Teacher Candidates' Perceptions of Individual and Collective Virtual Reality Experiences for Teaching History

"Can Virtual Reality Revolutionize Education?"
"Virtual Reality for Learning Raises High Hopes and Serious Concerns"

– Headlines from 2018

Lauren McArthur Harris, *Arizona State University*
Toby Vaughn Kidd, *University of Exeter*
Bea Rodriguez-Fransen, *Arizona State University*
Victoria E. Thompson, *Georgia Institute of Technology*

THESE HEADLINES from 2018 point to questions and potential benefits and concerns regarding virtual reality (VR) as an emerging technology for education.[1] While the headlines were written seven years ago, a VR *revolution* in K-12 schools has yet to occur; however, interest and investment in the technology have grown.[2] VR experiences in history are one area of pedagogical interest and research.[3] Considering that a major factor in adopting new technology in schools is how teachers perceive the technology as aligning with their goals,[4] our team[5] sought to study how future history teachers (teacher candidates) perceived two types of VR history experiences—collective and individual—to understand how they might consider using VR in their future teaching. In this study, we asked:

1) What affordances and challenges do teacher candidates experience and consider pedagogically in an individual VR history experience versus a collective VR history experience?

2) What potential do teacher candidates see in using VR technology in their future history teaching?

In what follows, we first examine some of the prior research on individual and collective VR experiences before discussing our methods and findings.

Collective and Individual VR Experiences

Lindsay Gibson and colleagues defined VR as "an immersive and interactive computer-generated three-dimensional (3-D) digital environment designed to create presence in a virtual place or space."[6] The immersion can be through sound, images, touch, and/or smell. Most research has focused on experiences where a person engages in VR on their own;[7] however, there has been some research on collective and social experiences that people can have through VR. For example, in studying a VR tourist experience at a Marine Life Center where participants were able to see and interact with each other, Sarah Hudson and colleagues found the social interaction within the VR had "significant positive effects on customer satisfaction with the experience."[8] Another study found that a multi-person therapeutic VR experience could produce connectedness comparable to psychedelics, "where people dissolve their sense of self in the connection to others."[9]

Some scholars have argued that history is a well-suited subject for VR experiences.[10] For example, John Allison noted "the ability to simultaneously depict many aspects of the past, several strands of research, and different points of view make the development of virtual environments particularly useful for history educators."[11] There has, however, been limited research on VR in history education; as Gibson and colleagues noted in describing research on virtual environments (VE) writ large: "most VE research in history education focuses on historical digital games that utilize technologies that are not 'virtual' because they feature low levels of immersion and natural interaction."[12]

The research that has been conducted on VR experiences in history has, to our knowledge, focused on individual rather than collective experiences. This individual VR research has highlighted areas of potential as well as challenges. Ashley Riner and colleagues studied the impact of VR history experiences on high school student

learning.[13] The quasi-experimental study compared students' experiences in the fully immersive Anne Frank VR using Oculus Quest (experimental group) and the non-immersive experience using the 3D website (control group). Although there were not statistically significant differences in student learning between the groups, qualitative data showed positive learning benefits and engagement in both groups. The authors also found that there were significant increases in three levels of historical empathy in both groups. Students faced some challenges using the headsets, and the teacher expressed concerns about the cost of the technology.

Another recent study examined the potential of using VR devices to promote college students' historical empathy. Participants were placed in two groups and experienced the same film—*Defying the Nazis*—either on a flat screen or through a more immersive "head mounted VR device,"[14] where the device tracked head movements and displayed scenes in the direction where they looked. The authors found that the group who used the VR device demonstrated "slightly higher historical empathy scores in their writing samples."[15]

As seen in these two examples, because of the design of VR to transport people to another "reality," including different time periods, some scholars have linked VR experiences in history to goals to develop historical empathy. Jason Endacott and Sarah Brooks defined historical empathy as "the process of students' cognitive and affective engagement with historical figures to better understand and contextualize their lived experiences, decisions, or actions."[16] Historical empathy is included in many state standards in the United States and in the *C3 Framework*, a national document intended to help frame state standards. Despite these widespread goals, however, some scholars have cautioned about the use of the VR space for historical empathy work when dealing with sensitive and traumatic topics. For example, Sara Pitcairn, Silvina Fernandez-Duque, and Michael Haley Goldman wrote:

> It is tempting to use the VR machine to take you immediately into someone else's shoes to assume that you will gain knowledge this way—but it could be a trap. There is value in visualizing a spatial environment that cannot be gleaned from photos or written descriptions, but we can only enter that place of trauma from the perspective of an observer; the complexity and impossibility of knowing someone's traumatic situation should be at the forefront.[17]

To address this concern in their work with VR at the United States Holocaust Memorial Museum (USHMM), the authors used Liora Gubkin's framework of *engaged witnessing*[18] to promote an observer stance with a focus on multiple perspectives and engagement with the broader historical context.

