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Teacher Support for Virtual Instruction in the Social Studies Classroom

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TEACHER SUPPORT FOR VIRTUAL INSTRUCTION

IN THE SOCIAL STUDIES CLASSROOM

by

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ABSTRACT

This research study focuses on providing professional development for teachers using virtual reality in secondary social studies classrooms. Literature surrounding virtual reality for education focuses on the effects of virtual reality on student motivation and engagement. However, there are no current studies available to help instructional coaches or academic leaders provide adequate professional development for their staff on this topic. The purpose of this mixed-methods exploratory case study is to design a professional development founded on best practices in VR and instructional coaching to help support social studies teachers integrate VR in the classroom. Research questions include: 1) How do teachers in the school district currently use VR in the classroom? 2) What relationship exists between self-reported rubric scores and post-survey data as a result of participation in VR coaching cycles? 3) What influence does VR professional development have on future VR implementation?

The research participants are middle school social studies teachers in the school district in which I am employed, (N=4). The main phases of this research study include recruitment and consent, preparing the professional development according to the current understandings and needs of participants, coaching cycles, and debriefing. Data collection consists of using a pre and post survey, a focus group interview, a feedback rubric, and individual coaching conversations. Two statistical tests, Spearman's *rho* and a paired samples *t*-test will help determine answers to the research questions along with the qualitative data collected.

Although teachers have limited access to VR headsets, teachers are using less immersive formats of VR such as 360 degree videos and *Nearpod*. Based upon pre-survey data and focus group interview, teachers are excited to learn more about how to use VR in their class. However,

they lack the experience in using headsets themselves. Participation in the professional development had a large effect on teachers. Based on coaching conversations, participants wish to implement VR in their lessons more frequently and feel more confident to do so. Spearman's *rho* correlation test showed there were no statistically significant correlations between items on the rubric and the post-survey. However, when looking at the paired samples *t*-test, several statements from the pre and post surveys were statistically significant.

The implication of this research is that educational leaders can use this type of professional development as a model to build capacity in teachers to use VR in their classes. Recommendations are made to streamline implementation and support teachers in using VR at the district and school levels. Future studies may consider comparing different models of professional development to further explore best practices in VR instruction.

DEDICATION

It is impossible to put into words the amount of gratitude I have for the people who have supported me throughout this educational journey. I want to show special thanks in dedicating my work to my mother, who has always given me her strength, and to my father, who believes I can be anything I want to be. Without your love, guidance, and hours of conversation I could not imagine accomplishing this feat. It is my privilege and honor to be your daughter. Thank you so very much. I love you both. Always.

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CHAPTER 1: INTRODUCTION

Virtual Reality (VR) is an emerging educational technology that has become more accessible to schools in recent years due to fast-developing technological advancements and lower costs (Allcoat & von Mühlenen, 2018; Boel et al., 2023; Huang et al., 2010; Jong et al., 2020; Lei et al., 2022; Lui et al., 2020; Makransky et al., 2021; Meyer et al., 2019). Although it has become more widespread in consumer society, research in this area has reported mixed results. Some studies indicate that use of VR in the classroom produces higher rates of enjoyment and motivation, although others show that it may not produce significant increases in learning measures when compared to video or text instruction (Allcoat & von Mühlenen, 2018; Makransky et al., 2021). These reported differences could be due to the nature of VR, in that it is available in many different formats and is incorporated through various instructional strategies in the classroom (Makransky et al., 2021). Variances in content area, assessment types, methodologies, students, and instructional frameworks can have influence on studies regarding the comparison of using VR for educational purposes against more traditional multimedia presentations, or less immersive VR technology (Makransky et al., 2021).

