<.05

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Analysis of Difficulties Perceived by Teachers in Programming Education in Elementary Schools

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Abstract

In 2020, programming education became a mandatory part of the curriculum in Japanese elementary schools, integrated into subjects such as mathematics and science. Despite extensive support from the Ministry of Education, Culture, Sports, Science and Technology (MEXT), including advancements in ICT environments and educational research, many elementary school teachers still face significant challenges. According to a survey,85% of elementary school teachers express anxiety about teaching programming (Oshima et al.,2019). Additionally, a questionnaire reveals that 40% of teachers do not want to teach programming. Many teachers tend to have a somewhat negative attitude towards elementary school programming education.

This study aims to investigate in detail the difficulties faced by elementary school teachers in programming education. Additionally, it will explore whether these difficulties vary depending on the teachers' motivation towards programming education. The methodology involved interviewing two teachers who had successfully integrated programming education into their classrooms to identify difficulties in their teaching practices. One teacher had a positive attitude and enthusiasm, while the other had a negative attitude. A literature review was then conducted to collect challenges faced by teachers in programming education. Based on the interview and literature review, a questionnaire was developed to investigate if teachers' difficulties are influenced by their attributes. The questionnaire has two parts: measuring motivation towards programming education and investigating difficulties faced in teaching programming, comprising 24 items in total.

A t-test of the data derived from the questionnaire showed thatThe results showed significant differences in the difficulties faced by teachers with high and low motivation. Teachers with lower motivation experienced more difficulties in all aspects, including training, classes, and technical support. The t-test results revealed significant differences items, with teachers with lower motivation reporting higher levels of difficulty. The study emphasizes the importance of enhancing teachers' motivation to mitigate the challenges they face. Providing tailored support and training that offer successful experiences can boost teachers' self-efficacy and motivation. Regular support and encouragement are crucial, especially for teachers with low motivation. The findings suggest that motivation enhancement and tailored support can improve the overall quality of programming education in elementary schools.

However, the study primarily focused on the impact of motivation on perceived difficulties, indicating that other factors may also influence the challenges in programming education. Future research should delve deeper into the specific causes and contributing factors behind these difficulties, providing a more comprehensive understanding of the challenges faced by elementary school teachers in programming education.

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Research on the basis of using ICT in Japanese elementary school music

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Abstract

The development of information technology has had a profound impact on society and education. Japan attaches great importance to the application of information technology in education, especially under the policy of "one person, one terminal" advocated by the Ministry of Education, Culture, Sports, Science and Technology in 2020, digital textbooks have begun to play an important role. Studies have shown that teachers and students' understanding and ability to use ICT forms such as digital textbooks have been continuously improved, but music education is relatively lagging behind in the use of information technology. Therefore, it is necessary to learn from previous studies to understand the current situation of the use of ICT in music subjects and put forward suggestions that are beneficial to promoting elementary school music education. This study currently only uses the method of literature analysis and summary to understand the current situation of the use of ICT in elementary school music subjects, as well as the policies and guidelines for the use of ICT in elementary school music subjects in Japan. MEXT highlights the critical role of Information and Communication Technology (ICT) in enhancing elementary music education. The goal remains to enrich students' understanding and enjoyment of music through multisensory experiences, leveraging ICT tools that are aligned with educational objectives. By incorporating both audio and visual technologies, ICT facilitates innovative musical expression and deepens students' musical comprehension. Key applications include digital recording, audio visualization, and music composition software, all aimed at boosting student engagement, creativity, and critical thinking.

Keywords: Digital Learning Tools， Elementary Music Education,Innovative Musical Expression,ICT in Education ， Student Engagement

Discussion

Next are some of my future research directions and plans.

First, I will conduct a more systematic and in-depth study on the use of electronic textbooks in Japanese elementary school music education. Then, I will carry out qualitative research to understand the current teaching methods and approaches used by Japanese elementary school music teachers. I will conduct systematic interviews to investigate reasons for the adoption or rejection of electronic textbooks, focusing on their effectiveness, future prospects, and potential enhancements. Using qualitative research methods, I'll conduct in-depth interviews with Japanese elementary school music teachers, education experts, and textbook

developers. Interview topics will cover the pros and cons of electronic textbooks, usage scenarios, encountered challenges, and improvement suggestions. Additionally, I'll observe electronic textbook usage in music classrooms. To ensure comprehensive data collection and analysis, I'll design a semi-structured interview guide, invite a diverse range of teachers for interviews, record and organize interview content meticulously, and utilize content analysis to categorize data. The analysis will highlight common themes and individual perspectives, providing insights into teachers' varying views and needs.

Finally, I will summarize Teachers' Overall Attitudes and Usage Situations Regarding Electronic Textbooks.Analyze Different Backgrounds of Teachers: (e.g., teaching experience, school type) and their different views on electronic textbooks.And then,identify Major Issues and Challenges,that teachers face when using electronic textbooks.

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Factors Influencing Pre-Service Teachers' Intention to Use SVVR for Teaching

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SVVR (Spherical Video-based Virtual Reality) technology is subtly influencing the traditional classroom by creating a multi-dimensional, immersive learning environment that not only enhances the quality of instruction, but also enhances students' motivation and optimizes the learning experience. As pre-service teachers are the future teachers, it is crucial to understand their initiative and motivation to utilize SVVR for teaching when they begin their careers. Therefore, this study aims to investigate the factors that influence pre-service teachers' intention to use SVVR for teaching. In this study, pre-service teachers will experience SVVR in a compulsory course and then fill out a questionnaire. The impacts of self-efficacy (SE), technological pedagogical content knowledge (TPACK), perceived ease of use (PUE), perceived usefulness (PU), and attitude toward use (ATU) on pre-service teachers' behavioral intention (BI) to use SVVR for teaching will be explored through structural equation modeling (SEM).

Keywords: Behavioral intention, Pre-service teachers, Structural equation modeling, SVVR

Introduction

The SVVR technology has shown tremendous potential in education and teaching. It is quietly revolutionizing the traditional classroom teaching model by creating simulated learning environments, which not only improves the teaching quality but also provides students with multi-dimensional perceptual learning experiences, thus enhancing their learning motivation and optimizing their learning experiences. Yang et al. (2021) reported by simulating an interactive scene, VR technology makes users believe they are instantaneously in another realm, which may bring in more possibilities for language teaching and learning. Learners may explore and learn in a less space-constraining and more interactive environment without the usual physical limiting attributes of a traditional classroom. Given the importance of SVVR, examining pre-service teachers' intention to adopt it is vital. This research gauges their info literacy and teaching integration, predicting SVVR usage potential through understanding their intention. The study explores the factors influencing pre-service teachers' intention to use SVVR for teaching, that is, analyzing SE, TPACK, PEU, PU, and ATU's impact on BI via SEM.

Research Model & Hypotheses

Technology acceptance model (TAM) theory. TAM is a universal model applicable in diverse research contexts. Core to TAM are perceived usefulness (PU) and perceived ease of use (PEU), proven to predict technology acceptance (Khlaisang et al., 2023). In this study, PU gauges pre-service teachers' belief in SVVR's knowledge or ability enhancement, while PEU assesses their subjective convenience in implementing SVVR (Teo, 2009). PU and PEU jointly influence students' positive evaluation of the application of SVVR technology in teaching (ATU), which in turn has a profound impact on their intention to use SVVR for teaching in the future as teachers (BI). Therefore, this study proposes the following hypotheses:

H1: ATU will affect BI;
H2: PU will affect ATU;
H3: PEU will affect ATU;
H4: PEU will affect PU
H5: PU will affect BI;

Technological pedagogical content knowledge (TPACK). TPACK is a well-constructed theoretical framework aimed at comprehensively elaborating the knowledge structure required by teachers in the field of technology integration. This framework is deeply inspired by Shulman's (1986) profound insights into pedagogical knowledge (PK), content knowledge (CK), and pedagogical content knowledge (PCK). TPACK offers teachers a holistic view of technology, teaching, content, and their interplay, deepening understanding of the intricate relationships within the learning ecosystem. To further explore how TPACK, as an external variable, affects PU and PEU, we intend to reveal its potential influence mechanisms and effects by testing the following hypotheses:

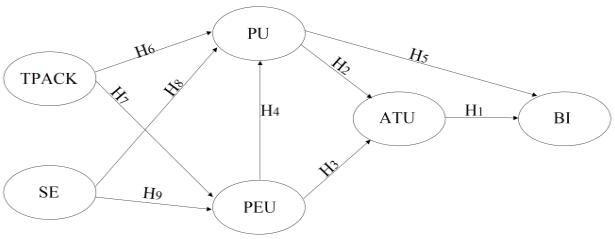
H6: TPACK will affect PU;
H7: TPACK will affect PEU;

Self-efficacy (SE). The concept of SE is rooted in Bandura's social cognitive theory (Bandura, 1977). In this study, SE specifically refers to pre-service teachers' belief in using SVVR for teaching. We aim to delve into how SE, as an external variable, affects pre-service teachers' PEU and PU by testing a series of hypotheses.

H8: SE will affect PU; H9: SE will affect PEU.

Figure 1

Research model.



BI = Behavioral Intention;
ATU = Attitude toward Use;
PU = Perceived Usefulness;
PEU = Perceived Ease of Use;
TPACK = Technological Pedagogical Content Knowledge;
SE = Self-efficacy

Method

Participants. Around 300 pre-service teachers.

Instruments. The questionnaire consists of 6 constructs, and each construct consists of 3 items: *Behavioral Intention (BI)* (Venkatesh & Bala, 2008), (e.g., "If my future school has SVVR conditions, I am willing to use SVVR technology for teaching in the near future"); *Attitude Towards Use (ATU)* (Davis, 1989; Fussell & Truong, 2023), (e.g., "Using SVVR technology in teaching is a good idea"); *Perceived Usefulness (PU)* (Davis, 1989; Venkatesh & Bala, 2008), (e.g., "I think the use of SVVR technology in teaching is useful."); *Perceived Ease of Use (PEU)* (Davis, 1989; Venkatesh & Bala, 2008), (e.g., "I think the use of SVVR technology is clear and understandable."); *TPACK* (Chai et al., 2012), (e.g., "I can teach lessons that appropriately combine my content, SVVR technology, and teaching approaches."); *Self-efficacy (SE)* (Venkatesh & Bala, 2008), (e.g., "I feel confident in using SVVR technology in my teaching even if there is no one around me to show me how to use it").

Experimental procedure. All pre-service teachers who attend in "Application of Modern Educational Technology" courses will experience SVVR for teaching and then will complete the questionnaire online.

Data analysis. This study will use AMOS25 to examine the research model (Figure 1.) through SEM.

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Case Study on the Routine Use of Online Chat for Teacher Learning

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This study implemented an asynchronous and distributed lesson study environment using online chat (hereinafter "chat") to facilitate daily learning and continuous improvement of schoolteachers. The first objective was to understand posting trends based on job positions such as research supervisor, school administrator, teacher, and so on; this was achieved by investigating the number and content of posts made by individuals in each job position. The second objective was to identify the advantages and challenges of chat-based lesson study by analyzing free-text responses. The results indicated that: 1) individuals in each job position used chat for different purposes based on their respective roles, and 2) while the variety and abundance of information shared in real-time encouraged daily learning for teachers, some teachers found handling the large volume of disorganized information burdensome.

Keywords: Asynchronous Distribution, Chat, Information Sharing, Lesson Study

Introduction

Lesson study is a structured and ongoing training activity undertaken by schools to promote children's growth and development (Kishimoto et al., 1986). It is a well-established activity that has long been used to develop teachers' instructional strategies.

However, according to Suzuki et al. (2010), the changing school environment has made it difficult to conduct training sessions by gathering multiple teachers at the same time and place. Traditional lesson study, wherein multiple teachers gather together, imposes temporal and spatial constraints, leading to an increased sense of hecticness, a reduction in opportunities for collaborative learning, and difficulties in maintaining continuous learning. Hence, it is necessary to design an environment that frees teachers from temporal and spatial constraints and allows them to learn on a daily basis. Therefore, this study implemented an asynchronous and distributed lesson study environment using chat to facilitate daily learning for teachers. The first objective of this study is to understand posting trends based on job position by investigating the number and content of posts made by staff members in each position. The second objective is to identify the advantages and challenges of chat-based lesson study through analysis of free-text responses.

Research Design and Methods

Survey Target and Period The survey targeted 42 teachers who participated in an asynchronous and distributed lesson study using chat. Their chat posts were examined from April 2023 to March 2024.

Survey Method and Analysis Method Two surveys were conducted.

Survey 1 examined the posting situation on chat from April 2023 to March 2024. Specifically, the posts were first categorized using the KJ method based on their content. Then, the number of posts by job position was calculated for each category (Tables 1).

Survey 2 collected free-text responses from the 42 teachers who participated in the asynchronous and distributed lesson study using chat regarding the advantages and challenges of this form of lesson study. Each comment was categorized as in Survey 1 (Tables 2, 3).

Results and Discussion

Number of Posts by Category and Position The results are shown in Table 1. It was confirmed that the research supervisor had the highest number of posts in seven categories. In addition to information about synchronous lesson

study conducted within the school, the research supervisor also takes the lead in sharing guidance and advice from university affiliates, initiatives from other schools, and educational information disseminated by external media such as websites and newspapers. This suggests that the research supervisor plays a role in promoting teacher learning both internally and externally. School Administrator had the highest number of posts in three categories, indicating their role in observing teachers' daily practices, introducing these practices to other teachers, and encouraging participation in external training, thereby supporting professional growth. It is inferred that research supervisors and school Administrator use chat to promote teacher learning and support professional growth. Teachers had the highest number of posts in the "Own teaching practices" category. By sharing information about their own practices, they reflect on their lessons and seek advice from others, which leads to refinement.
It is suggested that teachers use online chat to facilitate their own lesson improvement. These findings suggest that each job position utilizes chat for different purposes based on their roles.

Table 1

Number of Posts by Category and Position

Categories	Research Supervisor (*N*=1)	School Administrator (*N*=3)	Chief of Academic affairs (*N*=1)	Teachers (*N*=36)	Others (*N*=2)	Total
Colleague's teaching practices	227	366	13	209	3	818
Own teaching practices	48	59	12	306	15	440
Synchronous lesson study	140	22	4	70	6	242
Notices about external training and seminars	14	55	24	6	0	99
Guidance from university faculty and instructional advisors	28	12	1	15	12	68
Educational information disseminated via the web or newspapers	22	1	0	6	0	29
Teaching practices of other schools	11	7	2	5	0	25
Sharing teaching materials and tools	12	1	4	6	1	24
Sharing attended external training and seminars	2	3	0	3	0	8
Operational skills	4	0	0	3	0	7
Others	20	9	1	5	6	41
Total	528	535	61	634	43	1801

Advantages and Challenges The results are shown in Tables 2 and 3. Regarding advantages, the category with the highest number of items was: "Visualization of colleagues' daily practices (17 comments)." The highest number of comments was in the "Visualization of colleagues' daily practices" category, reflecting teachers' desire to know about their colleagues' daily practices.The real-time sharing and visualization of colleagues' daily practices likely contributes to lesson improvement and increased motivation for improvement.
Regarding challenges, the category with the highest number of items was: "Need for information categorization (5 comments)." The highest number of comments was in the "Need for information categorization" category, likely due to the mixed state of 1801 posts across 11 categories as indicated in Survey 1.
This suggests that while the variety and volume of real-time shared information visualize daily practices and promote teacher learning, the disorganized flow and large volume of information can be burdensome for some teachers.

Table 2

Categories and Number of Comments Regarding the Advantages

Category	Number of Comments
Visualization of colleagues' daily practices	17
Timeliness and promptness of information sharing	9
Reference for lesson improvement	9
Release from temporal and spatial constraints	9
Retention of information	8
Improvement of communication	5
Increase in motivation	5
Visualization of information	2
Total	64

Table 3

Categories and Number of Comments Regarding the Challenges

Category	Number of Comments
Need for information categorization	5
Individual differences in posting	4
Lack of time	3
Difficulty in understanding information	3
Acquiring skills to utilize	3
Increase in information volume	2
Balance with working hours	1
Awareness of posting	1
Total	22

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Comparative Study on ICT Utilization Instructional Competence Standards in in-service training between Japan and China

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Abstract

Since the outbreak of the novel coronavirus, the use of ICT in education has become an urgent issue. Japan and China share a common goal of enhancing teachers' ICT instructional skills and integrating them into education, each with their own unique teacher training systems. There are respective competence standards for in-service training on teachers' ICT Utilization Instructional Competence. This research aims to classify, compare, and analyze the major and minor items of Japan's "ICT Utilization Instructional Competence Checklist for Teachers" and China's "ICT Utilization Instructional Competence Standards," extracting their characteristics. Additionally, based on these results, we plan to conduct interviews regarding initiatives related to ICT utilization instructional skills in in-service training in two cities in Japan, we will explore what is being undertaken in the "ICT Utilization Instructional Skills" training for all teachers, including whether AI and other topics are covered. We will also examine the outcomes and challenges of these initiatives. And explore how competence standards can enhance teachers' ICT utilization instructional skills in practice and to provide valuable information for improving the competence standards.

Keywords: Comparative Study, ICT Utilization Instructional Competence, In-service training, Competence Standards

Introduction

Since the outbreak of COVID-19, ICT utilization in education has become a pressing issue globally. However, there is still a lack of sufficient in-service training for teachers to improve their ICT skills. Japan and China have their own training systems, and respective evaluation standard for in-service training on teachers' ICT Utilization Instructional Competence, with the common goal of enhancing their information technology skills and incorporating them into teaching. This study aims to clarify the similarities and differences in in-service training for improving ICT utilization instructional skills though comprehensive comparative analysis of the training projects and competency standards in both countries and tries to provide suggestions for more effective training in both countries.

in-service training

In Japan, newly appointed teacher training is designed for newly appointed teachers at public elementary schools and other schools to develop practical leadership skills and a sense of mission, and to acquire a broad range of knowledge. The purpose of this training is to provide newly appointed teachers with the skills needed in the educational field. Newly appointed teacher training plays a very important role in promoting teachers' growth and quality teaching (MEXT,2008).

