DOI: https://doi.org/10.56198/U6C0W37F1

Work-in-Progress—Exploring the Impact of Metaverse Worlds on Cross-Cultural Understanding in International Collaborative Presentations

Hayashi Masako

[1] Tohoku University, Sendai Miyagi 9808576, JAPAN
masako.hayashi.c5@tohoku.ac.jp

Abstract. This work-in-progress paper explores the effectiveness of multimedia, particularly Metaverse worlds, in enhancing cross-cultural understanding among students in international collaborative presentations. Challenges arise from constraints on direct cross-cultural experiences in online conferencing systems. This paper aims to determine if Metaverse worlds deepen cross-cultural understanding. Through qualitative and quantitative analysis of student evaluations, results highlight Metaverse worlds' efficacy in fostering interactivity, immersion, and realism. Active engagement and interactivity are determined to be pivotal in leveraging the efficacy of Metaverse worlds. By emphasizing immersive technologies' role in cross-cultural education, the study provides insights for instructional design and international exchange initiatives.

Keywords: Metaverse, Virtual Reality, Cross-Cultural Understanding, Virtual Exchange.

1 Introduction

"Metaverse International Virtual Exchange" program, which is implemented by this author at Tohoku University in Japan, is a real-time International Collaborative Learning program through the Metaverse between Japanese and international students at Tohoku University and students from partner universities abroad. This program's main objective is to promote collaboration among students from various countries and regions with diverse social backgrounds and values and to deepen their cross-cultural understanding.

In response to the challenges posed by the COVID-19 pandemic, measures were taken to accommodate international students who encountered obstacles in traveling to Japan. The adoption of an online conferencing system enabled the participation of students from various countries and regions, allowing for the alignment of program objectives with class requirements. However, it's important to note that utilizing virtual exchange via online conferencing systems presents challenges, including constraints on direct cross-cultural experiences.

To address this issue, the integration of Metaverse and 360-degree videos into international collaborative learning has been implemented since 2021 [1]. The adoption of these technologies was seen as a means to facilitate realistic cross-cultural experiences, because Morita [2] highlighted the effectiveness of utilizing 360-degree videos and Head-Mounted Displays (HMDs) in enhancing realism and immersion.

Moreover, starting from the first semester of 2023, Metaverse worlds have been incorporated into the program for international collaborative presentations. Metaverse worlds allow students to independently select their viewpoints and actively engage with different cultures through various elements present in the virtual environment. This active engagement within virtual space is believed to compensate for the lack of direct cross-cultural experiences and contribute to a more profound understanding of cultural diversity.

However, the efficacy of Metaverse worlds in enhancing cross-cultural understanding has not been fully elucidated. Hence, this study aims to address this research question: "Is the use of Metaverse worlds effective in deepening cross-cultural understanding?" If proven effective, the study intends to qualitatively and quantitatively investigate, based on student evaluations, the features that contribute to cross-cultural understanding compared to traditional methods.

2 Literature Review

In the context of advancing educational technologies, Stylianos Mystakidis [3] describes the Metaverse as a compound term consisting of "Meta" (a Greek prefix meaning 'post,' 'after,' or 'beyond') and "universe." Hence, the Metaverse is conceptualized as a "post-reality universe," characterized by a perpetual and persistent multiuser environment that blends physical reality with digital virtuality. This has significant implications for online distance education, where the Metaverse is poised to address the fundamental limitations inherent in traditional web-based 2D e-learning tools.

Research into the application of the Metaverse for fostering cultural understanding further underscores its potential. Shadiev et al. [4] explored cross-cultural understanding using virtual reality (VR) technologies, affirming their efficacy in enhancing multicultural interactions. Similarly, Lee et al. [5] proposed integrating virtual reality and Metaverse methodologies into classroom settings to overcome the drawbacks of existing remote practical education models. Further illustrating the Metaverse's utility in cultural education, Inaba et al. [6] conducted a study where students from three different countries used the Metaverse to learn about Japanese culture, demonstrating the platform's capacity to facilitate intercultural learning experiences.

Hayashi et al. [7] expanded on these findings by employing the Metaverse for an international collaborative project where students from various countries used Metaverse worlds, 360-degree videos, videos, and images to present their own and others' cultures. This study revealed that presentations utilizing the Metaverse worlds were considered the most memorable by audience members. Nevertheless, it also shed light on an area necessitating further exploration: the extent to which the Metaverse can deepen cultural understanding. This unresolved question forms the basis of the current study, which aims to clarify the effectiveness of the Metaverse in enhancing intercultural comprehension.