Study Context

The VR experiences in the current exploratory study consisted of a collective experience on World War I designed by faculty and staff at the Next Lab at Arizona State University (ASU) and an individual VR experience centered on the Anne Frank House. We briefly discuss each below before discussing our study method.

Collective VR Experience Context

Next Lab at ASU explores emerging technologies, cultivates future-ready skills, and activates interdisciplinary collaboration to shape interactions and insights that positively impact society. The Lab is positioned within the university to engage across all academic disciplines, collaborate with university support teams, and engage with external industry, government, academic, and nonprofit partners. Projects leverage the converging technologies of spatial computing, game tech, artificial intelligence (AI), and other emerging technologies. Huddle is a VR environment developed by Next Lab that features interactive educational tools for immersive visualization and learning facilitation that can be deployed in classrooms using a portable infrastructure. The Huddle environment provides a synchronous experience by which students can interact with objects and each other in real time. The presence of virtual objects and tools is controlled by a facilitator from a desktop computer, with full access to view the students' activity and communicate verbally without the need to be present in VR. When a 3D object is "spawned" for the students, they can reach out and pick up the item, rotate it freely, and pass it to the other users at the table.

In 2022, Next Lab staff teamed up with historian Victoria Thompson (Author 4) to create a VR experience on World War I using Huddle. The goal was to help students understand how

and why the experience of fighting on the Western Front affected soldiers' attitudes toward the war. The experience was designed around a series of objects that were available in VR form.[19] These included an army uniform, a leather and steel helmet, and several weapons. The environment in which students viewed the objects was a VR rendering of no-man's land (the territory between the British/French and German trenches) developed by the Next Lab team.

Individual VR Experience Context

The Anne Frank House VR fully immersive experience is a publicly available application (app) developed by Vertigo Games in coordination with the Anne Frank House Museum in Amsterdam. The museum website describes the app as providing "a very special view into the Secret Annex where Anne Frank and seven other people hid during WWII."[20] Although the rooms of the Secret Annex in the physical museum in Amsterdam are empty, in the app, people can see and interact with furniture and objects as observers as they tour the rooms using headsets. A contextual video plays at the beginning of the VR tour, and at various points during the tour, a voice reads sections of Anne Frank's diary.[21]

Method

Course and Participants

Study participants were teacher candidates enrolled in a secondary methods of teaching history course taught in the history department at ASU, a large public research university. The course focused on pedagogical strategies instead of any one historical period, region, or topic. Throughout the course, teacher candidates participated in instructional strategy activities (e.g., Socratic discussion, mock trials, primary source analysis) related to different historical topics and analyzed how they might apply those activities to their future teaching. Before the VR experience in the last part of the course, the class had discussed topics such as historical empathy, historical thinking skills, and designing inquiry activities.

Twenty-four of 25 students participated in the class activities related to VR technology, and all consented to their work being used

in the study. The participants were junior or senior undergraduate students enrolled in one of two combined majors in secondary education and history. Before taking the methods course, as part of their majors, the teacher candidates had taken college history survey courses in U.S. history and world history that included instruction on World War I and World War II.

Virtual Reality Sessions

Students participated in two VR sessions as part of their coursework. First, during a class session, students met at Next Lab to participate in the Huddle World War I VR session. Because of the limited number of headsets, students met in two groups for about an hour each. Each group had twelve students at two tables of six.

Following an introduction to the Lab and the Meta Quest devices by Next Lab staff, the instructor, Lauren McArthur Harris (Author 1), read from a script created by Victoria Thompson while the students interacted with the objects inside the immersive environment. Here is an excerpt from the script:

1) Welcome to the front line of the war. I want you to put yourselves in the mindset of a soldier who has just arrived. Think about what your motivation was for joining up. What do you think about what you see around you?

2) You've been issued your uniform (Object #2). What do you think? The uniform is wool, with leather boots. By the end of 1914 and throughout the war, leather was in short supply since it was imported from Argentina. So, you would receive an extra payment if you could bring your own boots. By 1916, you might be wearing your own pants as well. When you are preparing to attack, you will have leather pouches for ammunition attached to your belt. You will also have a backpack for extra ammunition. Do you feel prepared for battle?

3) Here's your helmet (Object #3). It is also made of leather. However, if you enlisted at the end of 1914, when leather was scarce, you might get one made of felt or tin.