In April 2019, to improve teachers' ICT utilization skills in the new era, the Ministry of Education, PRC government portal (2019) decided to implement the "Primary and secondary school teachers' information technology application ability improvement project 2.0" (hereinafter referred to as improvement project 2.0).

Competence Standards

According to the MEXT, Japan's ICT Utilization Instructional Competence Checklist was established in 2007 and revised in 2018, The specific revisions are divided into two parts: revision of the questionnaire items and changes to the options. The revised version is categorized into four major items: "A. Ability to utilize ICT for materials research, preparation, evaluation, and school affairs," "B. Ability to utilize ICT in teaching lessons," "C. Ability to guide students in utilizing ICT," and "D. Ability to instruct on the knowledge and attitudes foundational to information utilization." Each of these major items consists of four sub-items.

The "Competency Standards" propose basic and developmental competencies for the application of information technology by primary and secondary school teachers. These standards serve as a fundamental basis for activities such as training, application, and evaluation of information technology application competencies, aiming to effectively utilize information technology in education and professional development. Based on the main lines of teachers' educational activities (basic competencies) and learning development (developmental competencies), the standards divide information technology application competencies into five dimensions: "Technical Literacy" (5 items), "Planning and Preparation" (6 items), "Organization and Management" (5 items), "Evaluation and Diagnosis" (4 items), and "Learning and Development" (5 items).

Discussion

Due to time constraints, I have only summarized and briefly analyzed the in-service training and Competence Standards for improving ICT Utilization instructional skills in China and Japan from 2019 to 2022 by reading literature and have understood the current situation and some potential problems of the in-service training for improving ICT Utilization instructional skills in both countries. Next, we plan to conduct interviews regarding initiatives related to ICT utilization instructional skills in in-service training in two cities in Japan. Additionally, we will explore what is being undertaken in the "ICT Utilization Instructional Skills" training for all teachers, including whether AI and other topics are covered. We will also examine the outcomes and challenges of these initiatives.

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The Types and Purposes of ICT Use in Autonomy-Supportive Teachers' Classes

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Abstract This study aims to examine the characteristics of Information and Communication Technology (ICT) use by teachers in classrooms oriented toward autonomy support, where students utilize information devices during lessons. An analysis of the types and purposes of ICT equipment used in the classes of eight teachers, confirmed to be oriented toward autonomy support, revealed the following. All teachers utilized a computer for teachers on a one-to-one basis and were using the cloud. Furthermore, ICT devices were predominantly used to check the learning status. These findings suggest that as each student selects learning contents and methods to address their learning tasks, teachers may be using computers to monitor students' learning status and connect this monitoring to guidance and support. Additionally, compared to the course of whole class teaching, it was suggested that the types and purposes of ICT device use by teachers might differ.

Keywords: Autonomy Support, The Teachers' Teaching Behavior, ICT Devices

Introduction

In Japan, PISA 2022 results showed that many students lacked confidence in autonomous learning compared to other OECD countries. This highlights the need for school education to foster autonomous learning and provide environments where students can choose materials and methods based on their individual pace and interests (National Institute for Educational Policy Research, 2023). Teachers are expected to support self-regulated learning.

Wakatsuki (2024) found that teaching behaviors supporting autonomy with information devices differ from traditional methods. Teachers use information devices for individual student support and desk-to-desk instruction. These findings suggest that personal computer use is essential. However, the characteristics of ICT usage in autonomy-supportive lessons remain unclear. This study aimed to examine ICT usage by focusing on eight elementary school teachers, investigating their types and purposes of ICT device usage.

Research Design & Methods

The survey was conducted between late December 2023 and early February 2024. The Problems in Schools Questionnaire (PSQ) (Oya et al., 2020) was given to 16 teachers at Public Elementary School F to select those oriented toward autonomy support. The survey focused on the classes of eight teachers identified as being oriented toward autonomy support, teaching second through sixth grades

In the targeted classes, a 360-degree camera was installed in the center of the classroom, and the teacher wore a lapel microphone to record spoken words. The first author created field notes detailing the teacher's spoken words and behavior with time references. Following Murakami et al. (2022), the lesson recordings were divided into 30-second frames, and ICT device usage was counted for each frame. ICT devices included children's computers, teachers' computers, document cameras, and projectors. The instructors verified their teaching behaviors' intentions. Using the KJ method, categories were created from field notes detailing teachers' speeches, actions, interactions with students, and teaching intentions to determine ICT device usage purposes.

Results

Types of ICT devices used by teachers

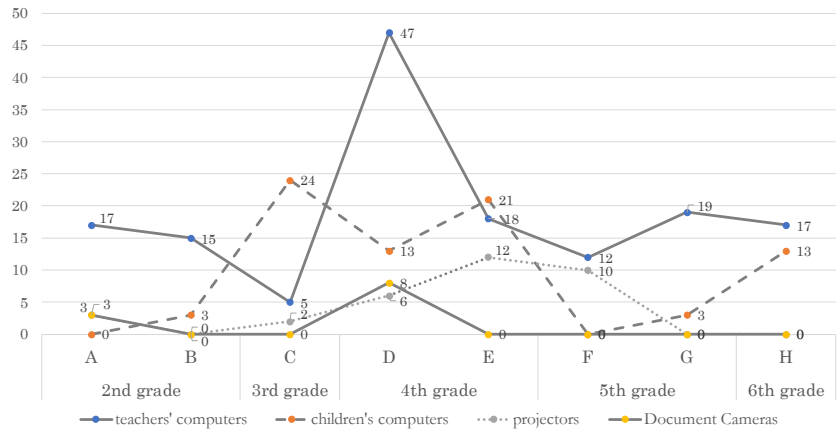
Teachers used children's computers, teachers' computers, document cameras, and projectors in the classroom. Children's computers: Teachers were guided and supported by actively using the computers that the children were operating. Teachers' computers: Used for checking students' learning statuses shared on the cloud and explaining materials prepared by the teacher. Document cameras: Capable of enlarging physical objects. This was used to magnify parts of the textbooks or demonstrate how to use the learning materials that children were using. Projectors: Used to present tasks, display explanatory materials, and showcase models based on student learning status.

Figure 1 shows the types of ICT devices used by the teachers in each class. It was confirmed that in six out of the eight classes, computers were the most frequently used device by teachers. Under the GIGA School concept, each teacher responsible for a class is provided with a computer. Therefore, it is necessary that all teachers in the surveyed schools use their individual computers during classes. Additionally, students can learn using educational tools on the

cloud. Thus, as students proceed with their learning activities, teachers provide guidance and support by monitoring the cloud, which suggests a high utilization of computers by teachers.

Figure 1

Types of ICT devices used by teachers of each grade level



Purposes of ICT used by teachers

Categories for purposes of ICT used by teachers were created using the KJ method. Consequently, categories related to presentation [presentation of tasks, presentation of explanatory materials, presentation of models, presentation of physical objects] and categories related to verification [verification, verification of students' learning status, verification of students' outputs, and preparation of learning materials] were formed. Additionally, categories related to the preparation of learning materials were established.

Table 1 shows the categorized and counted results for ICT utilization by each teacher. It was confirmed that verifying students' learning status was the most common purpose of ICT usage. In the lessons conducted in this study, the cloud was utilized, allowing for real-time verification of the students' learning status. Furthermore, in classes where students could choose their learning content and methods in response to the learning tasks, each student's learning activities varied. This suggests that in a cloud-enabled learning environment where students select their learning methods and content, using cloud to verify students' learning status and link it to guidance and support is likely.

Table 1

Categories of purposes for teachers using ICT devices

Category	Specific Ways to Utilize	A	B	C	D	E	F	G	H
Presentation of tasks	Present the flow of the lesson in Google Classroom.	1	2	3	3	1	9	2	3
Presentation of explanatory materials	Show the parts explained using a digital textbook.	2	0	0	5	0	0	0	0
Presentation of models	Display learning materials that serve as models for students, such as how to read an atlas.	0	0	7	12	14	0	3	0
Presentation of physical objects	Present the strings used in the mathematics activity.	8	0	5	14	0	0	0	0
Verification of students' learning tasks	Confirm the objectives set by the students and the progress of learning through chat, etc.	0	4	4	16	14	0	5	12
Verification of students' learning status	Review the content organized by students on Jamboard.	0	5	9	24	21	10	12	15
Verification of students' outputs	Check the photos of the artifacts created and photographed by the students.	7	0	0	0	0	0	0	0
Preparation of Learning Materials	Set up places for posting student photos and reflecting on them.	5	6	0	0	1	3	0	0
Others	Check for malfunctions and manage operations of the students' computers.	0	1	3	0	0	0	0	0

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A Study on the Significance of ICT Utilization in Classical Chinese Education in Japanese High Schools

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Abstract

In Japan, Arai (2018) points out that students perceive Classical Chinese as didactic, limiting the potential of Classical Chinese texts. Meanwhile, although a practical study by Kaneko (2022) and Saito (2016) on the utilization of ICT in classical education yielded some effects of ICT activation, there has been limited exploration into the possibilities and effectiveness of ICT-integrated Classical Chinese education. Given the drastic reduction in class hours for Classical Chinese (Inai, Yoshida, Ozawa, Udou, & Hata, 2018), this study aims to explore the Significance of ICT Utilization in Classical Chinese Education. The study reveals that integrating ICT in Classical Chinese education not only reduces preparation time for materials and enhances teaching efficiency but also produces significant benefits for both teachers and students in their learning experiences. Furthermore, it discusses how leveraging ICT in Classical Chinese education could deepen the potential of Classical Chinese texts, enabling students to perceive them not merely as didactic lessons but as subjects that offer broader perspectives, deeper understanding, and enjoyable learning experiences.

Keywords: Japanese high school, Classical Chinese, ICT utilization, The Potential of Classical Chinese Literature, ICT-enhanced Classical Chinese education

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Structural Relationship among Learning Engagement, Perceived Teacher Support, Learning Motivation, Professional Identity and L2 Emotions in Chinese ESP Class

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Abstract: *This study investigates the structural relationship of learning engagement, learning motivation, teacher support, professional identity and L2 emotions in English for Specific Purposes (ESP) courses within Chinese higher education. Under the guidance of national educational policies, Chinese universities have promoted ESP courses to enhance students' international competitiveness. The research explores various intrinsic and extrinsic factors influencing learning engagement, including cognitive, affective, and emotional variables. It highlights the critical role of motivation, professional identity, and L2 emotions in shaping students' engagement and performance. The study aims to bridge the gap in understanding learning engagement in ESP education in China and offers pedagogical implications for educators to enhance teaching effectiveness and student outcomes.*

Keywords: Learning Engagement in ESP class, Learning Motivation, Teacher Support, Professional identity, L2 Emotions

Introduction

Chinese universities have extensively promoted English for Specific Purposes (ESP) courses (Cai & Chen, 2013), since 2010, the Ministry of Education of China promulgated'The National Medium and Long-term Education Reform and Development Outline (2010-2020) (2010)', proposing the goal of 'cultivating a large number of talents with an international vision, familiarity with international rules, and capability to participating in international affairs and international competitions. As a vital part of foreign language education, it is crucial to promote the language proficiency among ESP learners.

Learning engagement has been associated with numerous positive outcomes in education, including heightened levels of academic persistence, effort and achievement as well as high academic aspirations and improved mental health (Pianta et. al., 2012). Despite the well-known and extensively discussed importance of learning engagement among researchers and practitioners, the level of learning engagement in L2 classrooms is often low (Weaver & Qi, 2005; Zhang & Zhou, 2004; Zhao & Xu, 2012). Thus, improving engagement among L2 students in all dimensions is of paramount importance.

Motivation is considered as the most important variable affecting learning engagement in second language (L2) learning (Gardner & Lambert, 1959). Besides affective factors like motivation, learning environment, such as teacher or peer support, can also affect learning engagement (Oga-Baldwin, 2019) .In ESP classes, professional identity also plays a critical role in mediating the effect between learning motivation and students' learning engagement. Foreign language enjoyment (FLE) and foreign language classroom anxiety (FLCA) are the most significant factors in the L2 psychological education field and are frequently experienced by learners in language learning (Dewaele & Li, 2020; Li, 2018; Piniel & Albert, 2018; Shirvan & Taherian, 2018)

Research Design & Methods

The participants in this study will be 500 university students who are majoring in flight technology in China. All participants will be selected from 5 out of 21 universities across China that offer a major in flight technology.

Accordance with the research questions, five questionnaires will be used: learning engagement questionnaire, learning motivation questionnaire, perceived teacher support questionnaire, professional identity questionnaire and FLE and FLCA questionnaires.

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Structural Relationship Among Teachers' TPACK, School Support for TEL, Technology Self-Efficacy, Technostress, and Teacher Performance in Chinese College Classes

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Abstract……
The COVID-19 pandemic has necessitated a rapid transition from traditional face-to-face teaching to online learning environments worldwide, including in China. This transition underscores the imperative for teachers to effectively integrate technologies into their teaching practices to maintain high-quality education. This study explores the structural relationships among teachers' Technological Pedagogical Content Knowledge (TPACK), school support for Technology-Enhanced Learning (TEL), technology self-efficacy, technostress, and teacher performance in Chinese college classes.

Teacher performance, defined as teachers' contributions to educational goals in the use of technology, is influenced by various factors in the technology-integrated teaching landscape. Previous research primarily focused on student performance, often overlooking the performance and well-being of teachers, who face significant challenges due to varying levels of technological proficiency. This study aims to address this gap by examining both the direct and indirect effects of these variables on teacher performance.

The research employs a comprehensive approach, utilizing Structural Equation Modeling (SEM) to analyze data collected from Chinese college teachers. Key findings reveal that TPACK enhances teacher performance by providing a robust framework for integrating technology into pedagogical practices. School support for TEL is also pivotal, offering essential resources and a supportive environment that bolster teachers' technology self-efficacy and reduce technostress. High levels of technostress, identified as a modern maladjustment to rapid technology evolution, negatively impact teacher performance, underscoring the need for effective stress management strategies.

Technology self-efficacy emerges as a mediating variable, linking TPACK and school support with enhanced teacher performance. Teachers with high technology self-efficacy demonstrate greater resilience and adaptability in utilizing technologies, leading to improved teaching outcomes. Conversely, the study highlights the dual role of technostress, which, if unmanaged, can undermine teacher performance despite high TPACK levels.

This research contributes to the understanding of the multifaceted impacts of technology integration on teacher performance, providing actionable insights for educational institutions. By fostering a supportive environment and enhancing teachers' TPACK and technology self-efficacy, schools can mitigate the adverse effects of technostress and promote higher teacher performance. The findings underscore the importance of continuous professional development and institutional support in navigating the challenges of technology-integrated education, particularly in the post-pandemic era.

Keywords: TPACK, School Support for TEL, Technology Self-Efficacy, Technostress, Teacher Performance, College Teachers

Issues and Support Methods for ICT-based Learning in Elementary Schools from a Teacher's Perspective

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In this study, we identified the actual conditions and issues of ICT use in Japanese elementary schools from a teacher's perspective, and examined ways to create an ICT environment that can enhance student engagement. From a survey of classroom practices and interviews with teachers at elementary schools, it was found that the curriculum for ICT-enhanced classes was not sufficient, and information gathering varied from teacher to teacher. Therefore, teachers are required to establish service-specific supporters, such as those in charge of networks, hardware, and curriculum, and to improve the ICT environment at home through collaboration with parents.

Keywords: ICT, GIGA Schol, Teacher, Elementary School

Introduction

In Japan, the media use environment in elementary schools reached a major turning point with the GIGA school program, in which each student is provided with a PC environment. While the percentage of ICT use in the classroom is increasing, the use of ICT is left to teachers, increasing the burden on teachers who are experiencing trial and error. According to a PISA survey, the frequency of ICT use in classrooms is below the OECD average(National Institute for Educational Policy Research 2023), and it is challenging to improve learning guidance and support activities. The challenge is to improve the learning guidance and support activities. Therefore, there is an urgent need to enhance ICT in elementary schools. How do teachers approach the use of ICT in classes, and what kind of support do they seek?

Methods

The purpose of this study is to clarify the actual situation and issues of ICT use in Japanese elementary schools from the teachers' perspective and to examine ways to realize an ICT environment that can enhance students' engagement. To this end, the following two points will be examined: a survey of practice reports on ICT use and semi-structured interviews with elementary school teachers.

Results

The OECD points out the influence of the approach of parents and school education (Tracey and Francesca, 2019), and the GIGA school concept points out the importance of home learning, as homework also uses ICT (Noborimoto and Takahashi, 2021). Teachers also see the need for its effective use in home learning [4]. However, many parents are reluctant to use ICT, and more than 70% of them think that it is difficult to determine the status of their children's use and learning (Benesse Educational Research and Development Institute 2023). In addition, guides for home studies using ICT devices published by local governments only call attention to terminal malfunctions and health effects and do not clarify specific ways in which parents can support learning. Although many previous studies mentioned the improvement of teachers' skills and curriculum development, we considered it important to consider a system to support home learning using ICT. Based on the issues related to the use of ICT obtained in the previous study, semi-structured interviews were conducted with two elementary school teachers who were teaching classes using ICT.

Effects of ICT

The following were mentioned as learning methods that can be achieved with ICT: 1) the use of a large amount of data, 2) ease of visual comprehension, and 3) asynchronous learning activities. The students felt that the significance of using ICT was that they could learn regardless of place and time, and that they could work at home or in a different part of the classroom by using the collaborative editing function for issues that had previously been done on drawing paper.

