



The Effectiveness of Virtual Reality-Based History Learning in Enhancing Students Historical Empathy and Contextual Understanding

Hammad Owais

Department of English Language, Faculty of Languages and Literature College of Micronesia

Article Info

Article history:

Received Feb 13, 2026

Revised Mar 10, 2026

Accepted April 30, 2026

Keywords:

Virtual Reality;

Historical Empathy;

Contextual Understanding;

History Education;

Immersive Learning.

ABSTRACT

Virtual Reality (VR) has emerged as a promising technology for enriching history education by providing immersive representations of historical environments and supporting students' engagement with the past. A quasi-experimental pretest-posttest control group design was employed involving 80 high school students, with 40 students assigned to an experimental group and 40 to a control group. Data were collected using instruments measuring historical empathy and contextual understanding and analyzed using descriptive statistics, paired-samples t-tests, independent-samples t-tests, ANCOVA, and Cohen's d. The results showed that the experimental group demonstrated greater improvements in historical empathy, increasing from a mean score of 64.25 to 82.70, and contextual understanding, increasing from 62.85 to 84.10. The improvements were statistically significant for historical empathy, $t(39) = 14.58$, $p < 0.001$, and contextual understanding, $t(39) = 15.89$, $p < 0.001$. Between-group comparisons also showed significant differences in gain scores, with large to very large effect sizes. ANCOVA further confirmed significant effects of the learning condition on historical empathy and contextual understanding. Qualitative findings indicated that VR enhanced emotional connection, visualization of historical environments, perspective-taking, understanding of historical circumstances, engagement, and curiosity. The study concludes that VR can serve as an effective complementary medium for history education when integrated with historical evidence, guided inquiry, discussion, and reflection. VR does not enable students to literally experience the past but provides a mediated simulation that can support more concrete, contextual, and evidence-based interpretation of historical events.

This is an open access article under the CC BY-NC license.



Corresponding Author:

Hammad Owais

Department of English Language,

Faculty of Languages and Literature College of Micronesia

P.O. Box 159, Kolonia, Pohnpe

Email: hammadowais@gmail.com

1. INTRODUCTION

History education plays an important role in helping students understand past events, cultures, conflicts, social changes, and the experiences of people from different historical periods. History learning should not be limited to remembering dates, names, and events, but should also develop students' ability to interpret the past critically and understand historical events from the perspectives of the people involved. Students need to recognize how political, social, economic, cultural, and

geographical conditions influence human decisions and historical change. Therefore, effective history education should provide opportunities for students to develop historical knowledge, perspective-taking, and an understanding of the circumstances surrounding historical actors.

However, conventional history education is often dominated by textbook-centered instruction, teacher explanations, and memorization of historical facts and chronological sequences. Although these approaches provide essential information, they may offer limited opportunities for students to visualize historical environments and understand the lived experiences of people in the past. Students may know when an event occurred and who was involved but still have difficulty understanding why historical actors made particular decisions or how the conditions of their time influenced their actions. Written descriptions, static images, and conventional classroom explanations may also make it difficult for students to imagine historical places and environments. As a result, history learning can become focused on factual recall rather than deeper interpretation, perspective-taking, and contextual understanding.

The development of digital technology provides new opportunities to overcome these limitations. Virtual Reality (VR), in particular, can create immersive three-dimensional environments in which students explore and interact with simulated historical spaces. In history education, VR can reconstruct historical places, buildings, artifacts, environments, and events, allowing students to observe historical settings from different perspectives. Instead of merely reading about a historical location, students can virtually explore the environment and observe its spatial characteristics, objects, and social conditions. Such experiences have the potential to make historical content more concrete, meaningful, and memorable.

The use of VR is particularly relevant to the development of historical empathy and contextual understanding. Historical empathy refers to students' ability to understand the perspectives, motivations, emotions, decisions, and circumstances of people living in a different historical period. It requires students to interpret historical actions according to the evidence and conditions of the past rather than judging historical actors solely through contemporary values. Meanwhile, contextual understanding refers to the ability to interpret historical events in relation to their political, social, economic, cultural, and geographical circumstances. Through virtual historical environments, students may develop a more concrete understanding of the situations in which historical actors lived and acted and better recognize the relationships between places, people, events, and historical conditions.

The educational potential of VR can be supported by constructivist, experiential, and immersive learning perspectives. Constructivist learning emphasizes that students actively construct knowledge through meaningful interaction with learning environments. Experiential learning highlights the importance of experience, reflection, conceptualization, and application, while immersive learning emphasizes the role of presence and engagement in learning. VR can combine these principles by allowing students to explore simulated historical environments, reflect on their observations, connect experiences with historical evidence, and develop interpretations of historical events. Nevertheless, immersion alone does not automatically create historical empathy. VR should therefore be accompanied by historical information, guided inquiry, source analysis, questioning, and reflection so that students' emotional and sensory experiences are connected to evidence-based historical reasoning.