There has recently been an increase in consumers of VR technology, especially for instructional purposes. Current market value in 2023 is approximately 12 billion US dollars; in 2033, it is projected the market value will increase to $233.79 billion US dollars (GlobeNewswire, 2023). Schools across the world are expected to increase spending on VR, with projected totals reaching $32.94 billion in 2026 (Business Wire, 2022). However, there are many challenges to implementing VR technology in schools. Current thoughts circulate regarding the physical landscape of schools and how spaces will be changed by the introduction of such

technologies, as class sets of twenty to thirty VR headsets require square footage that simply does not currently exist. Each VR headset requires 6.5 feet by 6.5 feet as well as an additional 2.5 feet buffer between walls and other students (VRScout, 2022). Schools in the future adopting VR will need to allocate money for large VR labs, much like they did when computers became more affordable and easier to use. Many schools are finding money through federal funding through Titles I through IV, or grants (US Department of Education, 2024), but struggle to find appropriate space for students to use VR in schools (ClassVR, 2023). In the wake of these changes, there is also an important concern with the instructional use of VR. Researchers have not yet agreed upon or established what best practices of VR should look like in the classroom. A modern curriculum that includes the use of VR is forthcoming, and further research is necessary to identify what best practices look like for VR in K-12 education in terms of pre-training, guided activities, group work dynamics, feedback, teacher role, and essential targets for learning.

Statement of the Problem

Currently available professional development curricula do not provide adequate guidance for teachers on how to use VR technology in the classroom. Most scholarly studies investigating VR show a lack of using clear, theoretical learning models in designing educational virtual environments for students. In a review of 59 publications between 2009 and 2018 on VR applications for education, two-thirds of the articles did not incorporate an explicit learning theory (Boel et al., 2023; Fowler, 2015; Huang et al., 2022). The lack of theoretical learning models is concerning because it suggests that scholars have yet to understand how VR can be effectively integrated into curricula. The research simply cannot keep up to the pace of

technological development. In addition to these uncertainties, the latest EDUCAUSE Horizon Report (2023) indicates that VR should be the focus of additional research and development.

The successful implementation of VR in education requires that teachers be prepared to use VR applications. Student outcomes maximize with the integration of multiple modalities of instruction (Pelletier et al., 2023). VR technology provides a wonderful opportunity for students to see places they may not have the convenience or financial ease to travel to such as destinations like the Pyramids at Giza, the Great Wall of China, or the islands of Greece. In addition, VR can help students understand and manipulate abstract concepts or practice tasks that are too risky otherwise, such as medical training or firefighting (Allcoat & von Mühlenen, 2018; Huang, Rauch, & Liaw, 2010; Lei et al., 2022; Liu et al., 2020; Makransky & Petersen, 2021; Mateen & Kan, 2020). Some issues currently exist in VR implementation, in particular, a lack of instructional framework for VR integration can lead to a disarray of missed learning opportunities fraught with lack of clear learning objectives, irrelevant information, or confusing interface manipulations.

Professional Development Inadequacies for VR in Education

Considering the mixed results associated with implementation of VR in classrooms, it is imperative to focus on professional development to help teachers learn about VR and design lessons incorporating activities using learning theory as a foundation. There is currently a gap in literature on VR professional development experiences for classroom teachers, especially in social studies. Some companies, like ClassVR, provide teacher training when the company software is purchased, but the website does not explicate the standards or theories used (if any) to design the training (ClassVR, 2023). Also, professional development is extremely limited in

some cases. For instance, ClassVR is a company serving over 80 countries with VR for education, but advanced online training and onsite training are only being offered in the United Kingdom (ClassVR, 2023). The lack of professional development opportunities for teachers can make the successful implementation of VR technology in classrooms exceedingly difficult.

Scholars predict that by 2025, over 15 million students will be using VR in the classroom (Makransky & Petersen, 2021). Research is rapidly expanding on VR technologies for purposes like learning, education, or training. However, meta-analyses suggest a failure to use theory in guiding this research as well as developing VR applications (Fowler, 2015; Radianti et al., 2020; Wu et al, 2020). It is important that teachers and instructional designers consider the theoretical basis for how students learn while using VR technologies. The benefit of using instructional theory in teacher education is that the design develops curricula beyond what is traditionally taught due to habit or ritual and increases the scientific measurement of learning outcomes for each instructional method (Artino & Konopasky, 2018). There is a need to investigate how incorporating learning theory into professional development will help teachers use VR as one of many multiple modalities available in the modern-day classroom. These ideas could be incorporated into professional developments for teachers to prepare them for creating lessons around VR experiences.