Homework

Whether students were given home-study assignments differed between schools. Private elementary schools assign homework, while some public elementary schools do not have a network environment due to economic problems. As a result, some students cannot do homework even if they want to.

Support

The support that parents would like to receive from their children's teachers includes the amount of time the devices can be used, charging the devices so that they can be used at school, and providing support for device malfunctions. As for collaboration between parents and teachers, there is no system for sharing class content. Therefore, sharing a portfolio of children's learning time at school would help promote parents understanding of learning. The results also showed that teachers looked for supporters because of the heavy burden of using ICT outside the classroom. It is desirable to have a department or community that handles each type of job or service, such as those responsible for networks, security, application distribution, and equipment terminals.

Table 1

Interviews with teachers

	A	B
1. Effects of ICT	A large amount of data can be utilized. Capable of asynchronous learning activities.	Easy to understand visually. Capable of asynchronous learning activities.
2. Distribution of homework	Yes	No
3. Cooperation with Parents	Yes(Notices and attendance confirmations only.)	No
4. Support needed	Responsible for networking, security and applications, and equipment terminals.	We don't want more people, we want support for each service.

A: Private elementary school; B: Public elementary school

Discussion

Based on the above research, the realization of the GIGA school concept requires not only the improvement of teachers' skills and the enhancement of the curriculum, but also cooperation between parents and teachers and the assignment of supporters to teachers. In the U.S., Dojo and Google Classroom are used for communication with parents. Teachers can communicate with parents individually and tell them whether homework is due and about the progress of issues. Google Classroom allows the sharing of portfolios, allowing parents to check the progress of school issues and their children's work. If a framework that allows children to continue learning at home using ICT is completed while referring to overseas examples and using private support systems, it will be possible to realize an environment in which learning does not stop, even when face-to-face learning cannot continue because of earthquakes, disasters, and infectious diseases. To consider concrete support methods for ICT use, more opinions must be collected from teachers who struggle with the GIGA school concept.

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An empirical study of generative artificial Intelligence technology supporting EFL students' learning

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Abstract

As a new educational medium, generative artificial intelligence (GAI) has been widely used in the field of language learning. This paper designs a human-computer interaction model based on generative artificial intelligence. Compared with the traditional human-computer interaction mode, it can help students improve their speaking skills by simulating real conversation scenarios and providing immediate feedback. A quasi-experimental method was used in this study. Forty-two college students were selected as research objects and divided into experimental group and control group. The experimental group used generative artificial intelligence tools for oral English training, and the control group used traditional artificial intelligence tools for training. After a semester of training, the results showed that the experimental group performed better in verbal logic expression than the control group. In addition, in terms of oral anxiety, the psychological anxiety of the experimental group was significantly improved. Therefore, GAI integrated oral teaching is worth spreading and applying in second language teaching.

Keywords: Oral expression, generative artificial intelligence, human-computer interaction, educational media

Introduction

Oral English is regarded as an indispensable skill in English learning. In the traditional teaching of Chinese universities, the cultivation of oral English expression ability is carried out in the form of listening and speaking training, which is often overlooked (Zou, 2023). Therefore, the traditional oral English teaching still faces difficulties, mainly focusing on oral dialogue and personal expression. For example, problems in personal expression are manifested as pronunciation difficulties and insufficient vocabulary, and students are prone to psychological anxiety (Jiang, 2022). Therefore, how to use more intelligent educational media to improve the oral human-computer interaction mode is particularly important.

In order to improve the oral expression ability of English students, this study proposes a human-computer interaction model based on generative artificial intelligence, and conducts a quasi-experimental study to verify its effect. Then, the research mainly focuses on the following problems.

RQ1: Compared with the traditional AI interaction mode, is the GAI based human-computer interaction mode more effective in improving students' verbal expression ability?

RQ2: Compared with the traditional AI interaction model, is the GAI based human-computer interaction model more effective in reducing students' oral learning anxiety?

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Development of a Class in which Students Watch News Videos with Statistical Information Using Critical Thinking

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The purpose of this study was to conduct a practice in which students were asked to critically watch news videos with statistical information, and to clarify whether this practice promotes the improvement of critical thinking skills. The results of the evaluation revealed that the practice promoted the improvement of critical thinking skills in the areas of (1) Clarification, (2) Examination of the basis for inference, and (3) Inference.

Keywords: News Videos, Statistical Information, Critical Thinking, Mathematics Education

Introduction

Statistical information used in news on television, radio, newspapers, and the Internet can sometimes be misleading to recipients. To obtain correct information from the news, it is necessary to judge whether the statistical information used is reliable. In addition, Even if correct statistical information is used, it does not necessarily mean that the derived claims are correct (Alberto 2020). It is important to evaluate whether the claims are not exaggerated or not.
One of the skills needed to obtain correct information from news videos is critical thinking. Critical thinking is "reasonable reflective thinking focused on deciding what to believe or do" (Ennis 1987). Kusumi (2013) describes the critical thinking process when obtaining information as including (1) Clarification, (2) Examination of the basis for inference, (3) Inference, and (4) Decision-making. The purpose of this study is to develop a practice that allows students to experience Kusumi's critical thinking process when viewing news videos containing statistical information, and to determine whether the practice promotes the development of critical thinking skills.

Teaching Practice Method

Outline of Class Practice

We implemented this practice with 50 first-year high school students at Z High School, having them critically watch news videos using statistical information in Mathematics I "Analysis of Data."

Development of the news videos

Six news videos were developed, two for each class. Each video featured one moderator and one professor, with the videos formatted as a Q&A session where the professor answered questions from the moderator. The researcher and a teacher from Z High School played moderator and professor. Each video was about 1 minute and 30 seconds long.

Worksheet Development

The worksheet was created so that participants can experience (1) Clarification, (2) Examination of the basis for inference, (3) Inference, and (4) Decision-making (Kusumi 2013). The first half of the worksheet consists of "STEP0" to "STEP3," while the second half consists of "STEP0" to "STEP2".
"STEP0" is the stage of (2) Examination of the Basis of Inference, in which the participants examine whether the basis is based on reliable statistical information. The worksheet is structured so that the participants can work on (2) Examination of the basis for inference before "STEP1" (1) Clarification.
In "STEP0", students pause the video when they see an incorrect line graph on the screen behind the presenter and the professor. They then write the correction in the blank space for appropriate line graph.
"STEP1" is the (1) Clarification stage, in which students clarify the claim and rationale of the news video. In the three blank spaces in the "Claim" column in the right frame, students fill in the "claim" by carefully listening to the professor's words in the video.
"STEP2" is the (3) Inference phase, in which one evaluates whether claims based on statistical information are not overgeneralizations.

"STEP3" is the (4) Decision-making phase, in which participants judge the reliability of the news images through dialogue with others. Participants write in the "STEP3" column at the bottom of the worksheet what they noticed in their peers' worksheets and what they modified in their own worksheets.
The second half of the worksheet was created using the same themes and the same statistical information as the first half, but with different data values.

Classroom Practice
The first researcher conducted the class practice in five phases: 1) Classroom overview, 2) Filling in the first half of the worksheet, 3) Group interaction, 4) Explanation, and 5) Filling in the second half of the worksheet.

1) **Classroom Overview:** During the first five minutes, students understood the objectives and contents of the lesson and learned how to fill in the worksheet through a PowerPoint presentation.
2) **Filling in the First Half of the Worksheet:** Students had 10 minutes to fill in the first half of the worksheet. Each student watched a news video on a terminal, pausing and replaying the video as needed.
3) **Group Interaction:** Students formed groups of about six and exchanged worksheets (the first half) for 10 minutes. They passed their worksheets around, asked questions about unclear content, and filled out "STEP3" based on their observations.
4) **Explanation:** Students had 10 minutes to listen to an explanation of the first half of the worksheet using a PowerPoint presentation.
5) **Filling in the Second Half of the Worksheet:** Students had 10 minutes to fill in the second half of the worksheet, again watching the news video and filling out steps from "STEP0" to "STEP2."

Evaluation Method

In order to clarify whether the practice promoted the improvement of critical thinking skills, we scored the first and second halves of the worksheets "STEP0," "STEP1," and "STEP2" in each class session, and analyzed the growth of scores using a corresponding *t*-test. We analyzed the overall improvement using scores from the first half of the first worksheet and the second half of the third worksheet.

Results

The worksheets from the first to the third session were scored on a 5-point scale for "STEP 0," a 3-point scale for "STEP 1," and a 2-point scale for "STEP 2. In order to clarify the extent to which critical thinking skills were improved as an overall effect of the three lessons, we analyzed the growth of "STEP0," "STEP1," and "STEP2" using the scores of the first half of the first worksheet (the first statement) and the second half of the third worksheet (the last statement), with a corresponding.
A *t*-test was used to analyze the growth of "STEP0," "STEP1," and "STEP2. The analysis included 45 students who had participated in both the first and third class sessions. The results of the analysis showed that in all the phases, "STEP0" ($t(44)=10.79$, $p<.01$, $d=1.81$), "STEP1" ($t(44)=7.21$, $p<.01$, $d=1.52$), and "STEP2" ($t(44)=14.71$, $p<.01$, $d=3.14$), the score in the first half of the first worksheet, which was written first, was higher than that in the second half of the last worksheet.

Discussion

The purpose of this study was to determine whether the practice of having students critically watch news videos containing statistical information promotes the development of critical thinking skills when watching news videos containing statistical information. Analysis using scores from the first half of the first worksheet (first statement) and the second half of the third worksheet (last statement) showed that scores for the last statement were higher than those for the first statements in all "STEP0," "STEP1," and "STEP2. This suggests that the developed practice facilitates the development of critical thinking skills when viewing news videos containing statistical information. However, the different themes and statistical information used in the first half of the first session and the second half of the third session require caution in drawing conclusions.

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Media Use in Technology Integration Framework for Service-Learning Pedagogy: A Call to Policymakers

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Abstract

This article examines the critical role of media and technology integration in enhancing service-learning pedagogy, urging policymakers to support comprehensive service-learning curricula. Service-learning, an educational approach that combines academic learning with community service, benefits significantly from the strategic use of digital tools. Technology expands access to information, facilitates communication and collaboration, enhances reflection and assessment, and promotes student engagement. A structured framework for technology integration is essential, encompassing infrastructure, professional development, curriculum design, assessment, and partnerships. In this research a Technology Integration Framework for Service-Learning model is used as a guide to assess where in the service-learning education framework is media useful. Policymakers are urged to highlight the benefits of service-learning, promote equity and inclusion, support funding, facilitate collaboration, and establish evaluation mechanisms. By advocating for these policies, policymakers can ensure that service-learning programs effectively prepare students for a digital and interconnected world, fostering civic responsibility and community development. Media use in service-learning pedagogic approach not only enriches the educational experience but also strengthens community ties, creating a mutually beneficial partnership between students and their communities.

Keywords: Integration, Media, Policymakers, Service-learning, Technology

Development of an Automated Pointing System for Lecture Videos

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Abstract: Effective presentation methods in lecture videos are crucial for enhancing educational outcomes. In particular, pointing, which synchronizes visual and auditory cues in instructional materials using an instruction stick or mouse cursor, can significantly improve learning effectiveness. Previous research by Tanaka et al. (2015) demonstrated that automating pointing reduces visual disruptions caused by hand tremors and enhances visibility compared to manual pointing methods. However, their system faced limitations such as fixed timing and delays, making it unsuitable for lecture videos. This study aims to address these challenges by developing a new "automatic pointing system for lecture videos." An experiment involving 30 university students compared three video formats: no pointing, manual pointing by instructors, and automatic pointing by the system. Results showed no significant difference in learning outcomes among the formats. However, videos with automatic pointing received higher ratings for "ease of understanding," "finding relevant content," and "screen visibility." Yet, no significant differences were observed in terms of "fatigue susceptibility" or "ease of maintaining concentration.

Keywords: Educational system development, lecture videos, pointing, multimedia teaching materials

Introduction

Background

Effective presentation methods are an important research topic in lecture videos. In particular, pointing, which synchronizes visual and auditory information of the material with an instruction stick or mouse cursor, can enhance educational effectiveness. For example, Mochida et al. (1997) and Ando and Ueno (2008) showed that the use of pointing significantly increased the percentage of correct responses in memory retention and comprehension tests. On the other hand, advances in information technology, including speech recognition, have made it possible to automate pointing. Tanaka et al. (2015) developed a system to point to relevant parts of materials in real time during a presentation. Their subjective evaluation questionnaire results showed that automated pointing significantly improved visibility compared to manual pointing, due to the reduction of flicker caused by hand tremors when using a laser pointer. However, due to the real-time processing of Tanaka et al.'s system, the timing of pointing cannot be freely adjusted, and there is an average delay of 2.03 seconds from audio to pointing. In addition, this system is not suitable for pointing in lecture videos because it assumes that the material is read out loud. In this study, we will devise a new method and develop an "automatic pointing system for lecture videos" based on Tanaka et al.

Research Design & Methods

System Development. In this study, we developed a system that automatically applies pointing gestures to lecture videos. The system operates as follows: Initially, the lecture audio is converted into text data using a speech recognition model. Concurrently, the lecture slides are transformed into text data utilizing the python-pptx library. These text datasets are then processed through an embedding model to compute their semantic similarity. Finally, OpenCV is employed to generate video data that points to the relevant sections of the slides corresponding to the lecturer's speech. Figure 1 shows an overview of the system.

Experimental Setup. To verify the effectiveness of the system, an experiment was conducted with 30 university students. Participants, divided into three groups based on their pre-test scores to ensure equal quality, were each shown a video lecture under one of three formats: without pointing, with manual pointing by the instructor, and with automatic pointing by the system. Each group was then given a post-test. After the test, the other two types of lecture videos were presented and a questionnaire was conducted. It used a six-point Likert scale was used and included an open-ended question asking whether they rated automatic or manual pointing higher and why.

Results and Discussion

The test results showed that the post-test scores for all groups were higher than the pre-test scores, indicating that all formats of the lecture videos had a certain learning effect. However, there was no significant difference in learning effect among the video formats. The results of the questionnaire showed that the lecture videos with automatic pointing were rated higher than the without pointing format in terms of "ease of understanding," "ease of finding the right place to look," and "ease of viewing the screen." However, there was no significant difference between the automatic pointing and the manual pointing formats. Additionally, there was no significant difference in "tendency to cause fatigue" and "ease of maintaining concentration" among all formats. The open-ended questions revealed that 20 participants found automatic pointing easier to learn from, while 10 participants preferred manual pointing. Some of the reasons for their preferences are summarized in Table 1.

Figure 1

System Development Methods

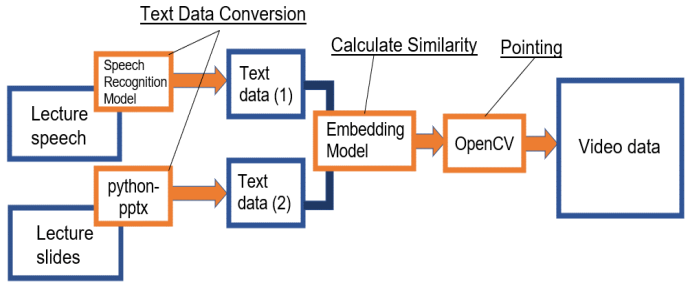

Table 1

Some of the reasons for their preferences

Reasons for Rating Automatic Pointing Higher		Reasons for Rating Manual Pointing Higher	
It was easier to understand what was being explained with a frame line than with dots.	The red squares made it clearer where to read the material at the moment.	Manual Pointing was a little too noisy for me because of the way it was highlighted.	The pointing was moving, so it was easier to understand the point I was learning.
With the laser pointer, my eyes would flicker and I would get tired.	I didn't like the fact that the dots were moving.	It was easier to follow with my eyes if only one point was shining.	Because I could follow it with my eyes.

The results suggest that automatic pointing by the developed system does not affect learning effectiveness. However, it was suggested that automatic pointing improves learners' subjective evaluations of "ease of understanding," "ease of finding the right place to look," and "ease of viewing the screen." Furthermore, the results suggest that automatic pointing does not contribute to "tendency to cause fatigue" or "ease of maintaining concentration." Additionally, the free-text responses revealed that many participants rated automatic pointing higher than manual pointing. However, some participants rated manual pointing higher, as indicated by the free-text and questionnaire responses. Therefore, it is not possible to conclude that automatic pointing is rated higher by all participants.

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Development and Educational Application Research of Emotion Recognition System Assisted by Large Language Models

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Abstract

This paper presents the development of a facial emotion and attention recognition software powered by a lightweight deep learning model, which is integrated into an educational framework. The software encompasses three key functionalities: facial emotion recognition, attention detection, and classroom engagement tracking. Additionally, it incorporates a feedback platform and a large language model, enabling real-time communication between students and the model. This interaction allows teachers to obtain instantaneous insights into students' emotional and cognitive states, thereby facilitating timely adjustments in teaching strategies and classroom dynamics.The software is designed to be universally compatible with all types of processors and requires minimal hardware specifications, such as basic webcams and standard computer setups. This accessibility ensures that the software can be easily implemented in diverse educational settings without the need for high-end technological investments.To validate the effectiveness of the software, a controlled experiment was conducted at a public primary school in Ouhai, involving 86 sixth-grade students. The study utilized a comparative approach to assess the impact of the software-enhanced teaching method against traditional teaching practices. The results indicated a significant improvement in the emotional regulation abilities of students who used the software, underscoring its potential as a transformative educational tool.The development of this software not only demonstrates the practical application of advanced AI technologies in the classroom but also lays a solid foundation for future research in precision data-driven education. By integrating real-time emotional and attentional data into the teaching process, it offers a novel approach to enhancing student engagement and optimizing learning outcomes.