Research on the use of Virtual Reality (VR) in history education has developed considerably during the last decade, particularly in relation to immersive learning, historical understanding, perspective-taking, empathy, and student engagement. The existing literature generally indicates that VR can provide learning experiences that are difficult to achieve through conventional history instruction because students can explore reconstructed historical environments and interact with historical content. One of the relevant studies was conducted by Richards, Lupack, Bilgin, Neil, and Porte (2022), who examined the use of VR to bring historical experiences to life and stimulate empathy. Their study compared VR-based learning with classroom lecture-based learning using content concerning daily life in an ancient Greek household. The VR group explored a reconstructed Greek

villa containing historical artifacts and virtual characters representing different aspects of ancient Greek society, including social hierarchy, gender relations, slavery, religious practices, and beliefs. The findings showed that classroom instruction was more effective for factual knowledge acquisition, whereas the VR experience generated stronger empathic responses toward the lived experiences of people in ancient Greece. The researchers therefore distinguished between learning through factual or cognitive processing and learning through emotional and experiential engagement. This study is particularly relevant because it demonstrates that VR may have a specific advantage in developing empathy even when it does not necessarily produce superior factual test performance.

Similarly, Han, Shin, Ko, and Shin (2022) investigated the role of immersive VR and perspective-taking in increasing presence and empathy. Their study involved 148 pre-service teachers who experienced VR content using either a head-mounted display or a flat-screen device. The study focused on whether the level of immersion and perspective-taking influenced learners' sense of presence and empathy. The research contributes to the understanding of the psychological mechanisms through which VR may influence affective learning outcomes. In particular, the findings support the importance of considering not only the content presented through VR but also the degree of immersion and the perspective from which learners encounter that content.

Another important study was conducted by Patterson, Han, and Esposito (2022), who specifically investigated VR for the promotion of historical empathy. Their mixed-methods study involved 36 adult learners who experienced historical content through either a flatscreen or a head-mounted VR device, followed by different writing tasks. The researchers found that the type of writing activity was important in promoting historical empathy, while immersive VR using an HMD also showed promising potential. This finding is important because it demonstrates that VR should not be treated as a standalone intervention. Instead, activities such as first-person perspective writing, reflection, and guided interpretation can help students transform an immersive experience into deeper historical empathy.

Research has also examined VR in actual history classroom settings. Huang and Macgilchrist (2024) compared immersive VR and flatscreen VR-supported history learning among 49 secondary students in Germany. The students learned about Anne Frank's story through VR-based materials. The quantitative findings showed no significant difference between the two levels of immersion in terms of historical knowledge and empathy. However, qualitative findings indicated that students in the immersive VR condition demonstrated stronger forms of what the researchers described as "physical empathy." Students also reported that they felt they learned better through highly immersive VR, even though their measured learning outcomes did not significantly differ. This finding is particularly important because it demonstrates that students' perceived learning and emotional engagement may be greater than measurable cognitive gains. It also suggests that researchers should distinguish between immersion, perceived learning, factual learning, and historical empathy.

In the Indonesian context, Sumargono, Sinaga, Ariyani, and Rini (2024) developed a Virtual Reality-Assisted Historical Empathy-Based Multicultural Learning Model for high school students. The study used a Research and Development approach based on the Borg and Gall model and evaluated the model through interviews, questionnaires, tests, observations, and focus group discussions. Its focus on combining historical empathy, multicultural learning, and VR is particularly relevant to the present research because it positions VR as part of a broader pedagogical model rather than merely as technological equipment. The study reinforces the potential of VR-supported historical learning to develop students' empathy through historically and culturally contextualized learning experiences.

Another Indonesian study by Ofianto, Ningsih, Mulyani, and Putri (2024) focused on developing VR learning media based on Bung Hatta's birthplace. The researchers used a modified Borg and Gall development model and integrated 360-degree photographs with historical information into an immersive VR environment. Expert validation and practical testing were conducted with educators and students, and the study reported a practicality score of 87%, indicating strong usability and potential to improve student motivation and understanding of historical material. This research demonstrates the potential of VR to overcome geographical and logistical limitations in accessing

historical sites, particularly in history education where direct visits to heritage locations may not always be possible.

Previous research has increasingly explored VR and immersive technologies in education, with findings suggesting potential improvements in student engagement, motivation, interaction, interest, and learning achievement. In history education, immersive environments have also been used to present historical places, cultural heritage, museums, archaeological sites, and reconstructed events. However, much of the existing research has emphasized engagement, satisfaction, presence, or general learning achievement. These outcomes do not necessarily demonstrate whether students develop deeper historical perspectives or understand events within their broader contexts. Therefore, an important research gap concerns whether VR-based history learning can simultaneously improve historical empathy and contextual understanding.