3 Research Method

The questionnaire survey was conducted during the first semester of the 2023 academic year within the "Intercultural Communication" course, with the class subject being "Multimedia Based Introduction of Culture and Intercultural Understanding." A total of 40 students from 15 countries and regions participated, comprising 17 Japanese students, 13 international students, and 10 overseas students. International students were from German, America, France, China, Korea, Britian, Hong Kong, Bolivia, Italy, and Hungary. Overseas students, who were students from partner universities in Kenya, Indonesia, Belgium, China, and Singapore, engaged via the Metaverse from their respective countries. Students were divided into 6 groups, ensuring a mix of Japanese, international, and at least one overseas student in each group. These groups collaborated transcending national boundaries to develop joint presentations comparing their cultures with those of their peers, fostering cross-cultural understanding and knowledge exchange. In addition to traditional slide presentations, students utilized Metaverse worlds, 360-degree videos, videos, and images to enrich their cultural exploration.

Throughout the semester, fifteen weekly lessons were conducted, featuring explanations of various technologies employed in the class, including head-mounted displays. These sessions provided opportunities for group work, dedicated days for group presentations and discussions, and comprehensive exploration of multimedia tools.

At the end of the semester, a survey was conducted covering the following topics.

Question 1)

In the presentations of the International Collaborative Learning class, do you think that the uses of the following types of multimedia are effective in terms of deepening the cross-cultural understanding of your classmates?

Responses were elicited using a five-point Likert scale: 1 "Strongly Disagree," 2 "Disagree," 3 "Neutral," 4 "Agree," and 5 "Strongly Agree."

Question 2)

Please rank from first to third the items you think would be effective to deepen cross-cultural understanding if utilized in the presentation of International Collaborative Learning class.

A) Images, B) Videos (excluding VR videos), C) 360-degree videos, D) Metaverse worlds.

Question 3)

In the International Collaborative Learning class presentations, do you think the following types of multimedia are effective in deepening your classmates' cross-cultural understanding? If you think it is effective, please state what aspects of it are effective. If you do not think it is effective, please state why.

A) Images, B) Videos (excluding VR videos), C) 360-degree videos, D) Metaverse worlds.

The most common reasons were analyzed. Given the ordinal nature of the data and the paired nature of responses, statistical significance was assessed using Friedman's Test followed by a Nemenyi post-hoc analysis, as per Spring [8].

4 Result

4.1 Results of Question 1

Figure 1 shows the results of the survey for Question 1. (The number of valid responses was 28.)

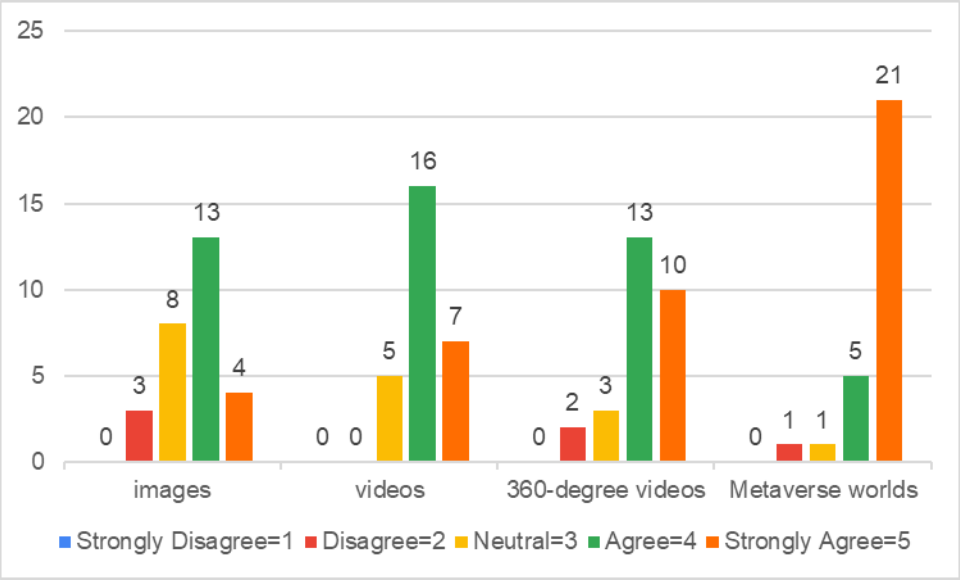

Fig. 1. Results of Question 1.

Metaverse worlds received the highest rating for "Strongly Agree" responses (21), followed by 360-degree videos (10), videos (7), and images (4). Similarly, in terms of overall scores, Metaverse worlds obtained the highest score (130), followed by 360-degree videos (115), videos (114), and images (110).