Failure to Employ Learning Theory in VR Professional Development

The most pressing issue is the consequence of not addressing this problem. Although much attention has been paid to understanding VR in recent years, critics highlight the lack of using learning theory or lack of best practices in research to guide application of VR learning in the classroom (Makransky & Mayer, 2022). Teachers do not know what key factors need to be

considered when creating lessons using VR in efforts to achieve an elevated level of meaningful learning in the classroom (Vergara et al., 2019). Identifying best practices is important to launch VR effectively and ensure that students experience VR to enrich their understanding of the content. If theory is left out of training, teachers may abandon rigorous instruction in favor of edutainment. The term *edutainment* is a combination of the words *education* and *entertainment* and refers to types of media that have learning objectives embedded within such as movies, shows, or games, to name a few examples (The World Bank, 2024). While many programs "gamify" content for students and tout increased engagement and motivation to learn, there is a fine line. Gamification of learning can result in watered-down content, poor instruction, or failure to learn important concepts (Faiella & Ricciardi, 2015). For this reason, teachers need to critique available VR instructional materials and programs to make the best pedagogical decisions for their students.

District Support and Training

School districts must invest in keeping technology current to attract and retain high-quality teachers. Often, a teacher will base their decision to work in an area on what technologies are being used and what supports are available to them as they learn and expand their practice (Stone, 2022). School districts develop plans to train teachers in how to use modern technology. A plan that explains the program in advance and details the training required of each user helps district personnel and technology coaches find success with higher rates of implementation (Stone, 2022). The issue is that VR is consistently updating, and modern technology is available at such at rate it is difficult for districts to keep pace- if they offer any training at all (Emergen Research, 2021). In a recent survey, 93.61% of teachers agreed that "VR integration is successful

only if adequate teacher training is available" (Kukalenko et al., 2022). Teachers overwhelmingly agree that support is needed in the school, a concise plan must be communicated, and a system must be in place to experience a successful roll out to staff and students. Teacher training may look different depending on the needs of the staff at each school. Districts could create a roll out plan that involves several cohorts, who in turn, are the support system and leaders at their respective schools. Research in this field is needed now to determine how best to guide teachers using VR lessons in classrooms to provide students with an opportunity for deeper understanding of grade-level content.

Purpose of the Study

This mixed-methods study is to design a professional development founded on best practices in VR and instructional coaching to help support social studies teachers integrate VR in the classroom. Research questions include: 1) How do teachers in the school district currently use VR in the classroom? 2) What relationship exists between self-reported rubric scores and post-survey data as a result of participation in VR coaching cycles? 3) What influence does VR professional development have on future VR implementation?

First, I will gather information about the ways in which participating teachers are already using VR in the school district where this study will take place. A focus group and pre-survey will provide insight into the development of the training. These first steps inform where teachers are in their ability and understanding of VR technology. This will allow me to create a tailor-made professional development for participants and form more intentional grouping for the collaboration piece during the workshop. After the professional development, I will conduct observations of the lessons in classrooms and provide feedback using the VR theory-based rubric

and instructional coaching strategies. Teachers will have a chance to reflect on their own experience through dialogue, self- assessment, and through conversation with the instructional coach. Effective coaching conversations should be organic and not too rigid or planned (Kho et al., 2019). Coaches have multi-faceted roles and constantly make decisions to shift roles as needed to maintain a trusting relationship with teachers (Kho et al., 2019). Rubric scores will be compared to post-survey data using Spearman's *rho* to determine the correlation between self-reported growth and performance. Finally, I will compare pre-survey and post survey results using a paired samples *t*-test analysis, as well as interview notes from coaching conversations, to determine the growth of teachers and likeliness of future VR implementation because of their participation in the VR professional development.