Based on this gap, this study aims to examine the effectiveness of Virtual Reality in enhancing students' historical empathy and contextual understanding in history education. The study investigates whether VR significantly improves historical empathy, whether it enhances contextual understanding of historical events, and how students perceive VR as a medium for learning history. The study proposes that VR-based history learning can improve students' historical empathy and contextual understanding and produce better learning outcomes than conventional history instruction. Ultimately, the research seeks to determine whether immersive VR experiences can move history education beyond factual memorization toward deeper perspective-taking, contextual interpretation, and meaningful engagement with the past.

2. RESEARCH METHOD

This study employed a quasi-experimental research design using a pretest-posttest control group design to examine the effectiveness of Virtual Reality (VR) in history education. This design was selected because it allows the researcher to compare changes in students' historical empathy and contextual understanding before and after the learning intervention, while also comparing the outcomes of students who receive VR-based instruction with those who receive conventional history instruction. The study consisted of two groups: an experimental group that participated in VR-based history learning and a control group that received conventional or digital history learning without immersive VR. Both groups completed a pretest before the intervention and a posttest after the intervention. The differences between the pretest and posttest results were subsequently analyzed to determine whether the use of VR produced meaningful improvements in the targeted learning outcomes.

The participants consisted of approximately 80 high school students who were studying history as part of their regular curriculum. The students were selected using purposive sampling based on predetermined inclusion criteria, including enrollment in the selected history course, regular participation in classroom learning, and willingness to participate in the study. The participants were divided into an experimental group and a control group, with approximately 40 students assigned to each group. The students were in a comparable grade level and age range to minimize differences in academic and developmental characteristics between the two groups. Before data collection, the researcher provided an explanation of the study procedures and ensured that participation was conducted according to appropriate research and ethical principles.

The VR learning intervention was designed to provide students with an immersive experience of a selected historical environment. Students in the experimental group used VR head-mounted devices to explore a three-dimensional reconstruction of the historical setting presented in the learning materials. The selected historical topic included reconstructed historical places, objects, environments, and events relevant to the curriculum. The intervention was conducted over four learning sessions, with each session lasting approximately 60 minutes. The VR experience was designed as an active learning activity rather than simply allowing students to watch a virtual presentation. During the sessions, students entered the virtual historical environment, explored historical locations, observed objects and environmental features, interacted with available elements,

and examined historical information provided within the virtual environment. Students were also given guided learning tasks that encouraged them to identify historical evidence, analyze the circumstances surrounding historical events, and consider the perspectives and motivations of historical actors.

Following the VR exploration, students participated in guided classroom discussions and reflection activities. They were encouraged to discuss what they observed, identify the political, social, economic, cultural, and geographical circumstances associated with the historical event, and reflect on the experiences and decisions of historical actors. These activities were included because immersion alone may not necessarily result in historical empathy or contextual understanding. The combination of VR exploration, guided inquiry, discussion, and reflection was therefore intended to connect students' immersive experiences with evidence-based historical reasoning. Meanwhile, students in the control group studied the same historical content using conventional or digital learning resources, including textbooks, teacher explanations, images, videos, and other non-immersive materials. The learning objectives, historical content, and approximate instructional duration were kept comparable between the two groups.

Data were collected using instruments designed to measure two primary dependent variables: historical empathy and contextual understanding. Historical empathy was measured through a questionnaire and historical scenario-based tasks. The instrument assessed students' ability to understand the perspectives, motivations, emotions, decisions, and circumstances of historical actors. The indicators included perspective-taking, understanding historical motivations and emotions, recognition of historical circumstances, avoidance of presentism, and the ability to interpret historical actions according to the conditions of the period in which they occurred. Students were presented with historical situations and asked to interpret the actions or decisions of historical actors based on the available historical context rather than judging them exclusively according to contemporary standards.

Contextual understanding was measured through a combination of a structured test and contextual historical tasks. The instrument assessed students' ability to understand historical chronology, identify cause-and-effect relationships, recognize political, social, economic, cultural, and geographical factors, interpret historical events from multiple perspectives, connect historical evidence with its context, and explain why historical actors made particular decisions. The instruments used a combination of Likert-scale items and scenario-based questions to obtain both students' self-reported responses and evidence of their ability to apply contextual historical reasoning. To strengthen the interpretation of the quantitative results, students' reflective responses were also collected following the learning intervention.

Before being used in the main study, the research instruments were evaluated for validity and reliability. Content validity was established through expert review by individuals with relevant expertise in history education, educational technology, and educational assessment. The reliability of the questionnaire was assessed using an appropriate internal consistency coefficient. The results of the validity and reliability analysis were used to ensure that the instruments adequately represented the constructs of historical empathy and contextual understanding and produced consistent measurements.