Keywords: Facial Emotion Recognition; Attention Detection; Educational Technology; Deep Learning; Classroom Engagement

SVVR-based Technological Intervention's Impact on STEM Career Awareness and Emotional Engagement

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Abstract

Due to the increasing demand for skilled professionals in science, technology, engineering and mathematics (STEM) fields, there is an urgent need to inspire young students to pursue careers in STEM fields. Consequently, educators are actively exploring new ways to raise students' awareness of STEM careers. However, in traditional STEM education, students' experience of STEM may be limited to the knowledge they gain from books or from simulated experiments in the classroom. They find it difficult to understand STEM applications and lack STEM career awareness due to the lack of practical experience and interaction with real STEM environments. To address this problem, this study conducts a quasi-experimental study in which the experimental group uses SVVR technology and the control group uses graphic media, and applies SVVR to STEM education in the fifth grade of primary school. The results showed that students in the experimental group showed significant increases in STEM career awareness and emotional engagement compared to the control group, and that students with low levels of emotional engagement showed more significant increases in emotional engagement after using SVVR compared to students with high levels of affective engagement. The results of this study have implications for more effective STEM career exploration.

Keywords: Emotional engagement, STEM Career awareness, STEM education, SVVR

Research Design & Methods

2.1 Participants

The study involved 53 fifth-grade students, aged 10 to 12, from a private school in a southeastern coastal city in China. These students are proficient in using mobile devices and are at a critical stage of career concept formation.

2.2 Methodology

Employing a quasi-experimental design, the study evaluated the impact of SVVR technology on STEM education, utilizing scales to track changes in STEM career awareness and Emotional engagement.

2.2.1 STEM Career Awareness

The STEM Future Career Interest Survey (STEM Future-CIS), adapted from Playton et al. (2023), a 25-question tool covering science, technology, maths, and engineering, was utilized. Scoring was conducted on a 5-point Likert scale, with a Cronbach alpha of 0.873, ensuring reliability (Appendix I).

2.2.2 Emotional Engagement

Adapting the Fredricks (2005) Learning Engagement Scale for STEM career emotional engagement, the 6-item Likert scale included a reverse question, resulting in a Cronbach alpha of 0.751 for high reliability (Appendix II).

2.3 Experimental Design

This quasi-experimental study aimed to evaluate the impact of SVVR on two dependent variables: STEM Career Awareness and Emotional Engagement. The sample randomly assigned to an experimental group (26 students) and a control group (27 students).

2.3.1 Experimental Conditions

The experimental group experienced a modern garment factory through SVVR, contrasting with the control group's use of graphic media materials. Both groups were instructed by the same teacher for 50 minutes, with the experimental group's SVVR exposure limited to less than 15 minutes to prevent visual fatigue.

2.3.2 Experimental Procedure

A pre-test assessed baseline STEM career awareness and Emotional Engagement. Students then engaged in group activities using either SVVR or graphic materials. Post-test data collection included the STEM Career Awareness Scale, Emotional Engagement Scale, and in-learning guide sheets, facilitated by a snowball discussion method.

2.3.3 Learning Activity Design

In the 'If you are an engineer' activity, students experienced a two-stage learning process to enhance their understanding of the engineering profession. Initially, The experimental group explored garment manufacturing through SVVR, identifying issues and clarifying needs with interactive labels and audio. The control group, meanwhile, relied on graphic media materials for the same exploration. Both groups then transitioned to a discussion phase, where they collaboratively addressed engineering challenges and shared insights, aiming to deepen their knowledge and interest in the field.

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Designing a Method to Support Collaborative Learning that Incorporates Reflection to Promote Positive Belief in Collaboration

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Abstract

Japanese students have a low positive belief in collaboration, which may reduce the effectiveness of collaborative learning. Therefore, we must examine a method to support collaborative reflection during collaborative activities. This study aims to develop a method to support collaborative reflection during activities after students finish their activities to promote positive belief in collaboration. We will interview secondary mathematics teachers to develop a collaborative script for the method.

Keywords: collaborative learning, belief in collaboration, reflection

Introduction

Johnson et al. (1998) report that collaborative learning improves academic performance, interpersonal skills, and self-esteem compared to individual learning and learning with competition from others. Moreover, Nagahama et al. (2009) point out that learners may fully realize the effect of collaborative learning if they are sufficiently aware of the meaning and function of collaborating and helping others. However, the PISA 2015 survey reveals that few Japanese students think that "I can show my ability in collaborative work" and "I prefer collaborative work to work alone" (National Institute for Educational Policy Research 2017). From the above, we need to improve students' belief in collaboration.

Johnson et al. (1991) identify that teachers should include reflection time on group activities as a condition for creating an environment for collaborative learning. Sugie (2011) also states that students can rediscover the significance of collaboration and foster a positive attitude towards collaboration by including reflection time. However, students were less likely to reflect on their actions during activities to achieve the task in project-based learning (Ueda, 2017). Thus, we should support students to reflect on their actions during activities.

Collaborative scripts are one of the ways to support students' reflection, which provide scaffolding and guidance in completing collaborative learning activities (Popov et al. 2019). Wang et al. (2017) reported that collaborative scripts increased opportunities for students' reflection during activities. Therefore, we assume that collaborative scripts will support students' reflection on their actions after activities.

This study aims to develop a method to support collaborative reflection after activities are finished, promoting a positive belief in collaboration.

Research Designs & Methods

Alexander et al. (1977) developed the pattern language to help citizens with insufficient knowledge become involved in urban development. Even unfazed students can use pattern language to become more reflective on their actions since pattern language describes situations, problems, and solutions separately. Here, we refer to the pattern language structure used to develop collaborative scripts, which comprise three parts: situation, problem, and solution. We will interview secondary mathematics teachers to determine what activities support students' reflections. The interviews comprise the contents described in the mining interview pattern by Iba (2014):

1. What do you advise junior or new teachers when they will do the activity with their students?
2. Why is the point important, and what problems might arise if you do not follow it?
3. Under what situations can problems occur?

We will summarize the results of the interviews and develop a card-type collaboration script. After that, we will have students use it in collaboration reflection and verify whether students' positive belief in collaboration improve by using the cooperative work perception scale (Nagahama et al. 2009). At the conference, we will present the interview results.

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Developing The Self-Efficacy of Novice Programmers Through a Multiplayer Game

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Abstract

The growing demand for information technology such as artificial intelligence and robotics has led to an increased need for Computer Science (CS) graduates. Nevertheless, instructing students in programming continues to pose a major hurdle in CS education (Bennedsen & Caspersen, 2019), as newcomers to the field often face multiple obstacles in mastering programming skills. One of the key constructs related to the issue is self-efficacy, which refers to an individual's belief in their ability to succeed in specific situations or complete a task (Bandura, 1977, 1982, 1986, 1997). Studies have found that self-efficacy plays a vital role in academic achievement in CS courses (Steinhorst et al. 2020) and influences learners' effort and persistence in programming tasks (Lin et al. 2023). An effective strategy to enhance learners' self-efficacy is incorporating a game into programming practice activities. Previous studies have consistently reported that well-designed educational games can enhance learners' self-efficacy (Chase et al., 2021). Thus, this project aims to enhance the self-efficacy of novice programmers through a turn-based multiplayer coding game, as shown in Figure 1. A turn-based multiplayer game involves multiple players in an environment where players can either compete or collaborate with each other. As one player engages in a programming task within the game, fellow players have the chance to observe it, fostering opportunities for observational learning and social interaction among players. This approach not only helps reduce frustration, confusion, and anxiety that novice programmers commonly encounter during individual coding practices, but also promotes learners' mastery experience. Furthermore, Bandura (1977, 1982, 1986, 1997) identified four sources of self-efficacy: mastery experience, vicarious experience, verbal persuasion, and physiological and affective state in the formation of self-efficacy. Consequently, it is anticipated that a game environment to stimulate such experiences, i.e., observational learning, will positively contribute to the development of self-efficacy. In order to obtain a comprehensive understanding of the intervention trial, this study will utilize a mixed-methods quasi-experimental design with an explanatory sequential approach. A survey questionnaire will assess the impact of the educational intervention on learners' level of self-efficacy, while follow-up focus groups will explore how game features relate to participants' sources of self-efficacy. The data analysis will include a joint display that visually links quantitative and qualitative data to show the relationship between increases in self-efficacy measurement and sources of self-efficacy. By combining both quantitative and qualitative data, this study aims to draw new insights into the effectiveness of the game-based intervention.

Keywords: computer science education, game-based learning, programming, self-efficacy

Figure 1

A turn-based multiplayer coding game

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Roundtable Session2

Evaluating an Escape Room Metaversal Quest as a Teaching and Learning Tool for Undergraduate Students in an Open and Distance e-Learning

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This paper outlines the development and evaluation of a gamified Metaversal quest designed as a teaching and learning tool for instructional design theories within a three-unit undergraduate course at an open and distance e-learning university in the Philippines. Utilizing FrameVR, the researcher created a virtual escape room environment where students must solve instructional design-related challenges to progress through various levels and decipher a code that leads to a final quiz in the learning management system. The primary objectives were to assess the impact of the Metaversal Quest on student engagement and their attitudes toward the technology. The study involved 24 undergraduate students from an undergraduate program. Data collection included surveys measuring perceived engagement, technology acceptance, and attitudes towards technology use, supported by learning management system analytics. Findings indicated that students felt highly engaged with the course, with a mean engagement score of 4.33, and perceived the Metaversal Quest to significantly enhance this engagement (mean score 4.21). Strong positive correlations were found between perceived usefulness, ease of use, attitudes toward use, and behavioral intentions, supporting the Technology Acceptance Model. Despite the high perceived engagement, traditional LMS engagement metrics showed a weak correlation, suggesting a need for more comprehensive engagement measures that capture cognitive, emotional, and behavioral dimensions. This study concludes that gamified learning environments like the Metaversal Quest can boost student engagement and positive perceptions of learning in distance education settings. However, further research with larger, more diverse samples and a mixed-methods approach is recommended to validate these findings and refine the gamification strategies for broader educational contexts.

Keywords: educational metaverse, gamification, immersive learning, immersive media, metaverse learning

Introduction

Gamification has been increasingly used in education to enhance student engagement and learning outcomes by integrating game mechanics into non-game contexts. This study explores the use of a Metaversal Quest, a gamified virtual reality experience mimicking an escape room game, to teach instructional design principles to undergraduate students at an open and distance e-learning university. The Metaversal Quest was designed using FrameVR to create an immersive environment where students must solve problems to progress through levels.

Research Design & Methods

The study employed a quantitative approach to investigate how the Metaversal Quest impacted students' perceived engagement and attitudes toward technology use. Participants included 24 undergraduate students who chose between a regular learning path and a gamified path involving the Metaversal Quest. Data was collected through surveys on perceived engagement, technology acceptance, and attitude towards technology, along with LMS analytics. Descriptive statistics and non-parametric tests were used for data analysis.

Results

Engagement: Students reported high engagement with the course (mean score 4.33) and felt that the Metaversal Quest significantly contributed to this engagement (mean score 4.21). The Spearman's correlation test showed a strong positive relationship between perceived engagement and the use of the Metaverse (Spearman's rho=0.674, $p<0.001$). However, there was a very weak negative relationship between perceived engagement and total LMS engagement (Spearman's rho=-0.033, p=0.880).

Technology Acceptance: The survey results indicated high scores for perceived usefulness (mean = 4.091) and attitude towards use (mean = 4.227). Strong positive correlations were found between perceived usefulness, attitude towards use, and behavioral intention to use the technology. These results support the Technology Acceptance Model, suggesting that students who find the Metaversal Quest useful are more likely to have a positive attitude towards it and intend to use it in the future.

Perceived Engagement vs. Behavioral Intention: There was a moderate positive correlation (Spearman's rho=0.425, p=0.048) between students' perceived engagement with the course and their behavioral intention to use

the Metaversal Quest. This suggests that higher engagement levels can lead to greater acceptance and usage of educational technologies.

Discussion

The study's findings indicate that the Metaversal Quest can significantly enhance student engagement and positive perceptions of learning in a distance education setting. The high perceived engagement and positive attitudes towards the Metaversal Quest align with existing literature on gamification and educational technology. However, the weak correlation between perceived engagement and LMS interaction metrics suggests the need for more comprehensive measures that capture cognitive, emotional, and behavioral dimensions of engagement.

Conclusion

The Metaversal Quest has the potential to boost student engagement and positive perceptions of learning in distance education. Despite limitations such as small sample size and lack of diversity, the findings provide preliminary evidence supporting the effectiveness of gamified learning environments. Future research should include larger, more diverse samples and mixed-method approaches to validate these findings and refine gamification strategies for broader educational contexts.

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International Exchange Activities between Cambodian and Japanese School Students to Foster Mutual Understanding

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This study explores an exchange learning program between an after-school in Japan and a primary school in Cambodia. Aimed at improving English skills and broadening perspectives, the program involves field research with local educators to develop sustainable, mutually beneficial exchanges. Leveraging relationships with graduates from a teacher training college in Siem Reap, the program includes online meetings supported by letters and video messages. Initial activities revealed low interest among Japanese students, contrasting with the enthusiasm of Cambodian students. Weekly sessions improved preparation and engagement, highlighting the need for prior education and participant involvement. Future research will examine how diverse backgrounds influence international exchange

Keywords: Exchange Learning Program, Cultural Differences, Sustainability, Cambodia

Introduction

International understanding education has been increasingly implemented in many schools (e.g., Fujimoto, 2021). Due to the impact of the COVID-19 pandemic, online exchanges have become more feasible, leading to various initiatives for online exchanges with overseas schools. Through these activities, there are expectations for enhancing children's abilities and qualities (e.g., Kimura, Kurokami, & Taniguchi, 2020). Based on this background, considering requests from schoolchildren, I am currently planning an exchange learning program between an after-school program in Japan and a primary school in Cambodia. The purpose of this exchange is not only to improve English skills but also to allow children of the same generation living in different countries to broaden their perspectives by learning about each other's lives. I am considering specific methods of exchange between Japanese and Cambodian primary school students, requirements for sustainability, and initiatives that will produce mutually beneficial impacts.

Methodology

Field research will be conducted in collaboration with local educators to establish specific exchange programs. Relationships were built with graduates from a teacher training college in Siem Reap, Cambodia, during our university years. I visited the area and interacted with primary school students in February of both last year and this year. Leveraging these existing relationships, I have decided to implement our project plan in May and August. The online collaboration meeting using Zoom is planned, but primary school students who are not native English speakers will need some support to interact effectively. In fact, the importance of preparation in cultural exchange education has been emphasized in previous studies (e.g., Imai, Shinagawa, & Nohata, 2009). Therefore, I plan to exchange letters and video messages prior to the Zoom meetings. Furthermore, I aim to reflect on the outcomes of the May exchange to improve the interactions in August.

Results and Discussion

Preparatory Activities

During the preparation period for the online collaboration meeting in May, I organized a series of activities to deepen Japanese elementary school students' understanding of Cambodia. These activities included informational sessions about Cambodia, gift-making, and video letter creation. Initially, we conducted quiz-based activities, but some participants showed low interest or negative reactions towards Cambodia. During the gift preparation phase, there was a noticeable difference in motivation among the participants.

Online Exchange

The online collaboration meeting itself had fewer participants than expected, and some of them reacted with

statements like "This is boring!" and "I don't want to do this." In contrast, the Cambodian students were eager to participate and engaged with smiles. This difference may be due to variations in the children's backgrounds and daily lives.

Post Activities (or Reflection)

The post-exchange reflection highlighted the low interest of Japanese elementary school students in international exchanges. To prepare for the August exchange, I designed a more effective program based on our previous experiences. I conducted weekly sessions to enhance understanding of Cambodia, allowing all participants to prepare adequately. By fostering an environment where students could teach and learn from each other, interest and participation levels improved, leading to higher-quality interactions. This experience demonstrated that successful cultural exchange programs require prior education and engagement of participants. Additionally, further research is needed to understand how differences in participants' backgrounds and daily lives affect their approach to international exchanges.

Online Exchange

The online meeting had fewer participants than expected, with some reacting negatively. In contrast, Cambodian primary school students were eager and engaged with smiles and cheerfulness. This difference may stem from variations in backgrounds and daily lives. Approximately 40 students participated on the Cambodian side, as it was conducted in a classroom setting. Analyzing the footage filmed in Cambodia, almost all the children were focused, listening attentively to the online explanations, and reacting enthusiastically. In contrast, the Japanese primary school children appeared more reserved, possibly due to shyness. There seemed to be a noticeable difference in the level of expectation and enthusiasm for the exchange learning between Cambodian and Japanese children, but I plan to analyze the details further in the future.

Post Activities and Preparation for the Next Stage

Post-exchange reflections revealed Japanese primary school students' limited interest in international exchanges. For August, I've planned weekly sessions to deepen understanding of Cambodia, fostering an environment where students teach and learn from each other. This experience emphasized the importance of prior education and engagement. Recent efforts to respect Japanese primary school students' autonomy and emphasize collaborative preparation have increased Japanese primary school students' sense of ownership. These changes lead me to anticipate greater enthusiasm in the August sessions, aiming to bridge gaps between Cambodian and Japanese primary school students.

Conclusion

This exchange program underscored the importance of mutual cultural learning between Japanese and Cambodian students. Challenges faced during initial preparations led to a more effective program for August. Creating an environment where participants could teach and learn from each other increased interest and participation. Moving forward, research is needed to explore how diverse backgrounds and daily experiences influence approaches to international exchanges. This initiative highlights the critical role of education and preparation in successful cultural exchange programs.

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Exploring Self-Reliance through the Internet: The Case of Myanmar Refugees in Japan

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Abstract

Refugees in Japan have historically received both public and private support to adapt to life in the country. However, in recent years, the accessibility of necessary information through the Internet has transformed the lives of refugees. For example, Kishi & Aoyama (2021), who studied the lives of Syrian refugees who evacuated to Turkey, reported how Syrian refugees were living self-reliantly, using the Internet, building communities, and helping each other. They claimed that Syrian refugees in Turkey used the Internet to live self-reliantly and support each other. Non-Turkish-speaking Syrians used a smartphone to have a Turkish-speaking Syrian friend interpret and give directions to a taxi driver. Similarly, Asano (2024) reported that Ukrainian refugee children in Japan attended school online in their home country and that workers used the Internet to live self-reliantly, using their native language and skills.