The Huddle experience was designed to look like a classroom set against the backdrop of a World War I battlefield, with trenches and a war-like environment visible outside the windows (see **Figure 1**).

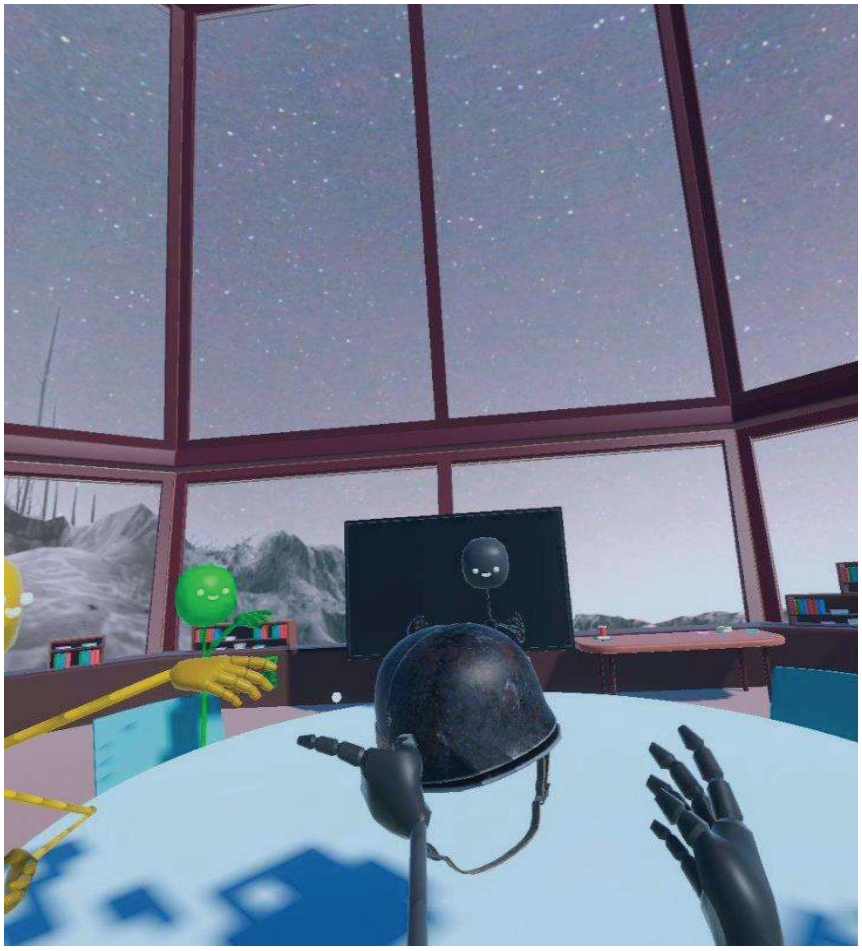


Figure 1: Student avatars passing an object inside the Huddle VR experience. Image by Amanda Federico/Arizona State University.

The students could hear the instructor, but the instructor was not an avatar in the experience. A Next Lab student staff member controlled the experience for the instructor, spawning 3D objects and tools in front of the students according to the script prepared by the instructor. Items could be spawned in different ways: (a) one item per person, allowing all students to hold a copy of the object; (b) one item per table, for the students to pick up and pass around to inspect the object one at a time (see **Figure 1** and **Figure 2**);

Figure 2: A student passes a World War I object to another student while the instructor looks on. Photo by Mike Sanchez/Arizona State University.

and (c) one per table, acting as a rotating "showcase" displaying a large 3D model in the center of the table, which does not allow the students to grab or interact directly with the object (see **Figure 3**). Each option changed the way the students engaged with the content of the lesson and each other.

At various points during the experience, the instructor asked questions that the students discussed at their tables while wearing their headsets (e.g., "What might the challenges be to using this sort of artillery in trench warfare?" "How would you feel if you were assigned to move and then fire this gun?" "How would you feel if you woke up to the sound of enemy guns?"). The students participated in the VR session for 15-20 minutes, and then the instructor led a debriefing discussion.

Second, students signed up to return to Next Lab to participate individually in the Anne Frank House VR experience, which is publicly available in the Meta app store. Twenty-two students

Figure 3: Example of a "showcase" object inside the Huddle VR experience. Image by Amanda Federico/Arizona State University.

completed this experience. Staff members skilled in VR devices were on hand in the Lab to help with the technology. This individual experience lasted approximately 25 minutes.

