Application of Virtual Reality Technology Combining Sustainable Development and History Education

Peng Guinong[1], Wai Yie Leong[1*]

[1]Faculty of Engineering and Quantity Surveying, INTI International University, Malaysia

Email: i24026150@student.newinti.edu.my, waiyie.leong@newinti.edu.my*

Abstract

Using VR to improve students' historical and environmental education is an important issue in the current educational and environmental challenges. This study explores the application of virtual reality technology in history education, especially how to educate students about environmental changes in historical events through immersive experiences. This study evaluates the impact of VR technology on enhancing student environmental awareness and promoting sustainable behavior by simulating environmental scenarios in different historical periods. Preliminary results showed that through this innovative teaching method, students not only improved their understanding of historical environmental events, but also showed positive changes in environmental behavior. The findings of this study provide valuable insights into the application of emerging technologies in education, particularly in promoting sustainability.

Keywords

Virtual Reality，History Education，Sustainable Development，Environmental Awareness，Education Quality

Introduction

With the rapid development of science and technology, the methods and means of education are also constantly innovating. Today, virtual reality (Virtual Reality, or VR) technology is gradually penetrating into every field of education with its unique immersive experience. In this context, this study focuses on the Application of Virtual Reality Technology Combining Sustainable Development and History Education, aiming to explore how VR technology can effectively integrate the sustainable development concept and history education, so as to promote the innovation of educational concepts and practices.

In recent years, virtual reality technology is widely used in the education field. Virtual reality technology has three important characteristics: immersion, interactivity, conceptualization, high emphasis on human subjective initiative, fundamentally breaking the traditional exhibition barriers around the exhibition, and transition to a new exhibition model with audience-centered.(Aoa, X., Dub, S., Wuc, Q., & Huangd, X.,2024). Its unique immersive experience can allow students to explore the knowledge personally, thus enhancing their interest and motivation in learning. In addition, VR technology can also resolve the limitation of time and space, allowing

students to explore the ocean of knowledge anytime and anywhere. In the field of education, VR technology has been widely used in geography, biology, physics and other disciplines, and has achieved remarkable teaching results. But there are still people cite the National Museum as the first place to visit. Generally, museums are inportant in learning activities, especially history learning(Suryani, M., Rusidiawan, R. S., & Rosadi, R.,2022)

Literature Review

In recent years, virtual reality technology has been widely used in the field of history education, providing students with a new learning experience. There are two aspects, the first, the introduction of new virtual reality devices, which are becoming increasingly affordable on the market. Particularly, big technology companies like Apple and Meta have released new advanced devices that are expected to become more popular in our homes and gradually trickle into everyday life, according to IDC. Their growing presence, coupled with the increasing tendency of the younger generation to interact with immersive digital reality to enable social experience, entertainment, and even information retrieval, now needs to re-evaluate teaching approaches to education by exploring immersive digital technologies that support experiential learning.(Romano, M., Frolli, A., Aloisio, A., Russello, C., Rega, A., Cerciello, F., & Bisogni, F.,2023). Second, for students of ancient history, traditional learning methods include reading designated primary and secondary school materials, attending lectures, participating in group work and tutorial discussions. In fact, these can be learned by visiting museums, watching cultural relics or visiting historical sites, and by watching documentaries and online educational videos. The support and guidance of an enthusiastic and knowledgeable teacher will help to activate these resources. The implementation of virtual reality (VR) technology can overcome access, logistics, and security issues related to field trips and international travel. In addition, the best preserved archaeological sites are incomplete, so immersive feeling in an ancient building, virtual reality technology provides a striking means to support knowledge exploration and substantial learning, can let in time and geographical space to give students a more comprehensive life in the ancient world. (Richards, D., Lupack, S., Bilgin, A. A. B., Neil, B., & Porte, M.,2023)

Virtual reality technology plays an important role in promoting students' understanding and practice of sustainable development. First of all, the environmental problems simulated through virtual reality technology, such as climate change and resource depletion, can deeply touch students' emotions and enhance their understanding of the importance of sustainable development. Secondly, VR technology can provide a safe practice environment for students to try to solve the challenges of sustainable development in a simulated situation, so as to cultivate their problem-solving ability and innovative thinking. In Virtual reality for the promotion of historical empathy: A mixed-methods analysis, the use of virtual reality technology to promote historical empathy and the importance of cultivating historical empathy in history education. Historical empathy not only helps learners to understand historical events and people deeper, but also promotes learners' civic participation and attitude towards democratic life.(Patterson, T., Han, I., & Esposito, L. 2022).The interactivity of virtual reality technology encourages students to take the initiative to participate in and explore, make learning more interesting and clear, stimulate students' interest and initiative in learning, and help them to internalize the concept of sustainable development into their own code of conduct.