In this way, even without public or private support, they can live firmly on their own, keeping their advantage of the Internet environment, building their relationships, and living self-reliantly. From this perspective, self-reliance is not an ability inherent in the individual. It is seen as the ability to contribute to society by maximizing one's abilities in the relationships between people and the environment. This indicates that having access to only the Internet does not guarantee self-reliance. Kishi & Aoyama (2021) noted that the refugee knew the geography well enough to direct the cab driver and that his friend had a phone-enabled work environment. Galynska & Bilous (2022) noted that less than a month after the war began, the Ukrainian governments and educational organizations set up Internet-based learning environments to enable displaced students to continue their studies in various locations. Therefore, analyzing how people connect to the Internet and achieve self-reliance is essential, considering the complex interrelationships of individual, technological, and organizational factors.

To further understand these dynamics, this study will interview a Myanmar refugee, X, who came to Japan as a refugee and has been living a self-reliant life there for an extended period. X came to Japan in the 1990s, when the Internet was not widespread. He is the central person who established a mutual support network to help people in the same situation become self-reliant.

Therefore, this research aims to clarify how refugees became self-reliant in their living environment. In addition, this study will focus on how the development of the Internet since the 1990s has affected him as a living environment. The results of the analysis will be presented in detail at the conference.

Keywords: Internet, Refugee, Self-reliance

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International Exchange Program and Borderless Collaborative Learning in Expanding with ICT

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Abstract

ICT has advanced, distances between countries have been reducing, which has enabled easy information sharing and communication at any time and from any location, through advances in technology like gadgets such as smartphones which are now owned by the majority of people. Furthermore, the rapid proliferation of internet conferencing innovations amidst the COVID-19 pandemic has ultimately contributed to increased utilization both domestically and on an international scale.

From the standpoint of international exchange, these advancements in ICT establish a conducive environment. Faced with challenges such as uncertain prospects for school visits and face-to-face activities as a result of the COVID-19 pandemic, we have been conducting "International Exchange Collaboration facilitated by ICT Platforms." This study aims to leverage the experiences gained during the COVID-19 pandemic and to present findings on the practice of "International Inquiry-Based Learning," proactively taking full advantage of the beneficial effects of face-to-face and ICT-online interactions.

Keywords: exchange learning, inquiry-based learning, international collaboration, qualitative research

Collaborative Process

1. Collaborative Process during the COVID-19 pandemic

In 2020, we faced the COVID-19 pandemic. We faced the challenge of whether or not we would be able to implement the international exchange programs that we had been approaching face-to-face. However, based on the motto "Education Never Stops," International Collaborative Learning also continued with the COVID-19 pandemic through the use of Zoom.

Team Building for International Collaborative Learning:

We had each student give a presentation introducing themselves and their culture via Zoom. Daily interactions among students through “SNS (LINE)," which started with a student-to-student approach, effectively enhanced the team building process. SNS became an easy way for Japanese students unfamiliar with English to communicate with each other, helping to build a relationship that facilitated discussion (Fig. 1).

Fig. 1 Students’ Use of and Invitations on SNS

Speech Training for English Presentation in World Youth Meeting:

Students collaboratively present what they have learnt through homestays in Japan and the Philippines in an international presentation competition WYM (World Youth Meeting). The international presentation competition requires presentations in English. This is a challenging activity for Japanese students.

Many Japanese students need help in presenting in English because they have few opportunities to speak in English in their daily lives. We conducted student-centered English speech training utilizing Zoom breakouts. The Filipino students who teach try to

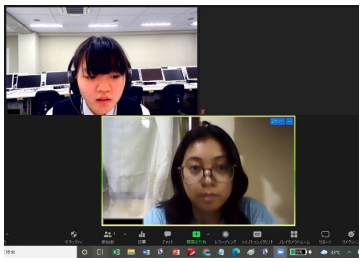

Fig. 2 Student-Centered English Speech Training via Zoom

make comments in “easy-to-understand (English) expressions,” while the Japanese students who are taught make an effort to “communicate accurately” using unfamiliar English. This simple speech training naturally led to deep collaborative learning (Fig. 2).

2. Collaborative Process after the COVID-19 Pandemic

We have gained much experiential knowledge through international exchanges based face-to-face before the coronavirus pandemic and through international exchanges centered on ICT during the COVID-19 pandemic. We thought that this experiential knowledge would allow us to evolve the international exchange program, which tends to be eventful and singular, into an ongoing activity throughout the year.

Hybrid Type of International Exchange Conference:

The experience of the ICT-centered international exchange program during the COVID-19 pandemic has led to the organization of a hybrid international exchange conference, GLOBAL MEETUP, in 2021. ICT allows us to create learning environments that transcend distance and time constraints. Students and teachers from the Philippines, Japan, Taiwan and Cambodia participated in the GLOBAL MEETUP, which took advantage of these features (Fig. 3).

Fig. 3 GLOBAL MEETUP

Results and Discussion

Nihon Fukushi University Affiliated High School hosted a hybrid international exchange conference called Global Meetup, with participants from the Philippines, Japan, Taiwan, and Cambodia, which was made successful because of the host experience with ICT-centered international exchange programs. Through Zoom, students showcased their culture, and regular conversations on the social networking site LINE improved teamwork by promoting relationships and communication amongst Japanese students who are unfamiliar with English. Furthermore, the event's focus on ICT-centred international exchange contributes to ongoing international exchange throughout the year.

Many Japanese students require assistance since they have few opportunities to use English in daily life. A student-centered English speech training using Zoom breakouts enables students to express accurately in unfamiliar English, resulting in deep collaborative learning.

Conclusion

ICT enables accessibility for individuals in the same country or those in a different one, transcending limitations of place and time. However, in-person or face-to-face communication is an excellent one that overcomes language barriers. Real-time engagement is experienced, there is less room for distractions, language and communication skills are improved, and connections with others from diverse backgrounds are made possible.

In order to give students better educational chances, the researchers would like to further collectively design SDGs for international collaborative inquiry-based learning while utilizing the advantages of both ICT and in-person engagement.

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Development and Impact Exploration of a Prompt Engineering Education Program for Middle-aged Women Pursuing Career Transition

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Abstract

This study aims to explore the impact of a prompt engineering education program for middle-aged women pursuing career transitions. Based on Richey and Klein (2005) and Moussa (2024), the program consisted of 12 sessions covering generative AI concepts and prompt engineering, including practical exercises. The data from learners who participated in a job training course at the D Center in Seoul were analyzed. A mixed-methods analysis was performed on learners' perception, satisfaction, trust, and improvement suggestions for generative AI. As a result, firstly, learners perceived generative AI as useful for tasks, information search, and skill enhancement, especially in educational contexts. Secondly, they evaluated AI responses as systematic and content-rich, highlighting high satisfaction with increased efficiency and knowledge range. Thirdly, learners viewed AI responses through prompt engineering as logical and trustworthy. Finally, the program was seen as highly useful, with prompt engineering recognized as a key tool for work and education. This study provides insights for designing learner-centered curricula and improving the program for middle-aged women's career transitions in the AI era.

Keywords: career transition, generative AI, middle-aged women, program development, prompt engineering

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Development and Evaluation of Modeling-Related Problem Posing Classes Aimed at Acquiring Mathematical Modeling Competencies

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Abstract

Recently, mathematics education has begun to reflect the increased emphasis on mathematical modeling as students must have mathematical modeling competencies.

Mathematical modeling is a method of problem-solving by mathematizing real-world problems and viewing them as problems in the mathematical world. However, mathematical modeling is insufficient for problem solving alone. Then, problem posing has also been attracting attention.

In this study, we developed and evaluate a class for students to improve mathematical modeling competencies, focusing on mathematical modeling and problem posing.

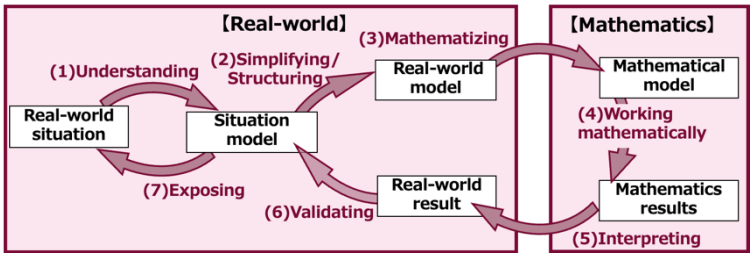
Keywords: Mathematical modeling, Problem Posing, Mathematical modeling competency

Introduction

Recently, mathematics education has begun to reflect the increased emphasis on mathematical modeling as students must have mathematical modeling competencies (Cai et al., 2014). Ikeda & Yamazaki (1993) defined mathematical modeling as a method of problem-solving by mathematizing real-world problems & viewing them as problems in the mathematical world. According to Blum & Leiß (2007), an ideal solution for mathematical modeling consists of a seven-step cycle: (1) understanding, (2) simplifying and structuring, (3) mathematizing, (4) working mathematically, (5) interpreting, (6) validating, and (7) exposing (shown in **Figure 1**). However, Leiß (2008) states that the actual process is usually not so linear. Schukajlow et al., (2015) define mathematical modeling competencies as the ability to carry out the above process.

Figure 1

Seven-step cycle for mathematical modeling (Created based on Blum & Leiß 2007)



However, Hartmann et al. (2023) point out that most mathematical modeling studies provide real-world problems and have students solve them. They point out that a process of problem discovery should be included in mathematical modeling activities, as problems are discovered and solved in a real-world.

A suitable process of problem discovery in mathematical modeling is problem posing. Problem posing is an activity in which students create problems (Silver, 1994). Hashimoto et al. (1996) state that students must discover a problem in problem posing. Learning to create a problem from a real-world situation and using the created problem to do mathematical modeling is called modeling-related problem posing (Hartmann et al., 2023). Hartmann et al., (2021) presented high school students with a real-world situation and asked them to create a problem and a solution. They suggest this may be useful for developing mathematical modeling competencies. However, no quantitative assessment of mathematical modeling has been carried out, and the impact of posing modeling-related problems on mathematical modeling competence needs to be investigated. Therefore, this study aimed to develop and evaluate a lesson on modeling-related problem posing to improve mathematical modeling competence. To achieve the research objectives, we carried out classroom practice. The lesson content is described below.

Research Design & Methods

To achieve the research objectives, we carry out classroom practice. The lesson provides support for the mathematical modeling step, which has been deemed particularly difficult in previous research. First, we present the students with a real-world situation. After that, we then ask the students to carry out an individual activity. We ask the students to read the real-world situation and give them instructions to (1) understand and (2) simplify and structure the steps of mathematical modeling, such as "What data can be calculated?" Next, give instructions such as "Create a mathematical problem and solution" and "Make it realistic" to encourage (3) mathematizing, (5) interpreting, and (6) validating the mathematical modeling steps.

It is expected that the above classes will improve mathematical modeling competencies. At the conference, the topics covered in class and the problems created by the students are presented and their mathematical modeling competencies are assessed.

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Formative Design and Development XR based Simulation for CPR Training

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Abstract

Cardiac arrest is a life-threatening condition that can occur suddenly and without warning, leading to a complete cessation of the heart's functioning. It is a significant cause of death worldwide, and every year, thousands of cases are reported (Gugelmin-Almeida et al., 2021). In light of this, healthcare students and the general public must be familiar with the cardiopulmonary resuscitation (CPR) process, which involves chest compressions to restore blood flow and oxygenation to the body (Birkun et al., 2021). Knowing how to perform CPR can make a significant difference in the outcome of a cardiac arrest and can potentially save someone's life.

The approach to CPR training primarily focuses on procedural learning. This type of learning is essential for trainees to understand and execute the necessary steps efficiently (Lauridsen et al., 2022). In other words, it is crucial to provide context for learning. Therefore, to enhance the effectiveness of CPR training, incorporating extended reality (XR) into procedural learning creates a realistic and immersive environment. With XR, learners can repeatedly practice procedures in a controlled yet lifelike setting (Chernikova et al., 2020). It effectively bridges the gap between theoretical knowledge and practical skills, allowing trainees to experience the urgency and complexities of real-life scenarios without any risks. As a result, this study aims to develop a CPR training simulation by incorporating XR interactions and evaluating its effectiveness.

This research study utilized a formative design approach to develop new CPR training simulations—the initial stages involved thoroughly analyzing existing CPR simulations to identify their strengths and weaknesses. The design process then included wireframing, storyboarding, and paper prototyping to create the structure of the training modules. The designs mainly focused on 3D space and included XR interaction components. Additionally, feedback from experts and potential users was integrated to refine the prototypes. In the final phase, functional prototypes were developed based on the designs and ready for practical application and further evaluation.

This study applied extended reality (XR) technologies to create immersive and interactive learning experiences tailored for CPR training. By aligning XR interactions with advanced learning experience design, the training is comprehensive but also intuitive and engaging. This approach is anticipated to significantly enhance learning, ensuring that individuals are better prepared to perform CPR in real-world emergencies.

Keywords: cardiopulmonary resuscitation, extended reality, procedural learning, immersive learning environment, formative design

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Designing Inquiry Learning with Mathematical History to Foster Students' Epistemic Curiosity

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Abstract

Arousing epistemic curiosity is one of the main goals of instruction. Epistemic curiosity is aroused when a knowledge gap occurs. One of the methods of learning that causes a knowledge gap is Researcher-Like Activity (RLA), which is one of the methods of inquiry learning, and it has been pointed out that the process of discovering a problem should be experienced as a task of adapting RLA to junior high school students. In this study, we designed an inquiry learning lesson using the history of mathematics to arouse epistemic curiosity in secondary education mathematics departments and verify their effectiveness.

Keywords: Inquiry-Based Learning, Epistemic Curiosity, History of Mathematics, Mathematics Education

Introduction

Arousing students' epistemic curiosity in the classroom is one of the main goals in academic instruction (Murayama et al. 2019). Epistemic curiosity refers to the desire that motivates behavior to explore knowledge and information (Peterson and Cohen, 2019). Uebuchi and Oashi (2019) identify a situation in which epistemic curiosity is aroused as when a knowledge gap occurs. A knowledge gap is a discrepancy between previously learned content and unlearned content such as new questions, complex ideas, or unsolved problems (Litman *et al.*, 2005).

Inquiry learning is a type of learning in which students construct new knowledge through new experiences based on their existing knowledge and past learning experiences (Panaoura, 2016). Ichikawa (1998) proposed Researcher-Like Activity (hereafter RLA) as a method of inquiry-based learning. RLA refers to learning activities in which the researcher's activities are imitated at the learner's level. One of the challenges of implementing RLA for junior high school students is that it is difficult for them to discover mathematical questions like mathematicians (Kobayashi and Irei, 2018). Lessons using the history of mathematics allows students to learn the process of inquiry mathematics (Kjeldsenc, 2016).

In this study, we design inquiry-based learning using the history of mathematics to stimulate epistemic curiosity in secondary education mathematics and verify their effectiveness.

Research Design and Methods

We designed a on the proof of Pythagoras'theorem using Wasan, a subject from the history of Mathematics. Wasan is a type of mathematics that developed in Japan during the Edo period. Table 1 shows the flow of this lesson, which incorporates the history of mathematics into RLA. Hori and Irei (2015) point out that the affinity between Wasan and the activities of mathematicians means that the activities of researchers are set in a natural context for students. Therefore, it is believed that using Wasan will make it easier for students to explore mathematics as researchers.

The designed lesson will be implemented in a workshop fir first and second year junior high school students. We then ask participants to answer a questionnaire on epistemic curiosity, inquiry-based learning using of history mathematics. At the conference, we plan to present the results of our analysis of the data obtained from the questionnaire survey and the lessons we have designed.

Table1
Mathematicians' activities in RLA and learning activities in this program

	Activities of mathematicians at the RLA	**Activities of this program**
1	Activities to construct problems	Introduction to proofs using Wasan Proof using "Tachiawase" Proof using "Genzu"
2	Activities to construct solutions	Proof of Pythagoras' theorem
3	Activities to express results	Each group summarizes their proof method, makes a presentation
4	Peer evaluation and sharing activities	Question-and-Answer session, Reflection

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A Systematic Review About Analysis of Challenges and Success Factors for Implementing OER in K12 Education

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Abstract: This study systematically reviews literature up to 2024 on implementing Open Educational Resources (OER) in K-12 education, identifying current challenges and success factors. While OER enhances educational digitalization and access to materials, it also presents technical and organizational challenges. This research aims to inform educational policy decisions and optimize OER use in K-12 education.

Keywords: K-12 education, OER, systematic review, Open Educational Resources

Introduction

Background

In recent years, advances in information technology have highlighted the potential benefits of Open Educational Resources (OERs). UNESCO (2002) defines OERs as 'The open provision of educational resources, enabled by information and communication technologies, for consultation, use, and adaptation by a community of users for non-commercial purposes,' essentially making educational resources accessible to all. Tang (2020) notes the increasing use and demand for OERs in both K-12 and higher education, while Hilton (2019) emphasizes the need to promote OERs in primary and secondary education to enhance accessibility in the digital era.

Research Design & Methods

Inclusion and Exclusion
To ensure this systematic review's relevance and quality, inclusion criteria were established to focus on studies explicitly addressing OER in K-12 settings.
The inclusion criteria for the study were as follows: articles written in English, involving primary or secondary school students or teachers, peer-reviewed, with full-text availability, and with OER (Open Educational Resources) as the main subject. Studies focused on higher education or published in other languages were excluded.
Boolean logic
Next, Boolean logic was used for keywords for the search. For the topic of OER, the keywords used were "open educational resources" or "OER" or "open access." For the education mode, the keywords included "primary school" or "elementary school" or "primary education" or "high school" or "k-12" or "elementary education" or "secondary education."
Review process
On this basis, the research performed the PRISMA review process (Figure 1), including identification, screening, qualification and analysis. After several rounds of screening, 38 papers meeting the standard were eventually retained.