Data Collection and Analysis

There were three data sources for the study. First, student classwork included a pre-VR reflection completed in class (n = 22) and a post-VR reflection completed as homework (n = 24). The pre/post reflections contained open-ended, multiple-choice, and

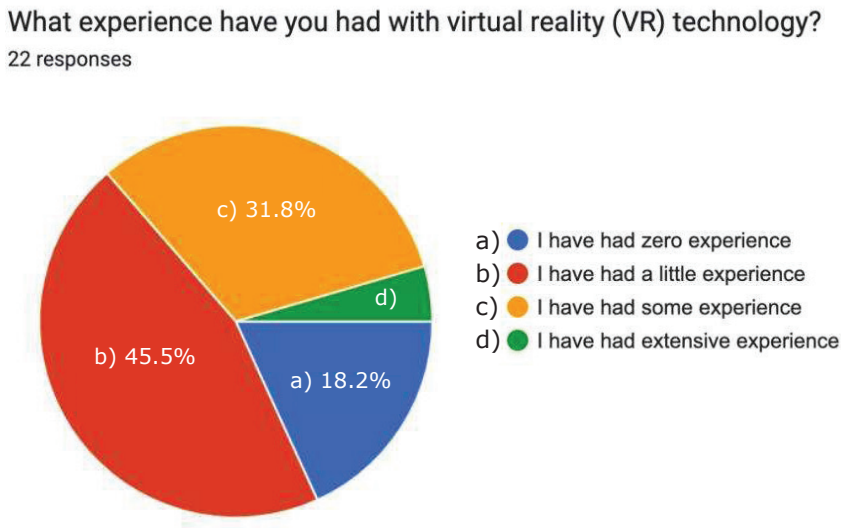
Likert-scale items (e.g., "To what extent are you likely to use VR technology in your future history teaching?"—not likely, somewhat likely, quite likely, extremely likely). Second, following the Huddle session, students (n = 17) completed a survey that is administered to everyone who participates in Next Lab VR experiences. The survey contained multiple-choice, Likert-scale, and open-ended items (e.g., "What issues did you have while using Huddle?"). Third, researchers took observation notes during the Huddle sessions and wrote *initial memos*[22] after each session.

To address our research questions, Likert-scale and multiple-choice responses on the pre/post reflections and post-survey were analyzed using descriptive statistics to calculate frequency and percentages. The first author used qualitative methods to analyze the memos and open-ended responses on the reflections. For the memos, a structural coding approach was used to highlight places where the memos addressed the research questions.[23] Open-ended responses on the reflections were coded by question using in vivo and initial coding to produce themes.[24] Examples of in vivo codes included "empathy," "playing around," and "collaborative learning." To triangulate these data, we also engaged in code landscaping[25] of the words and phrases that students wrote down after the Huddle session to create a word cloud, which allowed us to see the most frequently mentioned words.

Findings

Before the collective and individual VR sessions, most participants had at least a little experience with VR technology generally, but the majority (86.4%) had no experience with VR for teaching or learning history (see **Figure 4**). When asked about the potential benefits of using VR to teach history, participants wrote about "holding artifacts," having a "hands-on experience," and the potential to "feel themselves in history." As one participant who had "some" prior experience with VR wrote, VR "can provide an immersive experience to locations that students cannot get to or artifacts that they can't normally access."

Participants also noted potential challenges in using VR to teach history before they engaged in the sessions. The most cited challenge was access to the technology and cost (13 of 22 participants), with



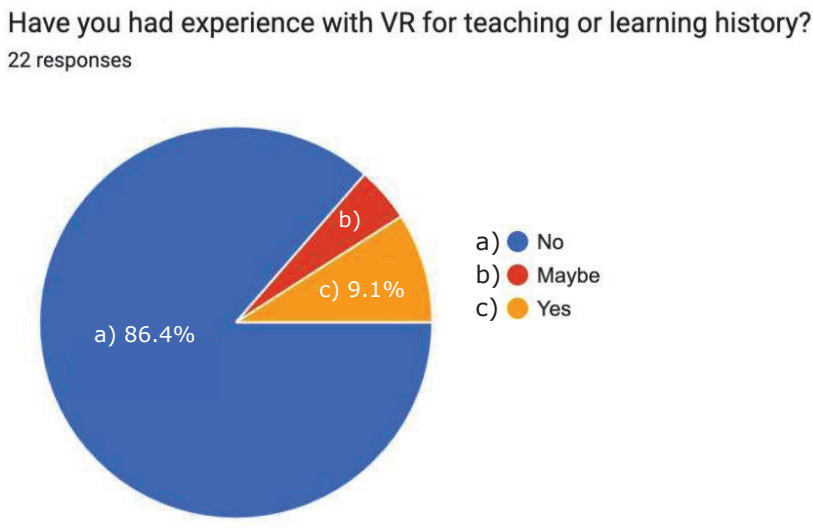


Figure 4: Responses from the pre-reflection.

one participant writing, "I think how it is applied across districts could be a challenge. Some districts that struggle with funding might have difficulties accessing the technology." Additionally, multiple participants were concerned about possible inaccuracies or biases in the history presented (5 participants), the possibility of motion sickness and/or migraines (4 participants), students' distraction or behavior (3 participants), and students feeling uncomfortable or "mentally scarred" (2 participants).