Methodology

This study is to explore the application effect of virtual reality technology in promoting sustainable development education. We would analyse how virtual reality technology improve the effect of history education. We also study how virtual reality technology embody the concept of sustainable development in history education Students experience and feedback will be investigated when using VR. Study design framework is shown in Figure 1.
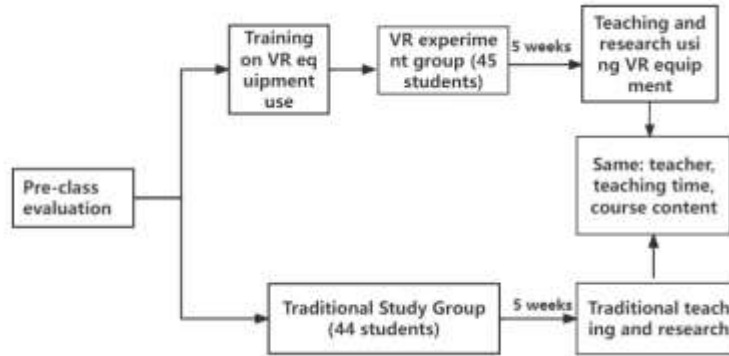

Figure 1.Study design framework (Xi, C., & Yahaya, W. A. J. W. 2024).

a) Case study

Table 1 is the test data of the students in the two classes. Class A will use the VR Pico all-in-one machine and VR screen projection for history teaching, while Class B is the traditional PPT and video teaching. The results of the sample T-test of paired classes V and traditional classes showing that based on the variable VR experimental class, the significance P-value is 0.021 * *, which is not significant at the level, and the null hypothesis is rejected. Therefore, there is no significant difference between the paired traditional classes of VR experimental class. The Cohen's d value is: 0.352.

Table 1.Test data before VR were used

Paired variable	Mean values ± standard deviation			t	df	P	Cohen's d
	Paired 1	Pair 2	Pair difference (pair 1-pair 2)				
The VR was paired with the Traditional	7.043±4.104	5.63±3.006	1.413±1.098	2.391	45	0.021**	0.352

Note: * * *, * * and * represent the significance levels of 1%, 5% and 10%, respectively

b) Classroom observation

The research assistant recorded the number of students arriving late and leaving early in VR class and traditional class weekly, respectively, and recorded the number of interactions between students and teachers in the class, and the activity duration of students in the two classes. This is the way to observe and collect data in class.

c) Questionnaire survey

We will distribute questionnaires to collect VR class and traditional class students a total of six questions (Learning in history lessons is interesting, The atmosphere of the history class is active, students are willing to continue to use VR technology learning history courses, students 'views on environmental sustainability, students' understanding of the sustainable economic development, students' understanding of the social sustainable development). The first three questions were collected once in the last week, and the last three questions were collected every week for 5 times in total.

d) Data collection

Figure 2 details the three dimensions the researchers used to assess students' learning interest, engagement, and perception of sustainability in history learning. In terms of learning interest and understanding of sustainable development, teachers record students' questions and questions, and their communication and interaction with classmates, etc.
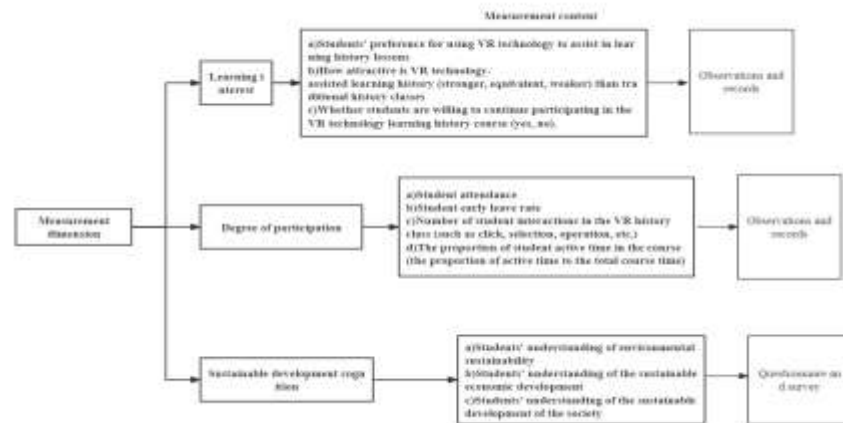