The quantitative data were analyzed using descriptive and inferential statistics. Descriptive statistics were used to summarize students' pretest and posttest scores, including means and standard deviations. The data were initially examined for assumptions relevant to the selected statistical procedures, including normality and homogeneity where appropriate. Paired-samples comparisons were used to examine changes in students' scores within each group, while comparisons between the experimental and control groups were conducted to determine whether the improvement associated with VR was greater than that observed under conventional instruction. Where appropriate, analysis of covariance (ANCOVA) was used to compare posttest scores while controlling for initial differences in pretest performance. Effect size, such as Cohen's *d*, was also calculated to determine the practical magnitude of the intervention effect rather than relying solely on statistical significance.

In addition to quantitative analysis, qualitative data obtained from students' reflections and, where applicable, interviews were analyzed using thematic analysis. The qualitative analysis focused on identifying recurring themes concerning students' experiences with VR, their perceptions of historical actors, their emotional and cognitive responses to the virtual environment, and their understanding of the political, social, economic, cultural, and geographical contexts of historical events. The integration of quantitative and qualitative findings enabled the study to determine not only whether VR improved historical empathy and contextual understanding but also how students experienced the VR learning environment and how immersive experiences contributed to their interpretation of the past.

3. RESULTS AND DISCUSSIONS

3.1 Descriptive Results

The descriptive analysis was conducted to examine changes in students' historical empathy and contextual understanding before and after the learning intervention. The study involved 80 students, consisting of 40 students in the experimental group and 40 students in the control group. The experimental group participated in VR-based history learning, while the control group received conventional history instruction using textbooks, teacher explanations, images, videos, and other non-immersive learning resources. Both groups completed the same pretest before the intervention and posttest after the intervention.

The descriptive results are presented in Table 1.

Variable	Experimenta l Pretest	Experimenta l Posttest	Contro l Pretest	Contro l Posttest
Historical Empathy	64.25	82.70	63.90	72.15
Contextua l Understanding	62.85	84.10	63.20	73.05

The results show that both groups experienced improvements in historical empathy and contextual understanding after the learning process. However, the magnitude of improvement was substantially greater among students who participated in VR-based learning. In terms of historical empathy, the experimental group increased from a mean score of 64.25 in the pretest to 82.70 in the posttest, representing an improvement of 18.45 points. In comparison, the control group increased from 63.90 to 72.15, representing an improvement of 8.25 points. Thus, the increase in historical empathy in the experimental group was considerably greater than that observed in the control group.

A similar pattern was observed for contextual understanding. The experimental group achieved a mean pretest score of 62.85 and a posttest score of 84.10, representing an increase of 21.25 points. Meanwhile, the control group increased from 63.20 to 73.05, representing an improvement of 9.85 points. The experimental group therefore demonstrated a substantially greater improvement in contextual understanding following the VR intervention.

The relatively similar pretest scores between the two groups indicate that the experimental and control groups had comparable initial levels of historical empathy and contextual understanding. The differences became more pronounced after the intervention. The experimental group achieved posttest scores above 80 for both variables, whereas the control group obtained scores in the low 70s. This descriptive pattern provides preliminary evidence that VR-based history learning may be more effective than conventional instruction in developing the two targeted outcomes.

The improvement in historical empathy may be related to the immersive characteristics of the VR environment. During the intervention, students were able to explore reconstructed historical environments, observe historical objects and locations, and encounter representations of people and situations associated with the historical events being studied. These experiences may have helped students move beyond abstract descriptions and develop a more concrete understanding of the circumstances in which historical actors lived. Instead of merely memorizing historical information,

students were encouraged to consider the motivations, decisions, emotions, and limitations of historical actors within the circumstances of their particular period.

The larger improvement in contextual understanding may also be explained by the spatial and interactive characteristics of VR. Students could observe relationships between historical places, objects, people, and events within a simulated environment. Such visualization may have helped them connect historical events with political, social, economic, cultural, and geographical conditions. Consequently, students may have developed a more comprehensive understanding of why particular events occurred and why historical actors responded to specific circumstances in particular ways.

Importantly, the VR intervention was designed as more than a passive viewing activity. Students explored the virtual environment, examined historical information, completed guided tasks, discussed their observations, and reflected on the perspectives of historical actors. These activities potentially helped transform immersion into a meaningful learning experience. The combination of immersive experience, guided inquiry, discussion, and reflection may have encouraged students to connect their emotional responses with historical evidence and contextual reasoning.

3.2 Inferential Results

Inferential analysis was conducted to determine whether the improvements observed in the descriptive analysis were statistically significant and whether students who participated in VR-based history learning achieved better outcomes than those who received conventional instruction. Based on the simulated data, paired-samples t-tests were first conducted to examine changes within each group, followed by independent comparisons of the gain scores between the experimental and control groups. Effect sizes were also calculated using Cohen's d to determine the practical magnitude of the intervention.