Collective VR: "[It] creates a shared experience with classmates"

A slight majority of participants (54.2%) indicated that the collective VR experience through Huddle changed their perception or feelings about World War I. They noted that it was interesting to "see objects right in front of me" and commented that the size of the weapons put things into perspective for them. One participant connected the VR session to their own experiences in a war zone:

> It did increase my empathy for soldiers who were fighting during the war. Myself having deployed to a war zone and received an abundance of protection equipment that was wildly more advanced than what the Germans were issuing at the time, I would have felt wildly unprotected by the gear that was issued to them.

A few other students mentioned empathy and being "put in their shoes." For the most part, the students who did not indicate that the experience changed their perspective wrote that this was because they felt that they already knew a lot about the war, although some still expressed their enjoyment of the experience: "As an adult, I am pretty familiar with this subject, so it was cool to see objects in a semi-real life size aspect."

In commenting on the benefits of a *collective* VR experience, participants noted the ability to engage in "collaborative learning," to "build relationships," and to have a "shared experience." One participant wrote, "It allowed the group to give input about one object they were all viewing at a time. Though it was virtual, it allowed us to communicate about the object while also independently looking at models." However, most (15 of 22 participants) worried about potential student distraction and "playing around." For some of them, it was because they themselves were distracted during the

Figure 5: Words written by students on a whiteboard immediately following the Huddle World War I session; larger words indicate more mentions. Students were asked to write: "Four words that express how you felt during the session." Word cloud created by freewordclouldgenerator.com.

experience: "It is very distracting if untrained. It was the first time many of us used VR, and we were very distracted by it, especially when we learned we could throw things."

Immediately following the collective experience, the participants and instructor engaged in a debriefing discussion. As part of the discussion, participants were asked to write "four words that express how you felt during the session" on a whiteboard (see **Figure 5** for a word cloud representation of those words). The words align with what participants wrote in the post-reflections and represent a range of feelings from "engaged" and "interactive" to "distracted" and "dizzy." Although some participants indicated that they did not have any issues during the collective session, eight mentioned in a survey that they had issues with the headsets and/or not being able to wear their glasses, and one wrote that they "got dizzy and found myself needing a break." However, the "interactive" and "engaging" nature of the VR experience was also heavily noted in the survey, aligning with previous research in history education.[26] Seven participants indicated that the collective virtual experience was "fun" and "engaging," and six participants appreciated the "immersive" and "authentic" experience that would not be possible when reading a textbook. Four

participants also noted the importance of accessibility: many students would be able to see various places and objects that they may not be able to afford to travel to or access in a physical environment.

Individual VR: "I am not sure if a teacher could provoke the types of feelings and perspectives that this experience provoked in me"

Of the participants who engaged in the individual Anne Frank House VR experience (n = 22), 72.7% indicated that it altered their perception or feelings about the Holocaust in World War II. They observed they were better able to "contextualize" the events, to "walk around," "grasp the living conditions," and get more of a sense of the "physical space" and "personal belongings." Two participants specifically used the term "empathy" in their responses, and even for some of those who did not use the term, the emotion was still evident. As two examples:

> This session blew me away. My perspective and feelings were gripped the entire time I was in the session. Being in a real recreation of such an impactful place in history brought me to tears a few times.

> Even though it wasn't "real" in the sense of me being physically there during the time, I still felt the fear and anxiety of the issues.

Participants who stated that their perspectives or feelings remained unchanged noted this was because they already knew a lot about the events and/or the house itself or had visited museums related to the Holocaust.

When prompted to comment on the potential benefits of this type of *individual* VR experience for teaching history, many participants discussed the general advantages of VR, such as the absence of physical travel, that it "makes history personal," and that it provides "different perspectives." However, some of the participants did comment on the individual nature of the session. Participants noted that it would allow students to move "at their own pace," that there would be more time for student reflection, and that there would be fewer distractions than in a collective session. As one participant wrote:

> Providing an individualized VR experience to teach history allows students to interact with history on their terms, and in a more focused environment with little to no distractions. This environment may be beneficial for students who struggle in collective experiences.