Investigating these research questions will help to address the problem of identifying best practices in preparing onsite VR trainings for teachers to successfully integrate VR activities into standards-based lessons. This study will directly address the lack of VR professional development by providing teachers with a professional learning opportunity to collaborate and create lessons incorporating VR using a theory-based rubric to create and deliver a VR lesson. Participants will be observed delivering this VR lesson and receive coaching feedback.

Design Principles

This study will use the five design principles proposed by Moreno and Mayer (2007) as a basis for creating the professional development. These five design principles for lesson planning VR experiences include: *guided activity*, *reflection*, *feedback*, *pacing*, and *pre-training* for students. Each of these design principles has a theoretical explanation according to the Cognitive-Affective Theory for Learning with Multimedia (CATLM) (Moreno & Mayer, 2007,

p. 316). The principles listed below will be modeled in the workshop for the teachers as they learn about how to integrate VR into their lessons.

Guided Activity

The principle of *guided activity* refers to students receiving feedback from a teacher throughout the lesson. Students learn better than when receiving direct instruction alone, or when purely exploring without teacher feedback, because they have help in selecting and organizing new learning material (Moreno & Mayer, 2007). This may look like a teacher rotating from a student or small group to a whole group to give appropriate feedback to students during the lesson.

Reflection

The principle of *reflection* is also important as best practice because students think about ways in which correct answers fit into the existing mental framework. Students who reflect and respond periodically are more readily able to integrate new information with previous knowledge (Moreno & Mayer, 2007). Teachers may give students a few questions to discuss with their partners or share out learning at the end of the lesson.

Feedback

Feedback that is purely corrective alone is not as effective as explaining the *why* behind information that is correct or incorrect (Moreno & Mayer, 2007). This can look like the teacher asking a question to a group, then saying, “yes, that is correct because...” instead of “right” and moving along. Students who receive explanatory feedback have more success at solving difficult problems, learned faster, and had greater gains on post-test achievement (Moreno & Mayer, 2007).

Pacing

Pacing is another important design principle according to the CATLM-VR learning theory (Moreno & Mayer, 2007). Since learners use both visual and auditory coding abilities independently, it may take more time for students to fully understand concepts in time. Controls that allow students to pause or rewind, or continue after a pause, help to increase the time needed for cognitive processing to occur (Moreno & Mayer, 2007). If it is not built into the VR lesson, students may rush through the content without paying appropriate attention to details and miss the learning target.

Pre-training

The last design principle used to create this professional development is *pre-training.* Students who are novice to learning in VR environments should experience a pre-training session, in which they are introduced to concepts or characters that are important to recognize before entering the VR environment. This helps to build the background information necessary to understanding the essential learning targets (Moreno & Mayer, 2007). Pre-training could also include information about how the interactive system works. Students may have questions about the headset, handheld controllers, or behavior expectations during the lesson. Reviewing this beforehand will ensure that everyone is on the same page and make the lesson go smoother, thus reducing cognitive load (Moreno & Mayer, 2007).

Theoretical Framework

Cognitive Theory of Multimedia Learning

The cognitive theory of multimedia learning (CTML), also seen in research as the cognitive-affective theory of learning with media (CATLM) has been recently expanded to

include the use of VR as a media for learning (CATLM-VR) specifically to focus VR educational constructs with an applicable learning theory (Huang, Roscoe et al., 2022; Moreno & Mayer, 2007; Sorden, 2013). The principles of this learning theory imply that learners gain knowledge through the presentation of content with media, including VR, with three assumptions: the dual-channel assumption, the limited capacity assumption, and the active processing assumption (Sorden, 2013). These three assumptions work together to form an understanding of how students learn using simultaneous auditory and visual information, both of which are necessary for an immersive VR experience.