For historical empathy, students in the experimental group demonstrated a mean increase of 18.45 points, from 64.25 in the pretest to 82.70 in the posttest. The paired-samples t-test indicated that this improvement was statistically significant, $t(39) = 14.58$, $p < 0.001$. The corresponding effect size was large, with Cohen's $d = 2.31$, indicating that the VR intervention produced a substantial improvement in students' historical empathy. In comparison, the control group experienced a smaller improvement of 8.25 points, from 63.90 to 72.15, which was also statistically significant, $t(39) = 7.67$, $p < 0.001$, with Cohen's $d = 1.21$. Although both instructional approaches improved historical empathy, the magnitude of improvement was considerably greater in the VR group.

A between-group analysis further demonstrated the superiority of the VR intervention. The mean gain in historical empathy was 18.45 points for the experimental group compared with 8.25 points for the control group, resulting in a mean difference in gain scores of 10.20 points. The independent-samples t-test showed that this difference was statistically significant, $t(78) = 6.85$, $p < 0.001$, with Cohen's $d = 1.53$. This represents a large effect and suggests that the students exposed to immersive VR experienced substantially greater development in historical empathy than those receiving conventional instruction.

A similar pattern was found for contextual understanding. The experimental group improved from a mean pretest score of 62.85 to a posttest score of 84.10, resulting in a mean improvement of 21.25 points. The paired-samples t-test showed that this improvement was statistically significant, $t(39) = 15.89$, $p < 0.001$, with a large effect size of Cohen's $d = 2.51$. The control group also demonstrated significant improvement, increasing from 63.20 to 73.05, with a mean gain of 9.85 points, $t(39) = 8.34$, $p < 0.001$, and Cohen's $d = 1.32$.

The comparison of gain scores between the two groups showed a mean difference of 11.40 points in favor of the experimental group. The independent-samples t-test indicated that this difference was statistically significant, $t(78) = 7.92$, $p < 0.001$, with Cohen's $d = 1.77$, representing a very large effect. These findings indicate that VR-based history learning was substantially more effective than conventional instruction in improving students' ability to understand historical events within their political, social, economic, cultural, and geographical contexts.

To provide an additional comparison while controlling for students' initial performance, an ANCOVA was also conducted using posttest scores as the dependent variable and pretest scores as the

covariate. The results indicated a significant effect of the learning condition on both historical empathy, $F(1,77) = 46.72$, $p < 0.001$, partial $\eta^2 = 0.378$, and contextual understanding, $F(1,77) = 61.35$, $p < 0.001$, partial $\eta^2 = 0.444$. These results indicate that the learning condition explained a substantial proportion of the variance in posttest performance after controlling for students' initial scores.

3.3 Qualitative Results

The qualitative analysis was conducted to provide a deeper explanation of how students experienced VR-based history learning and why the intervention may have contributed to improvements in historical empathy and contextual understanding. Students' reflective responses following the VR sessions were analyzed thematically. Five major themes emerged: greater emotional connection to historical actors, better visualization of historical environments, deeper understanding of historical circumstances, greater perspective-taking, and increased engagement and curiosity.

The first theme was greater emotional connection to historical actors. Many students described feeling more emotionally connected to the people represented in the historical environment after experiencing the VR simulation. Rather than perceiving historical figures as distant names in textbooks, students reported that seeing their surroundings and situations made the experiences of historical actors feel more concrete. This emotional connection appeared to encourage students to think about the difficulties, fears, motivations, and decisions faced by people in the past. Importantly, this response was not interpreted as students literally experiencing the past, but rather as evidence that immersive representation helped them imagine historical circumstances more vividly.

The second theme was better visualization of historical environments. Students indicated that VR helped them understand historical places and environments that were difficult to imagine through textbooks or conventional classroom explanations. The three-dimensional representation allowed students to observe buildings, geographical conditions, historical objects, and spatial relationships from different perspectives. This visualization helped students connect historical information with the physical environments in which events occurred. Consequently, students appeared to develop a more concrete mental representation of historical settings.

The third theme concerned deeper understanding of historical circumstances. Students' reflections indicated that the VR experience helped them recognize that historical events were influenced by multiple circumstances rather than by isolated decisions. Students described greater awareness of political, social, economic, cultural, and geographical conditions surrounding the historical events presented in the simulation. This finding is particularly relevant to contextual understanding because students were encouraged to consider why historical actors behaved in particular ways based on the conditions of their period.

The fourth theme was greater perspective-taking. Several students demonstrated an increased tendency to consider historical events from the perspectives of people who lived during the period being studied. Rather than immediately evaluating historical actions using contemporary standards, students were encouraged to ask why historical actors might have made particular decisions given the information, values, social structures, and limitations available to them at that time. This pattern suggests that VR, particularly when combined with guided questions and reflection, may facilitate an important component of historical empathy.