Figure 2.Measurement content and data sources for the understanding of learning interest, engagement, and sustainability (Xi, C., & Yahaya, W. A. J. W. 2024)

e) Data analysis

Qualitative data analysis: the content analysis method is used to code and theme analyze the interview records and classroom observation data, and extract the main views and patterns. Quantitative data analysis: Statistical software (e. g. SPSS, R) was used to analyze the questionnaire data and experimental data, and descriptive statistics, correlation analysis and regression analysis were used to verify the research hypotheses.Figure 3 and Figure 4 is a chart presentation of 7 aspects of classroom behavior and questionnaire survey data within 5 weeks of VR class and traditional class.
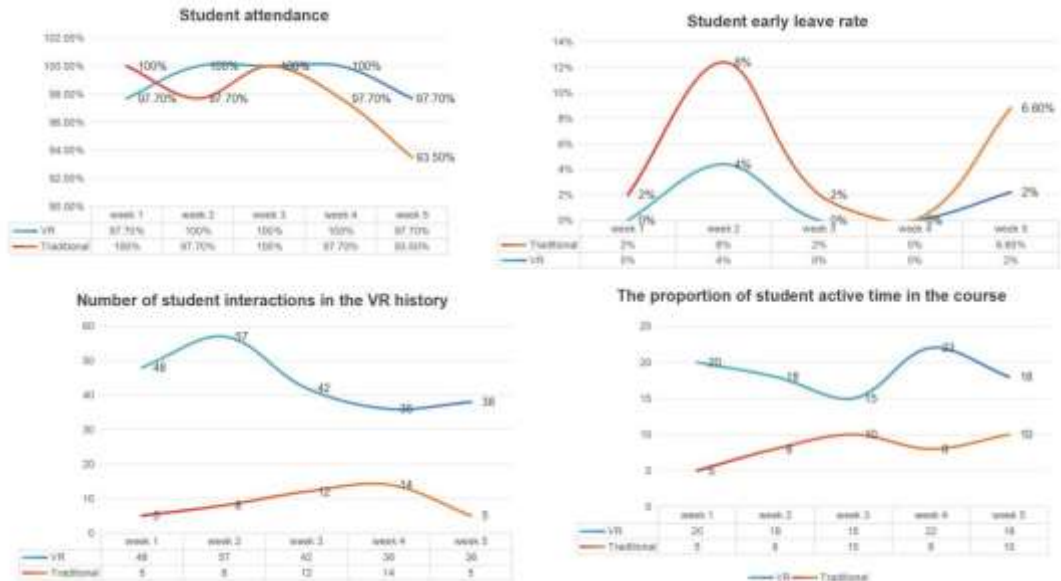
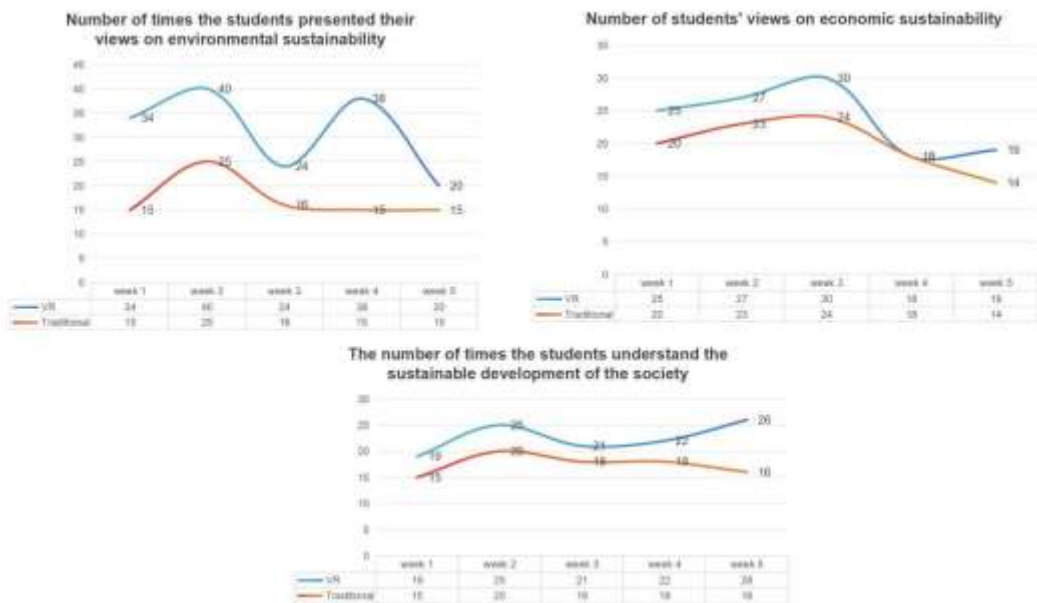Figure 3.The experimental study protocol and data collection (Xi, C., & Yahaya, W. A. J. W. 2024)