Results and Discussion

The analysis draws on the review papers of Otto et al. (2021) and Tlili et al. (2022). Therefore, in this paper, various factors such as technological and organizational challenges, research methodologies, related concepts, primary research subjects, future challenges, and publication trends are focused to analysis.
Concerning the research methods used in the studies on implementing OER in K12 education, qualitative methods are prevalent, accounting for 44.7% of the studies. In comparison, quantitative methods make up 28.9%, and mixed methods are used in 26.3% of the studies (Table 1). These findings indicate a preference for in-depth, context-specific insights into OER implementation. Future research should explore underrepresented areas, such as the impact of OER on student outcomes and teacher practices, and address identified challenges to enhance the effectiveness of OER in K-12 education.

Figure 1
Literature selection process

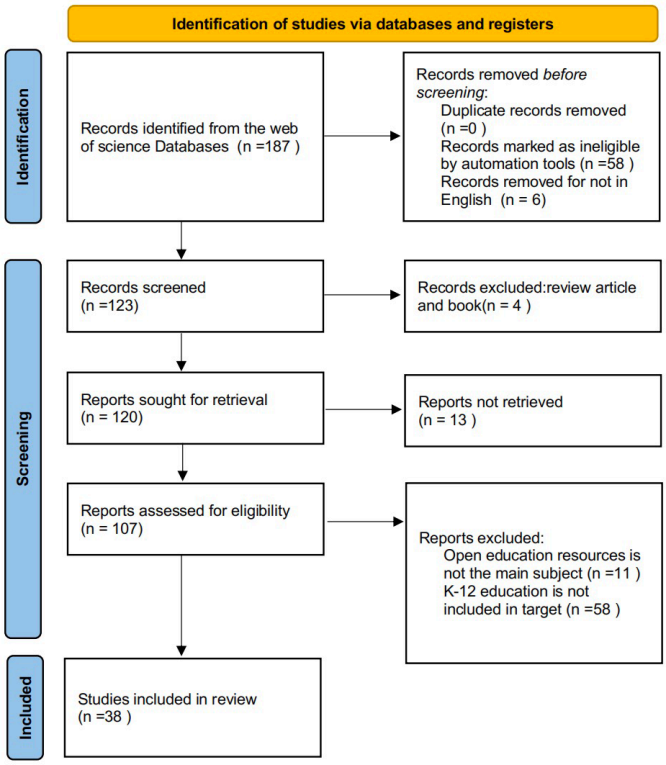

Table 1

Distribution of studies by research method

Research method	quantity	%
Quantitative	11	28.9%
Qualitative	17	44.7%
Mixed Methods	10	26.3%

Through this study, we will identify current and future research trends and changes in research on OER in elementary and secondary education. The study also aims to provide insight into educational policy decision making and effective use of OER in primary and secondary education.

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Theoretical Review and Educational Frameworks of Rubrics

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Abstract

Rubrics gained attention as a suitable method for assessing complex and qualitative learning activities, such as those in "Integrated Studies" formally introduced in elementary and junior high schools in 2002 (Kawai, 2003). They have since been widely recommended as a means to achieve more objective/intersubjective evaluations. In recent years, rubrics have been adopted to enhance the fairness, objectivity, and rigor of performance evaluations. However, interpretations of rubrics vary widely among educators and researchers, and their definitions remain ambiguous, leading to the needs of extensive research on their development and classroom implementation. This study aims to systematically organize the definitions and theories of key rubric researchers, providing a foundation for further investigation. Additionally, it discusses the historical background of rubrics in education and important elements such as intersubjectivity in rubrics. While examining how educators utilize rubrics based on practical experiences is a future goal, this paper focuses on establishing the groundwork for such studies by highlighting the significance of clear and consistent evaluation criteria.

Keywords: Rubrics, Educational Assessment, Performance Evaluation, Theoretical Review, Evaluation Standards

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Analysis of the Influences Contributing to the Achievement of Social Independence by Former School Refugee

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Abstract

Currently in Japan, school refugee has been increasing for 10 consecutive years and has become a problem. Therefore, in 2019, the MEXT added social independence to the goal of support for school refugee, which used to be only return to school. However, many studies on school refugee still focus on returning to school, and few papers focus on achieving social independence. Therefore, I decided to investigate the issues, conditions, and appropriate support for achieving social independence. The method used was to interview those who had experienced school refugee at the compulsory education stage and had achieved social independence, and to analyze their experiences up to social independence using TEA. The results of the analysis using the TEM diagram showed that changes in the environment and encounters with other people had a significant impact on social independence. The three-tiered structuring also revealed that the character of making efforts for the sake of those around them who cooperate with them also influenced social independence.

Keywords: compulsory education, School Refugee, Social Independence, TEA, TEM diagram,

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Research trends in Design and Development Research(DDR): A review of publications in ETR&D and BJET journals from 2012 to 2023

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Abstract

The development of various sciences and technologies has prompted educational technology researchers to investigate the most effective means of addressing educational issues through the integration of diverse technologies and pedagogical theories. Among the various research methodologies, Design and Development Research(DDR) offers a systematic and rational approach to identifying practical and viable solutions to educational challenges(Richey & Klein, 2014). Some fields have garnered significant attention from researchers due to their ease of implementation and popularity, while others may have been overlooked. To identify which areas have been neglected or extensively studied, we conducted a systematic literature review on design and development research methods. We have chosen to review the two most authoritative journals in this field: ETR&D and BJET. The research process followed the PRISMA protocol. Initially, 574 papers were searched and according to a specific screening criterion, 166 papers were selected for final analysis. Both descriptive statistical and keyword analysis methods were used for result analysis. The results provide insight into the application trends of design and development research methods on an annual basis and facilitate an understanding of the specific research methods employed in existing research. Additionally, the differences in the main keywords displayed in the research were examined. This will provide direction and basic information for future educational technology research.

Keywords: design and development research, keyword analysis, research trends

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The Effect of Using a To-Do List on Reflection Time

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Abstract
(Heading 1: Garamond, 13pt, Center, Bold)

This study proposed a learning method using To-Do list to facilitate students to engagement and reflect was examined in reflection time at classes. The effectiveness was analyzed from three viewpoint: the quantity of tasks written in each section of the activity, the rate of tasks deleted each hour, and the tasks that remained undeleted until the end of the activity. The findings of the survey are as follows. First, using To-Do list stimulated the students' awareness of the stage of activities in the unit. Second, using To-Do list continuously enabled students to use this learning method effectively. Finally, the teacher's support for reflection using To-Do list was examined by analyzing the tasks that remained undeleted until the end of the activity. And the tasks that remained undeleted were grouped into eight categories. For making students use this learning method more effectively, teachers should guide them to write tasks based on the issues written in their reflections. The guidance includes to refer other students' reflection, write using more concrete words, and so on. In the future, the research needs to be carried out to identify how descri

Keywords: Self-regulated learning, Self-regulation, To-Do list, Field research

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Feedback teaching supported by intelligent agents on programming performance the impact of cognitive adjustment

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Abstract This study delves into the specific impact of Large Language Models (LLMs) as intelligent agents on programming performance and cognitive adjustment in supporting programming teaching processes. Large language models, such as GPT and ERNIE Bot, have shown great potential in many fields due to their powerful language understanding and generation capabilities. Especially in the field of programming education, big language models, as intelligent agents, can provide personalized learning feedback in real time, helping learners to master programming skills more effectively.

Keywords: LLM, Cognitive, Programming performance

Introduction

Programming, as the "New Literacy" of the 21st century, has become a hot topic in global basic education. Since 2016, Finland has required the implementation of mandatory primary school programming education. According to a report released by Eurpean Schoolnet in 2015, nearly 20 EU countries have already or will soon include programming education in their curriculum systems (Kang Jianchao, 2021). The New Media Consortium (NMC) in the 2017 Horizon Report (Basic Education Edition) pointed out that programming, as a professional competency, will gradually become a key element driving the development of basic education in the next 1-2 years (2017). China also released the "New Generation Artificial Intelligence Development Plan" in 2017, proposing to promote programming education in primary and secondary schools, set up artificial intelligence related courses, and encourage social forces to participate in the development and promotion of entertaining programming teaching software and games (2017). However, at present, the practice and research of children's programming education in China are still in the early stage of development, mainly promoted and practiced by industries and enterprises. The curriculum system of programming education in primary and secondary schools has not yet been established, and there is a severe shortage of formal programming education teachers. The standardized teaching material system and mature teaching mode are still being explored. Most programming education research still emphasizes that teachers act as factual narrators, using oral, courseware, or blackboard writing to instill in children long established and unquestionable programming concepts and principles (Sun Yuehan, 2022). Moreover, most of the research on Python learning in China is focused on high school and college students, while programming research in primary and secondary schools mostly focuses on Scratch graphical programming (Wang Xiuying, 2013; Pan Peijun et al., 2018), maker education (Yu Baodong, 2017), and the value orientation of youth programming education (Wang Rongliang, 2017). Internationally, there is a greater emphasis on empirical research in youth programming education. Researchers have developed platforms to facilitate learners' hands-on experience of artificial intelligence principles and applications (Vartiainen et al., 2020). For example, Kahn et al. used the programming environment ToonTalk to teach the mathematical concept of "infinity" to elementary school students aged 9-13 (Kahn, 2011). Looking at the existing research on adolescent programming education both domestically and internationally, although the research areas and emphasis are different, they all attach great importance to the study of programming education.

Cognitive adjustment refers to learners consciously adjusting and managing their cognitive resources and strategies based on the nature of the task and their own cognitive needs during the learning and task execution process, in order to improve learning effectiveness and task completion ability. It involves how students monitor, evaluate, and adjust their learning methods, thinking strategies, attention allocation, and memory strategies to adapt to different learning tasks and goals. Self regulated learning is considered a comprehensive and holistic approach that influences students' learning, such as self-efficacy, academic performance, and willpower (Yoon et al. 2014; Zimmerman et al. 1996); For example, Schunk and Zimmerman (1996) pointed out that self-regulation ability may affect learners' intrinsic mastery goals, self-efficacy beliefs, and learning achievements. However, research has shown that learners are not always able to successfully adjust their learning and often require various forms of support during the learning process (Yoon, Anderson, Park, Elinich,&Lin, 2018). As self-regulation processes typically occur under the joint influence of students and other regulatory sources in the learning environment (such as teachers, peers, interventions, course materials, and assessment tools), students' cognitive adjustment is a mutually coordinated problem (Volet al., 2009; Allal, 2019). Therefore, in the teaching process, teachers should help students Collaborate together to improve their cognitive load. Upon reviewing most studies, it is found that few have combined cognitive load with cognitive adjustment, and only a few have studied collaborative regulation of learning. Therefore, this study

attempts to explore how cognitive adjustment affects the programming performance of primary school students and provide new ideas for programming teaching.

Research Design & Methods

(1) Participants

The participants came from a public primary school in Ouhai District, Wenzhou City, Zhejiang Province. The study used a random sampling method and selected 60 students in fifth grade, divided into an experimental group and a control group. The participating students had almost no exposure to large language models and Python programming. In addition, this study was approved by the school, class teacher, subject teacher, and myself.

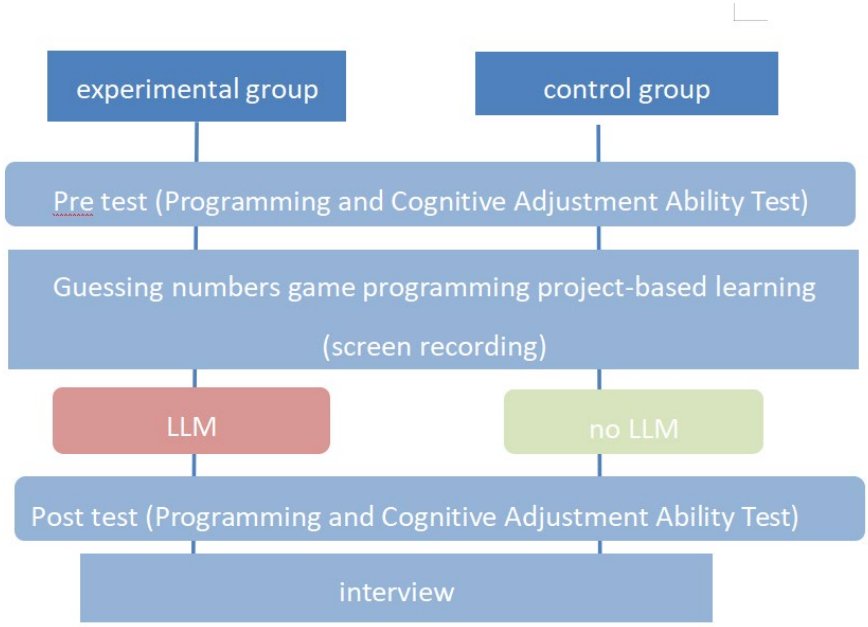
(2) Experimental Design: Teaching Content and Activities

This experiment is conducted in the information technology expansion course of fifth grade primary school. Select two classes with similar levels, and use students from one of them as the control group for project-based learning without intelligent agent support; A class of students serves as the experimental group and adopts project-based teaching supported by intelligent agents. Before class, students are introduced to the functions and basic operations of intelligent agents and Python 3.8.1, and the entire process of using intelligent agents is recorded on screen during the teaching process. In addition, this study intends to conduct a pre-test of students' programming scores and cognitive adjustment abilities before the experiment, and then conduct a post test of students' programming scores and cognitive adjustment abilities through a scale after completing the experimental course.

The data analysis results are not yet organized, and will be explained in detail when reporting. Thank you!

LLM

no LLM



How can students improve data literacy: Developing and Applying the Instructional Systems Design Model for a Cross-Curricular AI Convergence Class

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Abstract

As the need for cross-curricular classes to cultivate creative convergence talent and the need for cross-curricular AI convergence classes have been emphasized, continuous attempts have been made to implement "AI convergence between subjects" classes. In particular, there is a need to design such classes focusing on data, which is the foundation and core of artificial intelligence. However, current educational practices lack effective cross-curricular AI convergence classes to enhance data literacy due to insufficient methods and guidelines. This study aims to develop an easily applicable instructional design model and verify its validity. Using the model research method from design and development research, a final model with seven stages was developed: forming a council among cooperating teachers, analyzing, designing, usability test, development, implementation, and summative evaluation. Based on this model, a Korean language teacher and a informatics teacher designed and implemented a cross-curricular AI convergence class for 28 middle school students. The results showed improved student understanding and interest in data and artificial intelligence. The teachers were satisfied with the model-based design and confirmed the effectiveness of cross-curricular AI convergence classes. This study is significant as it provides specific steps and guidelines for teachers to design effective cross-curricular AI convergence classes.

Keywords: AI convergence education, Cross-curricular education, Data literacy, Instructional Systems Design Model

Following an initial design based on prior literature, the model underwent rigorous refinement through two rounds of expert validation and practical application in educational settings. The refined model includes seven distinct stages: team composition among teachers, analysis, design, usability evaluation, development, implementation, and general evaluation(Figure 1).

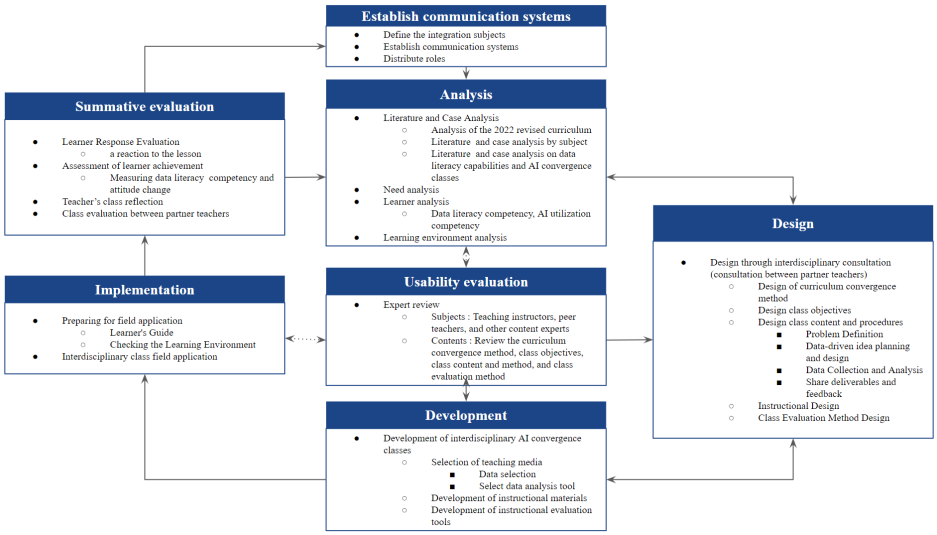

Figure 1. A instructional systems design model for a cross-curricular AI convergence class to improve data literacy

Initially, educators collaborate to define the integration subjects, establish communication systems, and distribute roles, developing an effective foundation for teamwork. In the phase of analysis, teachers involve a thorough review of existing literature and educational curriculum aimed at identifying critical elements for AI and data literacy integration, thus tailoring the content to meet learners' initial capabilities. Then they design a prototype that includes educational goals, content, procedures, and assessment methods selected from various curricular integration strategies.

Usability evaluation is a special process that peer educators and subject matter experts assess the prototype, refining educational strategies and content integration through iterative feedback. This assessment includes how the curriculum is integrated, objectives, content, methods and assessment of the lesson. Informed by usability feedback, teachers develop appropriate educational media and materials to support effective teaching. The resulting the prototype is implemented in actual classroom environments, with preliminary checks such as device and network functionality ensuring seamless delivery.