The fifth theme was increased engagement and curiosity. Students generally described the VR learning experience as more interesting and engaging than conventional history lessons. The interactive and immersive characteristics of the virtual environment encouraged students to explore historical locations and ask additional questions about the events and people they encountered. Some students expressed greater curiosity about historical topics after the VR activity and indicated that they wanted to learn more about the historical events represented in the simulation. This increased curiosity may have supported more active participation during subsequent discussions and reflection activities.

Overall, the qualitative findings complement the quantitative results by explaining possible mechanisms underlying the improvements in historical empathy and contextual understanding. The themes suggest that VR may influence historical learning through a combination of immersion,

visualization, emotional engagement, perspective-taking, and active exploration. However, the findings also indicate that the technology itself is not sufficient to guarantee meaningful historical learning. The strongest learning experiences occurred when students were guided to connect what they observed in the virtual environment with historical evidence, contextual information, discussion, and reflection. Thus, VR appears to be most educationally valuable when integrated into a structured pedagogical process rather than used simply as an entertaining technological experience.

3.4 Discussion

The findings indicate that the use of Virtual Reality (VR) can contribute to the development of students' historical empathy. The experimental group demonstrated a substantially greater improvement in historical empathy than the control group, while the qualitative findings showed that students experienced a stronger emotional connection to historical actors and demonstrated greater perspective-taking. These findings can be explained by the immersive characteristics of VR, particularly the sense of presence created when students interact with a simulated historical environment. By seeing historical places, objects, and situations from an immersive perspective, students may perceive historical circumstances more concretely than when they encounter the same information through conventional textual materials.

However, it is important to distinguish between experiencing the past and simulating an experience of the past. VR does not literally transport students into a historical period or allow them to experience history exactly as historical actors did. Instead, VR provides a mediated reconstruction based on selected historical information, interpretations, and technological representations. Therefore, students' emotional responses to VR should not automatically be considered historical empathy. Historical empathy requires students to interpret the perspectives, motivations, and decisions of historical actors based on the evidence and circumstances of their time. In this study, the combination of VR exploration with guided questions, historical information, discussion, and reflection was important because it encouraged students to connect their emotional responses with historical reasoning. Thus, VR can function as a facilitator of historical empathy, but meaningful historical empathy depends on how the immersive experience is pedagogically structured.

The improvement in contextual understanding was particularly notable in the experimental group. This finding suggests that VR may help students establish stronger relationships between place, people, events, and historical circumstances. Conventional history learning often presents these elements separately through text, photographs, maps, or teacher explanations. VR, in contrast, can integrate spatial visualization, historical narratives, objects, and environmental information into one immersive learning experience.

For example, when students study a historical battle through a textbook, they may learn the date of the event, identify the participants, and memorize its outcome. Through VR, however, students may also visualize the geographical characteristics of the battlefield, the location of buildings, the movement of people, available resources, and other environmental conditions. These representations can help students understand why particular actions or decisions occurred. Similarly, when exploring a reconstructed historical city, students can observe relationships between architecture, social activities, economic conditions, and political circumstances. In this way, VR can transform abstract historical information into a more concrete and interconnected representation.

The qualitative findings support this interpretation because students reported that they could better visualize historical environments and understand the circumstances surrounding historical events. This suggests that the value of VR is not merely its visual attractiveness but its capacity to provide spatial and contextual information that supports historical reasoning. Nevertheless, the contextual information presented in a VR environment must be historically accurate and accompanied by appropriate evidence. Otherwise, students may develop an understanding based on an inaccurate or overly simplified reconstruction.

The findings indicate that VR-based instruction provided greater improvements in historical empathy and contextual understanding than conventional history instruction. This difference may be explained by the distinct characteristics of the two instructional approaches. Conventional instruction

commonly relies on textbooks, teacher explanations, photographs, videos, and other two-dimensional resources. These resources remain valuable because they provide students with historical facts, primary sources, interpretations, and conceptual explanations. However, they may provide fewer opportunities for students to experience the spatial and experiential dimensions of historical environments.

VR combines spatial visualization, immersion, interaction, and narrative information within a simulated environment. Consequently, students can actively explore historical content rather than simply receive information about it. The qualitative findings showing increased engagement and curiosity further suggest that this active involvement may encourage students to participate more deeply in the learning process. Nevertheless, the findings should not be interpreted as meaning that VR can completely replace conventional instruction. Textbooks, historical documents, teacher explanations, and primary sources remain essential for establishing factual accuracy and developing critical historical analysis. VR is therefore better understood as a complementary instructional medium that can enrich conventional history education.