Similarly, the reflection prompt regarding challenges with an individual VR experience yielded many comments about VR in general, echoing many of the challenges noted above, for example, cost and access, illness, and possible student distraction. Participants who commented on the individual nature of the experience discussed logistical challenges such as the need for physical space for students to move around (whereas the collective experience involved students sitting at tables) and the time required unless there was a class set of headsets. Some also discussed the lack of opportunity for collective discussion, not having a teacher as facilitator, and possible misunderstanding or misinterpretation. For example:

> One possible challenge to using this type of individual VR experience to teach history is that some students may not be as engaged in a secluded environment than in a collective environment. It also allows for students to possibly misinterpret the information provided or just brush it off instead of asking questions and investigating as is usual in a group setting.

Last, because of the historical context of the Anne Frank House VR experience, participants noted the potential for students to be "overwhelmed," "too emotional," or "triggered." As one participant wrote, "'difficult' histories' would have to be handled delicately in this situation."[27]

Summary

We found that participants discussed both affordances and challenges to collective and individual VR experiences. For some, it was a benefit in the collective experience to be able to interact with classmates; for others, this interaction could be distracting. Similarly, in the individual experience, some participants enjoyed being able to move at their own pace, whereas others wondered if students may get off track without an instructor facilitating the experience.

Overall, more participants appeared to be interested in using VR after they participated in the collective and individual experiences. Participants indicated in their pre- and post-reflections how likely they were to use VR in their future history teaching (see **Figure 6**). There was a shift from pre to post, with only 9.1% choosing "quite likely" (and no one choosing "extremely likely") in the pre-reflection

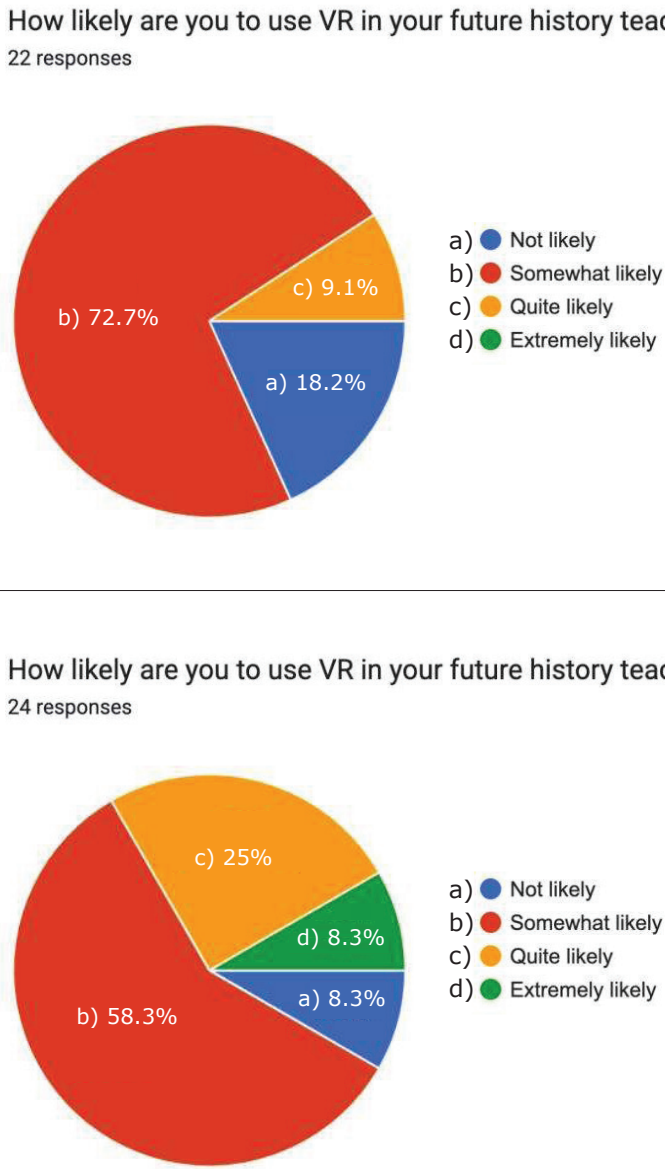


Figure 6: Responses from the pre-reflection (top) and post-reflection (bottom).

compared to 33.3% choosing one of those two categories in the post-reflection. Moreover, the "not likely" category went from 18.2% (pre) to 8.3% (post). These findings suggest that exposing teacher candidates to VR technology as students may increase their potential for including it in their future instruction. For the most part, participants seemed optimistic about some of the potential of VR for teaching history, particularly regarding their perceived increase in historical empathy, engagement, and connection to past events, while still holding reservations about issues of VR access and equity in schools, student distraction, and physical challenges such as headset use and motion sickness.