The dual-channel assumption states that working memory has both visual and auditory coding abilities (Sorden, 2013). Students learn content using both coding channels, but each has its own process, they are not one and the same (Sorden, 2013). The limited capacity assumption implies that this working memory has a threshold of cognitive load and is limited in the amount of information actively processed without elevated levels of mental effort, or cognitive overload (Mayer, 2017; Sorden, 2013). Students who have difficulties finding relevant information or navigating in the virtual environment may spend intellectual resources that are needed to learn the content or complete the task, thus increasing cognitive load. The last assumption is active processing, which means people construct knowledge by paying attention to information and then mentally organizing the new knowledge to incorporate into existing mental frameworks of prior knowledge (Sorden, 2013). These assumptions have also shaped this study in that they will be presented as how students process information in VR environments in the professional development of participating teachers. More information regarding these assumptions will be discussed in Chapter 2.

Cognitive Load

Cognitive load is the amount of mental effort it takes to process information, it is the cost required to complete the learning task. Research suggests that it has a direct and negative effect on cognitive engagement, which is correlated to learning achievement (Huang, Luo et al., 2020; Huang, Roscoe et al., 2022). Virtual learning environments are thought to increase the amount of visual and auditory information entering the brain at any one time. This can increase cognitive load, and therefore, affect the number of intellectual resources left to complete the learning task (Makransky & Mayer, 2022). There are three types of processing associated with cognitive load theory according to scholars. These types of processing are extraneous processing, essential processing, and generative processing (Mayer, 2009; Sweller, 1988, 1994). The types of mental processes, and cognitive load, have shaped this study because teachers need to be aware of the mental taxation that occurs simultaneously as students make cognitive efforts to learn in highly immersive environments. Preparations for creating lessons using VR need to include pre-training for students so that they understand what to look for first, so as to intentionally decrease cognitive load (Makransky et al., 2021).

Teachers will receive information on cognitive load when participating in the planned professional development and use these theoretical concepts while creating their lesson plan to meet the needs of VR learners. Information on extraneous, essential, and generative processing will also be delivered in the presentation portion of the VR professional development. Visual aids will be used to convey this information to teachers, and they will have a one-page handout for quick reference while collaborating with others in creating their lesson plan.

Research Questions

The three research questions were designed to examine the study's purpose. These research questions include: 1) How do teachers in the school district currently use VR in the classroom? 2) What relationship exists between self-reported rubric scores and post-survey data as a result of participation in VR coaching cycles? 3) What influence does VR professional development have on future VR implementation?

Significance of the Study

This study will contribute to the limited body of research on what works for teacher development and VR implementation. Teachers who participate in the professional workshop designed for this study will be exposed to the cognitive demands that students experience using VR and how to design lessons that embed VR but reduce cognitive load. This study will use the five design principles proposed by Moreno and Mayer (2007) as a framework for designing the professional development. These five design principles for lesson planning VR experiences include: guided activity, reflection, feedback, pacing, and pre-training for students. The lessons will center on concise learning targets, background information through direct instruction, checkpoints throughout a guided activity, and a moment for reflective thought or whole group discussion at the end.

Theory-based Professional Development

By incorporating these concepts and research questions, the study will successfully address the research problem. The research was designed to satisfy the need for theory-based professional development and training for teachers learning to use VR in class. The study will investigate the ways in which teachers are already using VR technology, create personalized

professional learning opportunities, and determine if there is a relationship between self-reported rubric scores and post-survey data as a result of participation in VR coaching cycles to gain insights on the likelihood of future VR implementation.