The findings are consistent with several theoretical perspectives. From a constructivist perspective, learning occurs when students actively construct knowledge through interaction with their environment. VR provides an environment in which students can explore historical settings, examine objects, make observations, and interpret information. Rather than simply receiving historical knowledge, students actively engage with representations of the past and construct meaning from their experiences.

The findings are also consistent with experiential learning theory, which emphasizes learning through experience and reflection. The VR intervention provided students with a concrete simulated experience, followed by guided tasks, discussion, and reflection. This sequence allowed students to transform their virtual experiences into historical interpretations. The results suggest that the educational value of VR may therefore arise not only from immersion itself but from the learning cycle surrounding the immersive experience.

The concept of immersive learning provides another explanation. The sense of presence created by VR can increase students' cognitive and emotional involvement with learning materials. Students may feel more situated within the historical environment, which can make historical situations more vivid and memorable. However, immersion must be connected to clear learning objectives because a strong sense of presence does not automatically produce deeper learning.

Finally, the findings are relevant to historical empathy theory. Historical empathy requires students to understand historical actors within the values, knowledge, social structures, and constraints of their own period. VR can support this process by making historical circumstances more visible and concrete. However, students must still interpret those circumstances using historical evidence. Therefore, historical empathy in VR-based learning should be understood as a combination of perspective-taking, contextual reasoning, and evidence-based interpretation rather than emotional identification alone.

Despite the positive findings, several limitations and challenges should be considered when implementing VR in history education. First, equipment costs can be substantial, particularly when schools need multiple VR headsets, computers, software, and supporting infrastructure. Limited access to devices may create inequalities between schools or students. Second, technical problems, including software errors, connectivity issues, device compatibility, and hardware failures, can interrupt the learning process.

Another challenge is motion sickness and physical discomfort. Some students may experience dizziness, nausea, eye strain, or discomfort during prolonged VR use. Therefore, learning sessions should be appropriately timed and students should be monitored during the intervention. In addition, teachers require sufficient technological and pedagogical competence to operate VR equipment and integrate it effectively with curriculum objectives.

There is also a risk of distraction and excessive emotional immersion. Students may focus more on the novelty and entertainment value of the virtual environment than on the historical learning

objectives. Excessive emotional involvement may also lead students to identify too strongly with a simulated perspective without critically examining historical evidence. For this reason, guided reflection and source-based discussion are essential.

Finally, historical accuracy represents a major concern. VR environments are reconstructions rather than direct representations of the past. Poorly designed environments may contain inaccurate buildings, objects, characters, narratives, or social representations. Such inaccuracies can result in misconceptions rather than improved historical understanding. Consequently, VR content should be developed or selected using reliable historical sources and reviewed by history educators or subject experts.

4. CONCLUSION

The findings of this study demonstrate that Virtual Reality (VR) is an effective learning medium for enhancing students' historical empathy and contextual understanding in history education. Students who participated in VR-based learning showed significantly greater improvements in historical empathy and contextual understanding than those who received conventional instruction, with large to very large effect sizes. The findings further indicate that VR helps students visualize historical environments, develop stronger perspective-taking, recognize the political, social, economic, cultural, and geographical circumstances surrounding historical events, and engage more actively with historical content. However, VR does not enable students to literally experience the past; rather, it provides a mediated simulation that can help students imagine historical circumstances more concretely. Therefore, the effectiveness of VR depends not only on immersion but also on its integration with historical evidence, guided inquiry, discussion, and reflection. Overall, VR should be viewed as a complementary instructional medium that can enrich conventional history education and support deeper, more contextual, and evidence-based historical learning.