Instructor Reflections on Collective VR

Although there has been some research on using VR to teach history,[28] that research has focused almost exclusively on individual VR experiences. In comparing a collective VR experience to an individual one, the current study explored the challenges and affordances of both types of VR learning environments. In particular, collective VR experiences have much more of an instructor presence and opportunities for student discussion within the VR setting itself. In what follows, two of the authors who taught using the Huddle collective VR experience share their reflections on using the technology. Victoria Thompson worked on the design of the Huddle experience and taught it in her undergraduate history course the year before the current study. Lauren McArthur Harris made some minor adjustments to the instructor script and taught it during the time of the study.

Victoria's Reflections

I was excited about the possibilities of VR but did not know what to expect. After touring Next Lab and meeting with its staff, I chose World War I as the topic for the lesson and provided Next Lab staff with a list of websites where I thought they might find relevant objects. Next Lab staff then compiled a choice of objects related to World War I for me to examine. Given that museums design virtual reality experiences for a "mass audience," it was not surprising that the objects available were primarily uniforms and

weapons.[29] After researching the objects, I built a lesson around the deficiencies of both uniforms and weapons during the early years of the war. Because I was going to show the students several objects in a relatively short period of time, I wrote a script that would keep me on track and would also provide Next Lab staff cues for when to switch objects. In writing the script, I decided which objects would be in presentation view and which objects could be passed around.

I began the lesson by asking students to choose a motivation for enlisting (a topic previously studied in the course). My goal was to have the students view and handle the objects while I presented them with information about each object, at what point during the war it was used by soldiers, and larger issues that went into the production of the object, for example, shortages of materials and slowdowns in manufacturing. I then asked students a question about each object and how a soldier would feel about going into battle with, for example, a leather helmet. After discussing all the objects, I asked students to write down the feelings they had about going into battle. After the VR experience, students were asked to write a paper about the impact of the war on nationalism, drawing on this experience and a selection of soldiers' letters.

I designed this exercise as a typical combination of very short lecture and classroom discussion. It started out well. However, I found that by the end of the lesson, many students were not participating in the discussion because they were distracted by the VR environment. This was especially true when they were viewing objects that could be passed from person to person. I was outside the VR environment in which they were immersed; they could hear my voice but not see me. As a result, it was challenging to keep their attention focused on my questions. Overall, however, the students appeared to have had a successful learning experience. The papers that they wrote following the VR experience demonstrated considerable empathy for the soldiers and were enriched by what they had learned in the VR setting.

Lauren's Reflections

As I approached the sessions with my students (all history teacher candidates), I felt apprehensive, as I had little experience with

VR either as a user or a teacher. In the first session, the students seemed excited as they listened to the orientation and put on their headsets. It was helpful to have several Lab staff on hand to help troubleshoot headset issues. When the experience started, I read from the script. Some of the students seemed to focus more on passing and throwing the objects than on the substantive questions I was asking them. It was hard to know if the redirection strategies that I typically use in teaching were as effective with students in the VR environment. After this first session, several students expressed feeling distracted, as previously mentioned. They also found it strange to hear my voice but not see me in the experience.

I felt fortunate to be able to adjust my instruction for the second session, which took place immediately following the first. In this session, students were just as excited to put the headsets on, but I slowed my reading of the script and allowed the students to work with the objects before we discussed them. Perhaps because of this adjustment, students in the second session had much more in-depth conversations with each other about the objects and the war, and they seemed to be less distracted. For example, both tables talked about how soldiers might have felt in these dangerous conditions and working with the weapons outside the trenches. Both tables also wondered about the horses mentioned in the script (e.g., what they ate). One table discussed specific features of an object and asked each other questions about the details that they could see. As an instructor, I was energized by these discussions and could easily see the potential of exploring different historical periods and events in this way.

Discussion and Recommendations

Given the likely continuation of VR technology for educational purposes in the future, it is important to examine teacher candidates' perceptions of this technology. Our study found that many candidates had reservations about the technology that were somewhat alleviated after they participated in collective and individual VR experiences. This finding has implications for the role of VR in teacher education programs, where teacher candidates could be introduced to the potential of VR to immerse students in historical time periods. Jason Abbitt and Darrel Davis suggested that subject-specific

methods courses, such as history/social studies methods, would be optimal places to introduce VR technology to pre-service teachers.[30] Moreover, instruction using VR for teaching history should be introduced as a strategy that complements, but not replaces, others in a robust history curriculum. Teaching the Holocaust solely using VR, for example, would not allow for rich experiences with multiple survivor testimonies and other visual and written sources. Writing about VR experiences at the USHMM, Sara Pitcairn and colleagues raised important questions about the ethics of VR to teach about sensitive and traumatic topics such as genocide. The authors noted that "One must be aware of the risk that the playful or novel aspect of an immersive environment will overshadow the substance of the history."[31] VR experiences centering on sensitive histories should be carefully selected and vetted before use, and while goals of student engagement are important, they should not overshadow rigorous instructional objectives.