Distance Learning

Virtual Reality will change the way that students learn using class management systems, or CMS. One of the most popular examples of CMS is Blackboard (Penland et al., 2019). Technology is becoming more readily available to students so that one day, students can log in to their CMS, view the agenda and work for the day, and click the link to enter a virtual meeting with the instructor as well as fellow colleagues (Penland et al., 2019). Students would be able to experience events such as national conferences, presidential inaugurations, protests, or visit ancient places as a part of distance learning (Penland et al., 2019). While this is still in the near future, schools are already looking into how VR can increase learning outcomes in distance learning. For example, when comparing instructional videos versus virtual environments, students were able to recall more vocabulary, answer more questions correctly, and showed a slight preference for the virtual method of instruction (Penland et al., 2019). While students currently believe that learning in a traditional classroom is easier than online schooling, VR may impact that trend over time with new innovations. Students may find that distance learning is more preferable, cheaper, more accessible due to less travel, and more relevant to their education overall (Penland et al., 2019). VR has the ability to change education.

Policy Regarding VR Use with Minors

Research calls for the need for policy-making when it comes to the well-being and protection of people using VR, especially more vulnerable subgroups such as minors. As VR

becomes more advanced and accessible to larger groups of people, it is important to think about the ethical implications for humans. For all of the positive aspects and benefits, there are also trade-offs that people need to be made aware of. The use of VR has already been associated with "cybersickness," a term used to describe the side effects are similar to motion-sickness (Spiegel, 2017). Evidence also points to mental health issues such as depersonalization and derealization, or the inability to readjust to the real world- or having feelings that the real world is not real (Spiegel, 2017). Mental and physical ailments are not the only concerns. There is also heavy emphasis on the moral and ethical well-being of a generation.

The virtual world provides many opportunities for students to have experiences without dire consequence. For instance, a medical student can perform surgery without risk of losing the patient. However, this can also be a negative as students and young people are increasingly removed from the concept that their actions indeed have real consequences (Spiegel, 2017). This illusion can exacerbate already existing compulsions and addictions, such as gambling (Gainsbury & Blaszczynski, 2017). Protection of privacy is also a huge concern. VR companies, especially those connected to social media networks, have the ability to harvest data from consumers and use it to manipulate users in the form of influencing offline behaviors, which has already been a hot topic in the United States Congress (Spiegel, 2017).

There is still much unawareness among the general population concerning the benefits and negatives associated with VR (Gainsbury & Blaszczynski, 2017). For this reason, governments should form public policy and communicate the potentiality for adverse effects to the consumer before purchase or play (Gainsbury & Blaszczynski, 2017; Spiegel, 2017). Steps should be taken to create age group ratings for VR modules and games, as well as a warning

about potential mental or physical ailments that may occur. In addition, companies should let consumers choose which data is collected and shared to protect privacy rights, especially for groups of people such as minors (Spiegel, 2017).

Assumptions of the Study

Assumptions

Assumptions in research are important to understanding the research framework and methodology. Research assumptions are often unexamined beliefs that may have influence on the study itself (University of Louisville, 2023). One assumption for this study is that participants voice honest experiences and background information when completing surveys and focus group interviews. It is also assumed that the participants will be open to coaching conversations due to my role as a doctoral candidate and the district social studies coach. It is further assumed that the lesson observed during the study is one thoughtfully planned according to guidance in the specially designed professional development session using VR headset technology and incorporation of South Carolina State Standards. Finally, it is assumed that students who are observed during the VR lesson will act differently because of my presence in the room due to the Hawthorne Effect. The Hawthorne Effect is based upon a wide body of research that suggests people act differently when being observed (Spencer & Mahtani, 2017). This is not a major concern for the study because the lesson plan rubric focuses on what the teacher has planned and attempted to execute, not student behaviors.