The only groups that exhibited statistically significant differences were Images and Metaverse worlds with a large effect size ($p < .01$, rs = 0.75.).

4.2 Results of Question 2

The results of the survey for Question 2 are shown in Figure 2. (The number of valid responses was 27.)

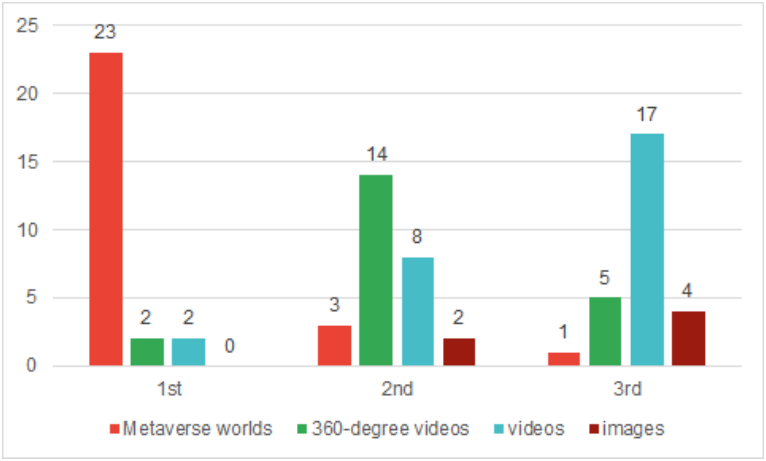

Fig. 2. Results of Question 2.

Metaverse worlds were the highest ranked, followed by 360-degree videos in second place, and videos in third place.

4.3 Results of Question 3

The students' opinions on multimedia effectiveness in cross-cultural understanding can be summarized across various perspectives. The number of students who indicated each perspective as positive and the number of students who indicated it as negative are tabulated in the table below. Negative reasons mentioned by students for each viewpoint are indicated by a minus sign.

- Interactivity with Content
- High Level of Immersion
- Curiosity Enhancement
- High Sense of Reality
- Interactivity with Other People
- Autonomy in Viewpoint Selection
- Ability to Experience Beyond Reality
- Ease of Use
- Others

*Note: The underlined section serves as the column headers for Table 1. Values above 5 were marked in pink. Of these, the highest value in each category was marked with dark pink and the second highest with light pink.

Table 1. Students' Perspectives on Multimedia Effectiveness in Cross-Cultural Understanding.

	Interactivity Content	Immersion	Curiosity	Reality	Viewpoint	Interactivity people	Beyond Reality	Ease of Use	Others
Images	-1	-2	-2	3	0	0	0	8	-2
Videos	0	-1	0	4	-2	-1	0	7	-1
360-degree videos	-1	8	6	3	12	0	0	-2	-5
Metaverse worlds	13	9	7	7	6	5	5	-4	-2

5 Discussion

In this study, a questionnaire was administered to investigate the efficacy of various multimedia formats in enhancing cross-cultural understanding among classmates engaged in International Collaborative Learning. When queried on the effectiveness of Metaverse worlds, 360-degree videos, videos, and images through Questions 1 and 2, the Metaverse worlds were consistently rated highest by the students, outperforming traditional image-based presentations. This finding highlights a significant preference for Metaverse environments in fostering deeper cross-cultural engagement.

To understand the factors contributing to the high ratings of Metaverse worlds, responses to Question 3 were analyzed. This analysis aims to dissect the specific attributes of Metaverse worlds that students found conducive to enhancing their understanding of diverse cultures. The data reveals that the following prominently mentioned characteristics were unique to Metaverse Worlds: "Interactivity with content," "interactivity with people," "high sense of reality," and "the ability to experience beyond reality." Therefore, the analysis indicates that the active experience offered by the Metaverse worlds—enabling students to interact dynamically with both the content and other users—is a critical factor in their effectiveness. This dynamic interactivity allows students to explore cultural elements in ways that traditional media cannot, enhancing their educational experience by providing a more tactile and engaging learning environment. Since this is a feature unique to Metaverse worlds, these four perspectives may be the reason why Metaverse worlds were rated most highly.

Students evaluated that "high sense of reality" in the Metaverse worlds" were effective in deepening cross-cultural understanding. Additionally, they have noted "the ability to experience beyond reality." This allows for the juxtaposition and simultaneous examination of elements that cannot be compared within the same physical space in reality, thus offering a unique advantage. Moreover, the visualization of virtual environments embodying abstract images or concepts enables audiences to deepen their cross-cultural understanding.

The data indicates that "high level of immersion," "curiosity enhancement," and "autonomy in viewpoint selection" were also highly valued. However, these items are prevalent in 360-degree videos as well. Thus, they cannot be considered a distinctive feature of the Metaverse World.