After all, summative evaluation should be done. After implementation, teachers evaluate learners' responses to the lesson and their achievement, which confirms the effectiveness of the model and guides future lesson improvements. Each step is non-linear, cyclical, and iterative, so teachers can work backward from the later steps to the earlier steps and repeat the same steps multiple times to create effective program(Lim & Yeon, 2006).

To verify the external validity of the model, one teacher of 'Korean language' and one teacher of 'computer and information' developed a cross-curricular AI convergence lesson for 28 middle school students based on the model and conducted a total of two lessons(Figure 2).

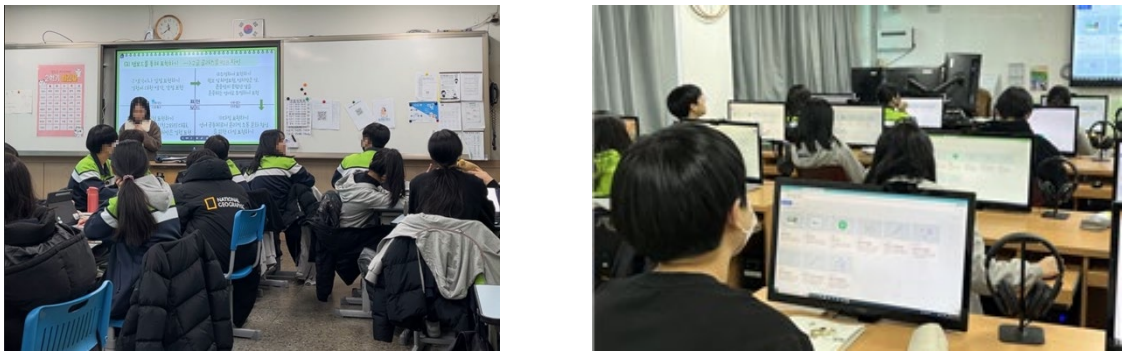

Figure 2. Application of a model in ‘Korean language’ and ‘Computer and Information’ subjects

After implementing the model in a school setting and analyzing the data from interviews and surveys, we found that student engagement and data literacy improved significantly. Teachers noted that the model could facilitate effective interdisciplinary learning and deepen students' understanding of complex concepts. Furthermore, both teachers and students were satisfied with the cross-curricular AI lessons designed using the model. In conclusion, this study synthesizes the steps that should be taken to design effective cross-curricular AI lessons. We also found that AI-infused lessons have a positive impact on improving learners' data literacy.

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How concepts related to agency are different between MEXT and OECD

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Japanese government (MEXT) revised the Courses of Study in 2018, emphasizing the importance of "Attitude of proactive learning." Around the same time, the OECD proposed the concept of wellbeing for a better future and the concept of "agency" as a key competency. As there is no global consensus on the definition of "agency", studies have been conducted in Japan comparing it to "proactivity" and it has been confirmed that "agency" is similar to "proactivity", but is a broader concept. However, there are still few studies that specifically show what items make a difference. Therefore, key words were selected by the author based on frequency and importance from the OECD's description of "agency" and compared with the MEXT's "proactivity" and "Attitude of proactive learning." For comparison, Japanese official documents, dictionaries, and articles written in Japanese, and documents published by the OECD that have also been translated into Japanese were used.

The comparison reveals that while "proactivity" encompasses elements of "act responsibly to effect change", "attitude of proactive learning" encompasses elements of "set a goal", "reflect", and "act responsibly to effect change", with "participation in community" and "participation in society" as underlying factors.

Keywords: Agency, OECD, MEXT, Courses of Study

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A Comparative Study of Information Moral Awareness among College Students in Japan and China

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Abstract

As social networking services (SNS) continue to evolve and become more widespread, they offer platforms for users to express themselves and communicate. However, their pervasive nature also raises ethical challenges such as privacy concerns, the authenticity of information, and cyberbullying. Information moral education plays a crucial role in teaching students to use SNS safely and responsibly. This study aims to explore the differences in the definition and educational practices of information moral between China and Japan, offering new perspectives on the formation moral education in both countries. Through comparative research and literature review, this study analyzes the differences in high school information moral education practices between China and Japan, focusing on the interpretation of information moral and the assessment of students' awareness of these moral. The results reveal that Japanese information moral emphasize personal information protection, human rights issues, and copyright concerns in the information society, along with network security and etiquette. In contrast, Chinese information moral focus on ethical awareness, norms, and behaviors across activities involving the collection, processing, storage, dissemination, and use of information, highlighting the differing emphases in information moral education between the two countries.

Keywords: Information Moral Awareness, SNS, Education, College Students, Comparative Study

Research Design & Methods

This study conducts a comparative analysis of the definitions and current situation of information moral education in high schools in Japan and China. Specifically, it identifies the differences in the scales used to assess students' awareness of information morals between the two countries. The aim is to provide a multi-perspective approach to the implementation and enhancement of information moral education in both nations.

Results

In Japan, at the Central Council for Education report from December 2016, which serves as the basis for the new curriculum, the general subject "Information" continues from the current curriculum, maintaining the three perspectives of information education goals: "Practical application of information," "Scientific understanding of information," and "Attitude towards participating in the information society." These aspects have not been changed and are firmly upheld. However, while previously there were subjects aligned with each perspective such as "Information A" for practical application of information, "Information B" and "Science of Information" for scientific understanding, and "Information C" and "Society and Information" for attitudes towards participating in the information society, in the new curriculum, these are required subjects for all students. "Information I" is established as a compulsory subject, and "Information II," an advanced elective predicated on completing "Information I," incorporates and builds on the content traditionally covered in "Science of Information," adding more advanced learning content.

The December 2016 report highlighted issues with the current curriculum, noting that "the instruction on the scientific understanding of information may not be sufficient, and may not adequately meet the learning motivation of students interested in information and computers." It further emphasized the importance of enhancing learning that includes information utilization skills, such as the ability to communicate based on the audience's context and information moral. It stressed that for high school information science courses, regardless of students' future pathways, it is

increasingly important to nurture information utilization abilities underpinned by a scientific understanding of information. Furthermore, in terms of improving and enriching educational content, "Information I" covers fundamental information technologies and methods such as programming, modeling and simulation, networking (including information security), and basics of databases, along with the fundamentals of content creation and information design and introduces information moral to consider the relationship between information society and humans. While the basic policy of the revision aims to "further enrich" information moral education, it remains merely an introductory element in "Information I" and no longer constitutes a separate unit. As stated, whereas the 2013 curriculum treats information moral education as one unit each in "Society and Information" and "Science of Information," in the new curriculum, it is treated as a small unit within "Information I".

In China, At the end of 2017, the Ministry of Education released the "2017 Edition of the Ordinary High School Information Technology Curriculum Standards" to meet the diverse needs of students. The curriculum category for high school information technology included elective compulsory courses. The new textbooks have been gradually used starting from the autumn semester of 2019.However, due to the use of textbooks from different publishing houses in various regions of China, to ensure the reliability of the research, the main summary includes five editions of textbooks listed in the "2019 National Curriculum Teaching Book Catalog for Ordinary High Schools" by the Ministry of Education, such as Educational Science Press, People's Education Press, Shanghai Science and Technology Education Press, Guangdong Education Press, and Zhejiang Education Press, totaling 10 volumes.

The summary found that the "Information Systems and Society" module in high school information technology teaches students how to use information systems to solve problems and improve their awareness of information security and social responsibility, adapting to the needs of surviving and thriving in the information society. This module covers "Characteristics of Information Society," "Composition and Application of Information Systems," and "Information Security and Social Responsibility in Information Society," and summarizes the chapter distribution of "Information Systems and Society" based on these three themes. Although the "Information Systems and Society" textbooks from these five publishers differ in the sequence of chapters and content distribution, the objectives of the material remain consistent. Through the study of this module, students are expected to correctly understand the relationship between people, information technology, and society, recognize the role of information systems in society, and use information systems rationally to solve problems encountered in study and daily life, employing them safely and legally. Fundamentally, this course module not only covers knowledge and skills education but also includes the education of students' morals. It organically integrates the cultivation of students' information moral literacy at the levels of emotions, attitudes, and values.

Discussion

The future research process is divided into two main parts; the first part is to design the semi-constructed interviews from a qualitative research perspective and the second part is to design the questionnaire from a quantitative research perspective. The current progress is to conceptualize the general content of the interviews. The purpose of the interviews is to understand the differences between Japanese and Chinese university students' knowledge of information moral gained through using and experiencing SNS, as well as their attitudes and behaviors when they are exposed to the online society. It consists of two main parts, the first of which is the status of SNS utilization and information moral curriculum at school, and the second is information moral awareness and action (which specifically consists of six components: risk avoidance in the use of ICTs, protection of personal data, maintenance of health in the use of information devices, crime prevention in the information society, software piracy, and copyright issues in the use of ICTs) The study is expected to be completed by the end of this year. It is also expected that there will be one university student from China and one from Japan (with the possibility of increasing the number).

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Educational Program for Media Literacy through Metacognition and Mutual Understanding

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Abstract

Presently we are living in an environment where we come into contact with a wide variety of media ranging from education and entertainment to communication. Many of us receive, transmit, and communicate through media such as television, and smartphones, and through these experiences we encounter feelings of joy, sadness, security, empathy, and solidarity. Some of these experiences enrich our lives and connect us favorably with society, but others can cause irreversible damage to us in the form of dis-communication, exposure to sensitive contents, etc. In such situations, it is necessary to develop media literacy skills - the knowledge, thoughts, and actions needed to minimize the risks from media and maximize the benefits we can receive (Buckingham, 2023). Many existing media literacy education programs teach students to read information from specific media critically, or the methods and rules of communication through media. Education programs that aim for mastery of one media may not necessarily be able to cope with different or new media. In addition, those that preach generalized morals and manners have difficulty in connecting with participants to make them aware of who the teachings apply to. The author believes that by focusing on the relationship between people and media, it is possible to provide media literacy education that enables participants to have a sense of ownership regardless of the type of media, or whether it is old or new. This is because even though a certain media may go out of fashion, human nature never fundamentally changes, and besides, participants can ensure their sense of ownership by reflecting on their own relationship with the media and understanding the relationship between others close to them and the media. This study proposes a media literacy education program that focuses on making participants meta-aware of their own relationship with the media and mutually recognizing the various ways in which they interact with the media through dialogue. Firstly, this educational program will provide an opportunity for each participant to reflect on his or her own relationship with the media, using a specialized application. The application will then be used to visualize and share participants' experiences, and through discussion they will learn about the differences and similarities that exist among them. Currently, a method for thinking deeply about the relationship between people and media is being devised through a process in which participants create a prototype for a new media they would like to use.

Keywords: media literacy, media education, metacognition, mutual understanding

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Development of an ethical competency framework for AI use in education for pre-service teachers

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Abstract

The possibilities for using AI in education are exploding. AI is already widely used in education, and with the recent emergence of generative AI, the possibilities are being more actively explored. However, ethical concerns about the use of AI continue to arise. Teachers, who take the lead in education, need to be empowered with ethical competencies that consider the impact of AI and digital technologies while using AI. Accordingly, this study aims to develop a framework for teachers' AI ethical competencies and instructional. To this end, an competency framework and instructional components were developed through a systematic literature review. This study has significance in that it systematically presents the ethical competencies of teachers for coexistence with AI amid the ongoing development of AI from a post-humanistic perspective.

Keywords: AI ethics, AI ethics education, teacher education, AI in education

Methods

Systematic literature reviews

This study utilizes a systematic literature review methodology to identify teachers' competencies in teaching AI utilization and the content and methods of AI ethics education. For this purpose, Korean and global databases are utilized. The Korean databases are KCI and RISS, and the global databases are Web of science and Scopus. The search query was (AI OR Artificial intelligence) AND ethic* AND (education or program or training), limited to peer-reviewed articles, English-language articles, and articles from the 2013-2024 period. As a result, a total of 568 articles were identified in the Korean literature and 1,539 articles were identified in the international literature. After removing duplicates and reviewing titles and abstracts, 43 Korean articles and 23 international articles were identified, and a total of 25 articles were selected as target articles through full-text review.

Literature selection

The selected literature is divided into two categories: literature related to AI ethics education programs and literature related to AI ethics competencies. The former includes students, teachers, pre-service teachers, the general public, and university students. In the latter case, the literature on AI-utilizing educational competencies and the literature on AI-utilizing educational competencies targeting only 'AI ethics competencies' were distinguished. The list of selected literature is listed in the references due to space limitations.

Results

1. Teachers' competency in teaching with AI

As a result of the study, a total of 11 articles were identified in the literature on teacher competencies for AI education. These can be categorized into AI expertise, AI ethics competencies, and curriculum management competencies according to Falloon's (2020) framework of teacher competencies for AI education. The AI expertise domain includes understanding AI, utilizing AI, and developing AI, while AI ethics competencies include critical evaluation and ethical use of AI. AI educational application competencies include AI-based educational design, AI educational knowledge, and AI convergence education operation.

2. AI ethics competencies for teachers

A teacher's AI ethics competencies can be categorized by ethical values or by ethical behavior. In the case of AI ethics values, teachers' AI ethics competencies can be categorized into Transparency, Privacy, Fairness, Safety, and Responsibility. In the case of AI ethical character, it can be categorized into AI ethical sensitivity, AI ethical judgment, and AI ethical synchronization.

3. Content of AI ethics education for teachers

The goal of AI ethics education is to strengthen teachers' "AI ethics awareness". The main contents of AI ethics education can be categorized into principle-centered education and issue-centered education. Principle-centered education includes topics such as diversity, transparency, accountability, and openness, and privacy. Issue-oriented education includes topics such as autonomous vehicles, brains and AI, cyborgs, and education and AI.

4. Training methods for AI ethics

AI ethics education methods are classified according to the content and purpose of the education, and include self-evaluation, reflection journal, role play, moral discussion, collaborative learning, self-directed learning, value conflict model, and direct use of AI-related programs.

Discussion & Conclusion

The results of this study are significant in that they provide a knowledge base for the field of ethics in AI utilization through the pedagogical interpretation of AI ethics. In addition, by emphasizing AI ethics, we propose a new educational paradigm called "ethical AI utilization education" based on respect for human values. This can help diversify and spread on-site AI literacy education for teachers and contribute to the revitalization of basic and applied research for the ethical practice of AI-enabled education. However, this study is limited in that it derived AI ethics education competencies, educational contents, and methods based on a literature review rather than directly reflecting opinions from the educational field. In future studies, efforts should be made to incorporate practical data through clinical studies or interviews and direct surveys.

Development of an Automated Responses AI Model in VR-based Simulations for Pre-Service Teachers

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Abstract

This research aims to develop an automated response AI model within a VR simulation, tailored for pre-service teacher trainig. SimTEACHER, a VR simulation for pre-service teacher, was created to allow pre-service teachers to practice addressing student misbehavior through a 3D virtual classroom, scaled to the dimensions of a real high school. Also, SimTEACHER enables practice in managing classroom disruptions and conducting parental consultations, beacuse the platform was specifically designed for the Korean educational context. Effective classroom management is crucial, especially for teachers, yet pre-service teachers often lack the necessary experience, underscoring the need for training in realistic settings. VR education surpasses traditional teaching methods by offering a risk-free environment for scenario participation, allowing pre-service teachers to engage repeatedly in simulations and thoroughly prepare for real classroom situations. However, the current platform is limited by a predefined range of dialogues and behaviors, necessitating an automated dialogue system to enable more flexible interactions between pre-service teachers and student avatars. Pre-service teachers can gain realistic classroom management experience through VR simulations featuring student avatars operated by an AI automated response model, thereby enhancing their teaching competencies. The research methodology includes several stages: the initial design of the automated dialogue system through fine-tuning and prompt engineering, followed by the system's integration and testing within the VR environment. The process starts with identifying essential personas for effective VR teacher-student interactions, followed by refining GPT models to reflect the complex roles and responses of actual teachers accurately. An integral part of the research is gathering user feedback and implementing systematic enhancements to optimize the user experience. This method closely simulates real teaching scenarios, assisting pre-service teachers in managing diverse classroom challenges effectively. This study revolutionizes pre-service teacher education by designing automatic responses generation models using AI technology to enhance practical training in classroom management and student interactions. By ensuring that pre-service teachers are thoroughly prepared for real-world classroom situations and can confidently tackle challenges in the educational field, this research marks the advent of a new era in VR-based teacher education, merging educational technology and AI to enhance practical training and address educational challenges substantially.

Keywords: AI Dialog management, AI automated responses model, Class management, Pre-service teacher education, Virtual Reality(VR)

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An empirical study of the effect of Artificial Intelligence Technology on EFL students' oral expression ability

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Abstract

Students' oral expression ability is gradually gaining attention from various countries, and the oral expression ability of college students has become one of the abilities to adapt to the future development of the society. Therefore, this study combines Artificial Intelligence (AI) technology with the oral expression instruction, focusing on the effects brought by AI technology on EFL students' oral expression performance and learning engagement. To verify effectiveness, a quasi-experimental study was conducted in a public university in Zhejiang Province, China. The experiment lasted for nine weeks and a total of 52 students participated in this experiment. The experimental group (EG, N=26) used AI-supported oral expression instruction, while the control group (CG, N=26) used traditional teacher-supported oral expression instruction. From the pre-test results, there was no difference in the initial level of oral expression performance and learning engagement between the experimental group and the control group. However, the post-test results indicate that the experimental group was able to obtain a detailed, intelligent feedback record while using the AI technology for oral speaking. This record pointed out the problems in students' speaking texts in detail from a diagnostic perspective, such as syntactic rules, structural logic, discourse intention, etc., which provided feedback for the students to recognize the problems in their speaking texts in time. Moreover, there are specific differences in the learning engagement of the experimental group and the control group. The post-test scores of behavioral engagement, emotional engagement, and cognitive engagement in the experimental group are higher than the control group. Students' learning engagement not only promotes the development of different thinking levels, which means achieving the leap from single-point structure to associated structure and extended structure, but also provides the innovation of students' oral speaking content. In conclusion, the results of this study provide inspiration in oral expression instruction for English teachers and EFL students. In the future, to further validate the effectiveness of the proposed strategies, our recommendations encompass extending the experimental duration to mitigate potential experimental confounders, optimizing the design of instructional scenarios to enhance the spontaneity of student presentations, implementing individualized training methodologies to enhance students' proficiency in technology application.