In addition to teacher preparation courses, college history courses could also be a place for such work. In these courses, VR activities could be grounded more in the historical context, such as historian Victoria Thompson did with the World War I collective VR experience. The development of the collective Huddle VR experience described in this study is an example of collaboration between a history instructor and VR designers, where the VR design and experience was driven by the instructor's goal to have students examine and "feel" artifacts related to soldiers fighting in World War I. More such collaborations between K-16 history instructors and designers would foster learning experiences that are closely tied to instructional goals.

Despite these potential areas for growth in the VR space for history education, there are important issues and challenges for educators to consider. While VR has become more affordable in recent years (with many consumer devices costing less than a smartphone), the cost of a VR headset still presents a barrier to entry for many programs and schools with limited funding. Compared to other common devices like a laptop, which can be used for a variety of activities and can be shared quickly between users, a VR headset currently has limited use based on the capabilities/limitations of the technology and the availability of apps. This challenge can be mitigated to some degree by having

a comprehensive deployment strategy across multiple school subjects and activities so that purchased devices have maximum impact for the investment.

In terms of accessibility, VR can present challenges for students with visual impairments. Moreover, while some scholars have studied the potential affordances of VR technology for students with disabilities or disorders,[32] teachers should carefully consider the extent to which all their students would be able to engage in VR experiences. Technical and physical challenges, such as cyber sickness and motion sickness and issues managing hardware and software in the classroom, can also occur. Additionally, there are important ethical and social questions about the use of VR in history classrooms, both in what topics are encountered and concerning student identities and how students may or may not connect to certain elements of the VR experience. Future research should examine how learners with different cultural histories move, sense, and feel within the digital learning environment of VR. This type of work could place more emphasis on culturally responsive technologies and immersive learning experiences that are "continuously and dynamically crafted through collaborative processes."[33]

Given the potential affordances and challenges of VR in educational settings, we offer the following for teachers to consider if they want to integrate VR as a supplemental instructional tool in history classrooms. Teachers should:

- carefully consider their learning objectives and target audience, focusing on inclusivity and the diversity of learners;
- contemplate the level of student collaboration and collective engagement in VR experiences;
- examine the social and ethical implications of VR use, particularly in teaching controversial and/or sensitive histories to diverse learners;
- seek out training and support for the use of VR equipment (school districts and universities interested in this technology could provide such training);
- anticipate possible distractions, particularly in collective VR experiences, and plan for ways to mitigate them;
- consider how to evaluate student learning in the VR space, extending beyond student engagement.

Conclusion

After conducting one of the first studies to examine *collective* VR experiences in history education, we see promise in teacher-facilitated sessions where students can discuss historical objects, people, and events within the VR space. In particular, this article contributes a focus on *feeling histories*—embodied ways of sensing, feeling, and moving within digital environments—to promote equitable learning opportunities. We also advocate for the design and enactment of VR that is attuned to the potential challenges mentioned above. Future study of collective VR experiences in history would help examine how students can best engage in meaningful collaborative work in VR settings and address important challenges related to issues such as access, ethics, and physical constraints. We look forward to continued practice and research in these areas.

Notes

1. Emma Kennedy, "Can Virtual Reality Revolutionize Education?" CNN, November 1, 2018, <https://www.cnn.com/2018/11/01/health/virtual-reality-education/index.html>; Benjamin Herold, "Virtual Reality for Learning Raises High Hopes and Serious Concerns," *Education Week*, February 8, 2018, <https://www.edweek.org/technology/virtual-reality-for-learning-raises-high-hopes-and-serious-concerns/2018/02>.

2. See, for example, Clare Duffy, "How Mark Zuckerberg is Reimagining the Classroom," CNN, April 15, 2024, <https://www.cnn.com/2024/04/15/tech/meta-quest-vr-education/index.html>.

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26. For example, see Riner, Hur, and Kohlmeier, "Virtual Reality Integration"; Patterson, Han, and Esposito, "Virtual Reality for the Promotion of Historical Empathy."
27. This comment aligns with Pitcairn, Fernandez-Duque, and Goldman's cautions about using VR for teaching topics such as the Holocaust in "Virtual History."
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