The high rating of "ease of use" (Question (3)) did not correlate with the high rating of the effectiveness of multimedia in deepening cross-cultural understanding (Questions (1) and (2)). This suggests that while usability is an important aspect of multimedia learning tools, it is the depth of interactive and immersive experience that primarily drives their effectiveness in enhancing cross-cultural education.

6 Conclusion

This study conducted a questionnaire survey among students to investigate the effectiveness of various multimedia tools in enhancing cross-cultural understanding during international collaborative presentations. The survey aimed to determine students' assessments of these tools' impact on fostering cross-cultural awareness, the rationale behind their evaluations, and which multimedia format was deemed most effective.

The findings reveal that Metaverse worlds were perceived as the most effective tool for cross-cultural understanding, followed by 360-degree videos, videos, and images. Audience participants attribute the effectiveness of Metaverse worlds to their interactivity with content, high level of immersion, curiosity enhancement, and interactivity with other people.

A noteworthy correlation emerged between the level of interactive engagement provided by the multimedia tool and its positive evaluation by students. The Metaverse, offering the most immersive experience, allows students to navigate freely and engage proactively with cross-cultural content. While 360-degree videos offer an advantage over traditional videos by allowing viewers to select their viewing angle, they fall short of providing the active engagement opportunities available in the Metaverse, such as interacting with virtual objects or experiencing the auditory culture of different countries.

This study concludes that multimedia tools rated highly for deepening cross-cultural understanding share characteristics of interactivity, immersion, realism, and the ability to foster student curiosity. These findings highlight the potential of immersive technologies like the Metaverse in enriching educational experiences by facilitating a deeper, more engaging exploration of cultural diversity.

The findings of this survey offer valuable insights into the learning effectiveness and distinguishing features of each multimedia platform, potentially aiding instructors in selecting appropriate multimedia for instructional design. Furthermore, within the context of this educational program, which seeks to foster cross-cultural understanding through virtual means and facilitate connections between students and international partner universities without the constraints of physical travel, the efficacy of utilizing the metaverse becomes evident.

Thus, the revelation of the effectiveness of metaverse utilization in enhancing cross-cultural understanding suggests its potential utility in expanding international exchange initiatives, such as "Metaverse International Virtual Exchange."

Acknowledgements

This research was supported in part by a grant from the Takahashi Foundation for Industrial and Economic Research, the Open University of Japan, the Center for Knowledge Creation at Tohoku University Research Promotion and Support Organization, and by a joint project research by the Research Institute of Electrical Communication at Tohoku University. I would like to express my gratitude to Dr. Ryan Spring, Hiroki Yoshida, Keisuke Goto, Takehiro Suzuki, Thien Nga Nguyen, and Alisa Yoshida Belotti for their invaluable assistance in compiling this manuscript.

References

1. Hayashi, M., Yoshida, H., Maruyama, N., Suzuki, T.: Advantages and Challenges of Intercultural Collaborative Learning Using Metaverse. Center for Culture and Language Education. Tohoku University 8, 78–86 (2022).
2. Morita, Y., Nagahama, T., Ohata, K., Tajiri, K.: A discussion on Reproducibility of Actual Space by Displaying Spherical Images on HMD. Japan journal of Educational Technology 43(suppl.), 129–132 (2019).
3. Stylianos, M.: Metaverse. Encyclopedia 2(1), 486–497 (2022)
4. Shadiev, R., Wang, X., Huang, Y.: Cross-cultural learning in virtual reality environment: facilitating cross-cultural understanding, trait emotional intelligence, and sense of presence. Educational Technology Research and Development 69(5), 2917–2936 (2021).

5. Lee, H., Woo, D., Yu, S.: Virtual Reality Metaverse System Supplementing Remote Education Methods: Based on Aircraft Maintenance Simulation. Applied sciences 12(5), (2022).
6. Inaba, M., Hosoi, K., Thawonmas, R., Nakamura, A., Uemura, M.: Research on Supporting Japanese Culture Learning Mediated by "Play" on Metaverse. Replaying Japan 5, 27–33 (2023).
7. Hayashi, M., Suzuki, T., Kawata, Y., Goto, K.: The Impact of Metaverse Worlds on International Collaborative Learning for Cross-Cultural Understanding. The 31st International Conference on Computers in Education, pp.896–898 (2023)
8. Spring, R. Free, Online, Multilingual Statistics for Linguistics and Language Education Researchers. Center for Culture and Language Education, Tohoku University 2021 Nenpo 8, 32–38 (2022).