Keywords: Artificial Intelligence, EFL students, oral expression

The Use of ChatGPT in EFL University Students' Oral English Learning and Its Effects on Learning Performance and Cognitive Load: An Empirical Study

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Abstract

As globalization continues to deepen, English has become an essential tool for international interpersonal communication. Oral ability is widely regarded as a crucial skill for effective communication. However, mastering this skill remains challenging for EFL (English as a Foreign Language) students. Traditional methods of teaching oral English often focus on the rote learning of grammar and vocabulary, lacking the interactivity and authenticity of real-life communication, thus failing to meet the needs of modern learners. In recent years, the rapid development of artificial intelligence technologies, such as the emergence and continuous optimization of large language models like ChatGPT, has brought new opportunities for oral English learning. These models possess higher mutualistic, generativity, and formative capabilities, enabling personalized learning support based on learners' needs and thereby improving the oral English learning experience. ChatGPT can simulate real conversation scenarios and generate rich linguistic material to help learners better understand and use English. Based on this, this study aims to explore the impact of integrating ChatGPT into instructional strategies on students' oral English performance and cognitive load, and further investigate its potential application in oral English learning. To validate the effectiveness of this instructional strategy, a quasi-experimental study was conducted at a university in Zhejiang Province, China. The experimental group (31 students) adopted integrated ChatGPT in instructional strategy, while the control group (29 students) used traditional lecturing instructional strategy. The oral English learning activities lasted for nine weeks. The results indicated that the instructional strategy integrating ChatGPT significantly improved learners' oral expression integrity and accuracy. Specifically, students in the experimental group showed notable improvements in vocabulary richness and grammatical accuracy in their oral English. Additionally, interviews revealed that students in the experimental group experienced lower cognitive load during the learning process, suggesting that this instructional strategy alleviates learning stress to some extent. Further Pearson correlation analysis showed a significant negative correlation between learners' oral performance and cognitive load, indicating that the lower the cognitive load, the better the oral performance. This finding confirms that the instructional strategy integrating ChatGPT not only enhances oral learning performance but also optimizes the learning process by reducing students' cognitive load. Overall, this empirical study demonstrates the advantages of integrating ChatGPT into instructional strategy. This

discovery offers new perspectives and practical pathways for EFL teachers and researchers, contributing to the innovation and development of oral English instruction.

Keywords: ChatGPT; oral English learning; EFL; instructional strategy

Exploring the Educational Effect of Generative AI-Driven "Wall-Hitting" Activities in Elementary Japanese Language Classes

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Abstract: Using generative AI in education can transform children's learning experiences. While prior research focused on teachers using AI-generated content, there is limited practice of students using generative AI for their own learning. To address this, we conducted a study with fifth graders in language, using a generative AI exercise called "wall-hitting." Students interacted with AI to refine their ideas, generating 151 prompts, averaging 6.6 per student. These prompts fell into categories such as "expressing personal opinions," "creating products," "modifying output," and "asking questions." Most prompts involved expressing opinions and creating products, showing that students used AI to articulate and produce ideas. Additionally, they asked questions and modified outputs for better understanding. These findings suggest that generative AI encourages active information reception and dialogue, enhancing learning. Effective AI lessons should focus on creating and iteratively improving products, with educators setting goals like "creating new value" to foster creativity and critical thinking.

Keywords: Generative AI, Elementary Education, Japanese Language

Introduction

One technology that has significantly impacted society in recent years is generative AI. OpenAI's ChatGPT attracted significant attention and interest, amassing one million users within five days of its release. The potential of generative AI extends to the education sector, where its utilization can bring about transformative changes in children's learning.

Previous practical research on the use of generative AI in primary and secondary education primarily focused on teachers using AI to generate content for student discussions. For instance, Jauhiainen and Guerra (2023) conducted a study utilizing ChatGPT 3.5 and ChatGPT 4.0 to create personalized learning materials tailored to students' knowledge levels. The results indicated that the use of AI-generated materials increased students' motivation and improved their understanding of the subject matter. This suggests that lessons incorporating generative AI can potentially cater to students' individual learning needs.

Generative AI can also transform outputs into formats that are easier for humans to understand (Sabzalieva & Valentini). Leveraging this capability, students can actively engage with AI through "wall-hitting" interactions, using the AI to gather information, create products, and refine or interpret these products. Using this approach, we aimed to explore the potential of generative AI in supporting students' active engagement and self-directed learning.

Research Design & Methods

In this study, we focused on the effective utilization of generative AI in learning activities and examined how fifth-grade students engaged in "wall-hitting" interactions with AI. The practical implementation took place in February 2024 and involved 18 fifth-grade students. During a language lesson focused on writing speech drafts, we incorporated learning activities that included wall-hitting using generative AI. The objective of this unit was to encourage students to critically examine the words they used daily, identify issues, and articulate speeches with clear reasoning aimed at addressing these issues.

Learning activities utilizing generative AI were conducted over four sessions (45 minutes each). In this study, we used the generative AI provided by Minna no Code, which is based on ChatGPT-3.5. Students were assigned to write speech drafts on proper Japanese usage addressing modern language issues. In the first session, they created speech memos independently, and then created generative AI memos. The AI asked questions related to language issues that the students answered. The AI compiled these answers into memos. Students compared the AI-generated memos with their own and revised them accordingly. In the second session, the students drafted speech manuscripts based on their

memos and generated AI-created manuscripts. They compared their drafts with AI-generated drafts and made revisions. In the third session, students received evaluations from the AI regarding their drafts, with feedback on their strengths and areas of improvement. Based on this feedback, students revised their speeches to complete their memos. In the fourth period, students presented their written speeches.

For instance, when directing the AI to create speech memos, the instructor provided the following prompt template: "User role: You are an expert in improving prompts. Assist me in creating a prompt. Goal: Create the most suitable prompt for my needs. Process: Your initial response should be, 'What topic should the prompt address?' Based on my input, generate two sections: Section 1 (Questions): Ask relevant questions to gather additional information. This iterative process continues until I indicate completion. Focus on 1) Motivation for the proposal, 2) Content of the proposal, 3) Current issues, 4) Reasons for the proposal. Section 2 (Speech Memo): Once complete, create the speech memo in the following format: 1) Motivation, 2) Content, 3) Current issues, 4) Reasons and evidence, 5) Summary. Responses should be simple and clear for fifth graders, and use positive and motivating language." Based on the generated memo, students were instructed to create a speech draft using generative AI. For evaluating and improving speech drafts, students were instructed to input: "Goal: Make the following speech text more 'communicative.' Conditions: Summarize expressions for clarity and conciseness. Highlight strengths and areas for improvement. Use language understandable to elementary school students"

Results

Throughout these lessons, we categorized the types of prompts students input into the generative AI. A total of 151 prompts were collected, with each student engaging in wall-hitting an average of 6.6 times (SD = 1.64). To clarify the wall-hitting process, these prompts were categorized into "Expressing Personal Opinions," "Creating Products," "Modifying Output Results," "Questions to Deepen Understanding," and "Other." There were 69 prompts in the "Expressing Personal Opinions" category, 29 in "Creating Products," and 17 in "Modifying Output Results." The category "Questions to Deepen Understanding" had 4 prompts, and there were 6 prompts classified as "Other."

Discussion

The results indicated that students primarily entered prompts related to "Expressing Personal Opinions" and "Creating Products." In this case, students used AI to generate presentation memos and drafts based on their opinions. They crafted prompts for AI to create products that reflect their thoughts. Additionally, for "Modifying Output Results," students were observed tailoring the output to formats they could better understand and incorporating the acquired information into their products. Prompts in the category "Questions to Deepen Understanding" included inquiries like "What do you think about the language used by Japanese people?" where students sought the AI's perspective on their questions. Based on the AI's responses, students engaged in discussions with their peers to clarify their thoughts. In the speeches created by the students, there were instances where they incorporated the AI's suggestions, such as "the appropriate use of honorifics," and argued for the necessity of using honorifics appropriately according to different situations and contexts.

Conclusion

The results of this study show that students sought answers from the generative AI to their own questions and requested modifications to the output to make the information easier to understand. This indicates that lessons incorporating generative AI can encourage students to actively receive information and engage in dialogue to deepen their understanding. To develop effective lessons for students using generative AI, it is essential to design activities that involve creating "products" and continuously improving them. Therefore, educators need to set higher-order goals, such as creating new value rather than lower-level objectives, and structure lessons to achieve these higher-order goals. Future research should continue to incorporate practical lessons that utilize generative AI, thereby expanding the findings of this study. This approach facilitates a deeper exploration of the effective application of generative AI in elementary education.

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Advanced Learner Model for Error Collection

Using Japanese honorifics as an example

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Key words: learner model, error collection, honorific language

With the development of the economy, many people are relocating to places where their native tongue are not spoken in daily life. Local language education for those learners has become increasingly important. The object of this study is advanced learners, who mainly enhance their language abilities through language using.

For example, Japanese have a honorific language system, and the use of it is depending on objective conditions. This complexity often leads to errors, and it is difficult to indentify correct through textbooks.

This study takes Japanese honorific language as an example to develop a learner model for advanced learners. This model uses a large-scale language model to classify, summarize, and analyze the errors that occur when using honorific language for each learner's input sentences, in order to assess the learner's honorific language ability and visualize the use of honorific language use in an appropriate way, making learners more aware of their errors in honorific language use.

In this study, errors were divided into two types. The first type is "regular errors", which include spelling errors and grammar errors, such as the Japanese spelling of "そうだすね", while the correct one is "そうですね". Another situation is "contextual error", which refers to the situation where the word spelling and grammar are correct but the usage is incorrect. The expressions "そうですね" and "仰る通りです" are equivalent to "as you say" in English. These two expressions are correct in word spelling and grammar, but may vary depending on the situation. Misusing these expressions can lead to misunderstandings. Advanced learners often face difficulties in choosing appropriate honorific language expressions.

This model includes the following parts:①Input section ; ②Detection section ; ③ Classification section ; ④Visualization section.

The author believes that in order to successfully develop this model, the following important issues need to be addressed:①How to find or establish a honorific languages dataset that includes different condition;②Each section will be completed by different

softwares or tools, how to organize these section together, and make sure can be used normally;

Development and Evaluation of Story-based Instructional Materials to Improve Engagement in Mathematics

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Abstract

This paper proposes story-based instructional materials including misdirection and fantasy contexts to improve engagement in secondary school mathematics. The aim is to develop instructional materials that improve engagement by incorporating fantasy and misdirection into the story requirements of goal-based scenario theory.

Keywords: engagement, story-based material, instruction design, misdirection

Introduction

A proactive attitude toward learning is required, captured in the academic concept of engagement (Sakurai, 2020). Engagement refers to the quality of a student's connection or involvement with schooling and the people, activities, goals, values, and places that compose it (Skinner *et al.,* 2009). Engagement has three sub-concepts: emotional, behavioral, and cognitive (Sakurai, 2020). The PISA (National Institute for Educational Policy Research, 2013) results indicate that Japanese junior high school students face challenges in terms of emotional and behavioral engagement.

As a means to improve engagement, Reigeluth *et al.* (2020) suggest incorporating compelling stories into lessons. Stories trigger emotions such as conflict or surprise through events (Zazkis & Lijedahl, 2009). According to Dietiker *et al.* (2023), misdirection, which refers to information that leads learners away from the answer, such as incorrect or ambiguous information, can generate surprise and further questions in students. Cordova and Lepper (1996) also state that learners actively participate in the class by incorporating learning activities into the fantasy context. This study examines the effects of story-based instructional materials on students' emotional and behavioral engagement, including misdirection and fantasy contexts.

Research Design & Methods

We developed story-based instructional materials for a unit on figure and similarity in junior-high second-grade Mathematics. Table 1 shows the instructional materials components and their corresponded design elements. Here, we incorporated the elements of the scenario context: roles, cover story, and mission based on goal-based scenario theory (Shank *et al.*, 1994). In addition, we incorporated the fantasy context and misdirection described in the background, aiming to improve students' engagement. We then ask learners to answer a questionnaire on engagement

to assess the effectiveness of the instructional materials. The questionnaire consists of items on engagement based on Skinner *et al.* (2009) and original items on fantasy context and misdirection, and is administered twice, pre and post. Finally, we analyze the relationship between engagement and instructional materials. At the conference, we plan to explain the assessment and analysis of the developed instructional materials.

Table 1

Instructional Materials Components and their Corresponded Design Elements

Objective	Design Elements	Overview of Learning Materials
Compose scenario context	Role	Being a detective
	Cover story	Rescuing hostages held in a building
	Mission	Identifying the building on the map where the hostages are
Improve engagement	Fantasy context	Rescuing the hostage as a detective
	Misdirection	Lack of information about the height of the confinement

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From traditional library to Metaverse learning commons

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Metaverse libraries are expected to play a key role in learning commons that promote collaborative and interactive learning environment (Chen et al., 2023; Fernandez, 2022). This study explores the theoretical and practical aspects of Metaverse libraries by proposing three types of library spaces focused on the spatial aspect. To achieve this, the study implemented two research methods: a literature analysis to identify the potential of Metaverse libraries and a case study of existing Metaverse library to understand their roles and necessity. Libraries were categorized into three types based on background theory and media perspectives: physical libraries (Cognitive Learning Theory, learning from media), virtual libraries (Constructivism, learning with media), and Metaverse libraries (Connectivism, meaningful learning in media). Engagement evolves from receiving information to actively constructing new knowledge. The study identified the purposes and roles of Metaverse libraries: empowering learners for the future, developing reading experiences, expanding the library, nurturing a reading culture, and providing rich teaching and learning opportunities. This transition transforms libraries from static repositories of information to vibrant learning commons where interaction, collaboration, and innovation thrive. This study highlights the potential of Metaverse technology to transform libraries, addressing current limitations while considering technical and ethical issues.

Keywords: learning commons, library, metaverse, metaverse library, virtual world library

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Enhancing Awareness of Unconscious Bias and Behavioral Change Potential through Playbuidling in Higher Education

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Abstract

This study aims to clarify how workshops utilizing playbuidling can enhance participants' awareness of unconscious bias (Eberhardt, 2020) and their potential for behavioral change when faced with problematic situations. Unconscious bias refers to preconceived notions that influence an individual's decisions and actions without conscious awareness. Such biases often stem from societal stereotypes and personal experiences, affecting how we perceive and interact with others. In our society, where unconscious biases can inadvertently cause harm to others, recognizing these biases is a crucial step toward building a better society. This workshop aims to use playbuidling to create scenarios reflective of everyday situations, allowing participants and observers to recognize unconscious biases and consider appropriate behaviors in such contexts. Playbuidling is a pedagogical method that involves simulating real-life scenarios, where multiple individuals assume various roles to gain experiential learning and prepare for appropriate responses to actual events.

This practice was implemented in a higher education setting with 30 students. The researchers presented scenes containing unconscious biases and had the students perform these scenes in groups. Following the performances, both the actors and the audience engaged in discussions to explore the unconscious biases embedded in the scenarios. Based on insights gained from these discussions, participants reconsidered appropriate actions for each scene and re-enacted the same scenarios. The reason for incorporating re-enactment is to provide participants with concrete behavioral images, thereby expanding their repertoire of appropriate actions when encountering similar situations in the future.

This study focused on two scenes: priority seating on a train and the guidance of a new employee in the workplace. Educational practices addressing unconscious biases often deal with gender bias, disabilities bias, and foreigner bias. However, this study aimed to raise awareness of the various biases embedded in everyday situations that are often taken for granted. Data were collected immediately after the practice through an online survey. Data analysis, based on the KJ method, revealed that through playbuidling, participants could reflect on their perceptions, question the fundamental biases influencing their actions, and gain insights into reconstructing their thoughts and behaviors.

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Creative Teaching: Towards a Pedagogy of Vitality and Possibility

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In education, the proverb "It takes a village to raise a child" resonates deeply, yet its application often overlooks wisdom beyond Western models, namely North American and European. This presentation challenges traditional educational discourses by advocating for a broader integration of global educational perspectives, particularly drawing from the rich heritage of Afro-Brazilian cultural philosophy. Inspired by my experiences in Brazil, this research highlights interdisciplinary frameworks that are designed to foster liberatory classrooms that nurture joy, community engagement, and institutional creativity.

I interpolate three interdisciplinary frameworks with autoethnographic experiences. The first framework, "The Body," seeks to examine embodied pedagogies researched by Katz and Greiner (2023), advocating for the integration of neuroscience and sociology to enhance classroom vigor through mindfulness, movement, and storytelling.

The second framework, "Enchantment," inspired by Afro-Brazilian philosophers Simas (2019) and Rufino (2019) delves into philosophical and political perspectives, proposing strategies for cultivating captivating classrooms through concept of disorientation as a catalyst for learning, the power of problem-posing, and the significance of rituals in educational settings.

The third framework, "Openings," emphasizes vulnerability, humility, and shared power dynamics in educational partnerships. Drawing insights from transgressive paradigms, this framework advocates for holistic approaches that address the diverse needs and aspirations of students, educators, and local communities (Tanaka, 2022; Rideau, 2022).

Throughout, this presentation posits that by embracing these frameworks, educators globally can reimagine and personalize their pedagogy to foster vibrant and curious conditions that resonate with the ethos of their communities and everyday aesthetics.

Keywords: Creative teaching, educational aesthetics, educational frameworks, global perspectives, liberatory classrooms, interdisciplinary approaches

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