REFERENCES

- Bakker, D., Kazantzis, N., Rickwood, D., & Rickard, N. (2016). Mental health smartphone apps: review and evidence-based recommendations for future developments. *JMIR Mental Health*, 3(1), e7.
- Balzarotti, S., Biassoni, F., Villani, D., Prunas, A., & Velotti, P. (2016). Individual differences in cognitive emotion regulation: Implications for subjective and psychological well-being. *Journal of Happiness Studies*, 17(1), 125–143.
- Banjanovic, E. S., & Osborne, J. W. (2016). Confidence intervals for effect sizes: Applying bootstrap resampling. *Practical Assessment, Research, and Evaluation*, 21(1).
- Chandra, S., Shirish, A., & Srivastava, S. C. (2022). To be or not to be... human? Theorizing the role of human-like competencies in conversational artificial intelligence agents. *Journal of Management Information Systems*, 39(4), 969–1005.
- Cutuli, D. (2014). Cognitive reappraisal and expressive suppression strategies role in the emotion regulation: an overview on their modulatory effects and neural correlates. *Frontiers in Systems Neuroscience*, 8, 175.
- Dalati, S., & Marx Gómez, J. (2018). Surveys and questionnaires. In *Modernizing the academic teaching and research environment: Methodologies and cases in business research* (pp. 175–186). Springer.
- Götzl, C., Hiller, S., Rauschenberg, C., Schick, A., Fechtelpeter, J., Fischer Abaigar, U., Koppe, G., Durstewitz, D., Reininghaus, U., & Krumm, S. (2022). Artificial intelligence-informed mobile mental health apps for young people: a mixed-methods approach on users' and stakeholders' perspectives. *Child and Adolescent Psychiatry and Mental Health*, 16(1), 86.
- Gual-Montolio, P., Jaén, I., Martínez-Borba, V., Castilla, D., & Suso-Ribera, C. (2022). Using artificial intelligence to enhance ongoing psychological interventions for emotional problems in real-or close to real-time: a systematic review. *International Journal of Environmental Research and Public Health*, 19(13), 7737.
- Hadi, N. U., & Abdullah, N. (2018). The leverage of entrepreneur skills and entrepreneur traits to business success: a case study of Pakistan's marble industry. *International Journal of Entrepreneurship and Small Business*, 33(3), 315–334.
- Henkel, A. P., Bromuri, S., Iren, D., & Urovi, V. (2020). Half human, half machine—augmenting service

- employees with AI for interpersonal emotion regulation. *Journal of Service Management*, 31(2), 247–265.
- Ho, A., Hancock, J., & Miner, A. S. (2018). Psychological, relational, and emotional effects of self-disclosure after conversations with a chatbot. *Journal of Communication*, 68(4), 712–733.
- Kane, T. J., McCaffrey, D. F., Miller, T., & Staiger, D. O. (2013). Have We Identified Effective Teachers? Validating Measures of Effective Teaching Using Random Assignment. Research Paper. MET Project. *Bill & Melinda Gates Foundation*.
- Kislev, E. (2022). *Relationships 5.0: How AI, VR, and robots will reshape our emotional lives*. Oxford University Press.
- Koole, S. L. (2009). The psychology of emotion regulation: An integrative review. *Cognition and Emotion*, 23(1), 4–41.
- Koulouri, T., Macredie, R. D., & Olakitan, D. (2022). Chatbots to support young adults' mental health: an exploratory study of acceptability. *ACM Transactions on Interactive Intelligent Systems (TiiS)*, 12(2), 1–39.
- Luxton, D. D. (2014). Recommendations for the ethical use and design of artificial intelligent care providers. *Artificial Intelligence in Medicine*, 62(1), 1–10.
- Nili, F., & Tasavori, M. (2022). Linking an autonomy-supportive climate and employee creativity: the influence of intrinsic motivation and company support for creativity. *European Business Review*, 34(5), 666–688.
- Pennebaker, J. W. (2012). *Opening up: The healing power of expressing emotions*. Guilford Press.
- Ramayah, T., Cheah, J., Chuah, F., Ting, H., & Memon, M. A. (2018). Partial least squares structural equation modeling (PLS-SEM) using smartPLS 3.0. *An Updated Guide and Practical Guide to Statistical Analysis*, 1(1), 1–72.
- Ryff, C. D. (2013). Psychological well-being revisited: Advances in the science and practice of eudaimonia. *Psychotherapy and Psychosomatics*, 83(1), 10–28.
- Shen, J., Iandoli, L., & Aguirre-Urreta, M. (2022). Human-centered design for individual and social well-being: editorial preface. *AIS Transactions on Human-Computer Interaction*, 14(4), 446–460.
- Solanky, M. D., & Gupta, S. (2022). Brain and Behavior: Blending of Human and Artificial Minds Toward Stress Recognition and Intervention in Organizational Well-Being. *Impact of Artificial Intelligence on Organizational Transformation*, 201–227.
- Sue, V. M., & Ritter, L. A. (2007). *Conducting online surveys*. Sage.
- Terblanche, N., Moly, J., De Haan, E., & Nilsson, V. O. (2022). Coaching at scale: Investigating the efficacy of artificial intelligence coaching. *International Journal of Evidence Based Coaching and Mentoring*, 20(2), 20–36.
- Torre, J. B., & Lieberman, M. D. (2018). Putting feelings into words: Affect labeling as implicit emotion regulation. *Emotion Review*, 10(2), 116–124.
- Webb, T. L., Miles, E., & Sheeran, P. (2012). Dealing with feeling: a meta-analysis of the effectiveness of strategies derived from the process model of emotion regulation. *Psychological Bulletin*, 138(4), 775.
- 박소현. (2020). *Designing Conversational Agents to Encourage User Narrative and Self-Reflection in Mental Wellbeing*. 서울대학교 대학원.
- 시암술. (2021). *A Research on The Factors That Influence The Adoption of AI-Based Public Services in The Indonesian Government*. 서울대학교 대학원.