Figure 4.The experimental study protocol and data collection (Xi, C., & Yahaya, W. A. J. W. 2024)

Results and Discussion

By simulating the environmental scenarios in different historical periods, this study found that VR technology can effectively enhance students' historical perception, and make students more intuitively understand the environmental changes behind historical events. This immersive experience makes the abstract historical knowledge vivid and concrete, which greatly enhances students' interest and participation in learning. At the same time, the application of VR technology

also helps to cultivate students' critical thinking and encourage them to conduct multi-angle and in-depth analysis of historical events.

Firstly Table 3 shows the data analysis of the behavior of four aspects (students' classroom attendance rate, early withdrawal rate, classroom interaction times, and course activity time) for the classes using VR technology and the traditional teaching classes within 5 weeks. The results show that VR classes are more engaged than traditional classes. Specifically: VR class and traditional class average weekly attendance is 99% and 97.8% respectively, early return rate is 1% and 3% respectively, tthe two sets of data do not have much difference and look similar. This is because the experimental session was conducted at a secondary school in Guangzhou, China. School and parent will monitor the student's attendance and an early leave record. VR class interaction between students and teachers is an average of 44.2 times a week. The traditional class is 8.8 times. Compared to VR class which is 35.4 times higher than the traditional class, this is a significant and huge gap difference. Based on the experiment it is because history class with VR technology is more open, students' active interaction times will be much higher. Student activity time using VR technology is 9.6 times higher per week than the traditional class on average.

Table3.Comparison of participation between both groups

	VR	Traditional
a)Student attendance	99%	97.8%
b)Student early leave rate	1%	3%
c)Number of student interactions in the VR history	44.2	8.8
d)The proportion of student active time in the course	18.2	8.6

Table 4 is the results of three questionnaire data collected in each week between VR technology and traditional teaching classes (the number of times students express opinions on environmental sustainable development, the number of views on economic sustainability and the views on the sustainable development of society). The results show that VR classes have more views on sustainable development and a deeper understanding of history than traditional classes. Specifically, the average number of comments on environmental, economic and social sustainable development in VR and traditional classes was 31.2 and 17.2,23.8 and 19.8,22.6. and 17.4, respectively, and the average difference between the three data was 23.2. The data gap is significant. Due to the higher investment and activity of VR, VR class has expressed considerable views and understanding on the content of history course from several aspects of sustainable development.

Table4.Comparison of perceived sustainability in both groups

	VR	Traditional
a)Number of times the students presented their views on environmental sustainability	31.2	17.2
b)Number of students' views on economic sustainability	23.8	19.8
c)The number of times the students understand the sustainable development of the society	22.6	17.4

The results show that VR technology has significant potential in promoting sustainable development education. By simulating the consequences of environmental damage and the

importance of sustainable practice, VR technology is able to intuitively show students the urgency and necessity of sustainable development. This intuitive education makes it easier for students to resonate and stimulate their environmental awareness and responsibility. In addition, VR technology provides students with opportunities to practice sustainability by simulating sustainability programs that allow students to experience and practice sustainability principles and methods in a virtual environment.

Acknowledgements

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