Definition of Terms

Definitions of Virtual Reality

There exist many similar definitions describing the phenomenon associated with the use of VR technology. In one definition, VR is computer-simulated technology that uses three-dimensional graphics and devices to provide a virtual experience, a psychological and emotional state of interacting with materials in a three-dimensional environment (Huang, Luo, et al., 2020; Huang, Rauch, & Liaw, 2010; Liu et al., 2020; Makransky et al., 2021). Other definitions emphasize immersion, stating that VR is a fully immersive three-dimensional world where individuals interact with computer-generated objects (Huang, Roscoe et al., 2022). Categories of VR exist that include full immersion in the computer-generated environment, called immersive VR (IVR) and non-immersive VR that allows users to view three-dimensional images from outside the computer-generated environment, usually on a desktop application or website (Lei et al., 2022). Although definitions vary slightly, scholars agree that VR is a digital simulation of an environment (Meyer et al., 2019). This study defines VR as an immersive environment that provides an experience in an alternate space or time. This definition is integral to understanding how to best prepare teachers in using this specific type of VR in the classroom. The VR activity chosen for implementation does not demand interaction with objects in the virtual environment. It is a guided tour for students to walk the path of Martin Luther King, Jr. from Selma to Memphis during the height of the 1960's Civil Rights Movement in the United States.

Definitions of Professional Development

As definitions of virtual learning vary slightly, so do definitions of professional development. Most research uses existing definitions based on a more traditional approach,

meaning that professional development is work designed to improve teacher practices, knowledge, beliefs, and skills to enhance student's learning (Sancar, Atal, & Deryakulu, 2021). However, some research articles express professional development according to innovative approaches. These novel approaches focus more on teachers' individual needs, characteristics, and prior experiences (Sancar, Atal, & Deryakulu, 2021). Research based on innovative approaches discusses professional development in terms of lifelong learning, which is self-directed (Sancar, Atal, & Deryakulu, 2021). Best practice for professional development involves teachers as co-leaders, which promotes ownership and change in mindset, as well as increasing confidence in implementing the desired instructional practice (Holmqvist & Lelinge, 2021). For my study, I will adopt a combination of the two most used definitions. This study defines professional development as work carefully crafted and intentionally planned for adults to reflect on their own practices and promote growth to increase student learning (Holmqvist & Lelinge, 2021; Sancar, Atal, & Deryakulu, 2021). Teachers should be co-leaders to promote ownership and ensure success regarding the implementation of VR in social studies classrooms.

Overview of Future Chapters

The next chapters are outlined as follows: Chapter 2 will consist of the literature review. The research will be synthesized to show what current trends and gaps exist in VR education. The history and evolution of VR and features and formats of various VR applications will be discussed. Much of the literature review focuses on the CATLM-VR learning theory, benefits, and challenges of using VR in the classroom, and instructional coaching techniques for guiding teachers to reflect on their practice and internalize improvements. There is little research available that discusses professional development and VR implementation specifically. Chapter

3 will explain the methods and methodology used to answer the research questions. Various stages of research using a mixed methods study will be outlined. Chapter 4 will consist of data collection and analysis, and Chapter 5 will summarize the study's findings.

CHAPTER 2: LITERATURE REVIEW

Introduction

This chapter summarizes the body of literature produced in recent years about VR in education. The discussion on CATLM-VR learning theory is analyzed and broken down with each assumption. Many different formats used in classrooms will be discussed below. The history of VR, instructional coaching, and various other topics associated with the use of VR in education follows to give more insight to the information used to guide the development of the research study. Obvious gaps exist in the literature for training in-service teachers to integrate VR technology into their lessons with fidelity. The research study provides valuable information to the scholarly discussion about VR professional development for secondary teachers.

Use of VR in Classrooms

The market for VR is projected to increase steadily at 27.7% each forecasted year with applications in the consumer, commercial, healthcare, and career training sectors (Emergen Research, 2021). A wide variety of augmented reality and virtual reality options are available for use in the classroom. One classroom might have a class set of headsets while another school might have a lab with VR stations. Students can wear special glasses and manipulate pens or hold controllers in their hands (Ogden, 2019). A teacher must pre-plan time and space for students to experience the activities and pre-teach the content in lesson plans before engaging students in VR. The role of the educator shifts towards being the facilitator of these experiences,

partnering students, walking around and monitoring students' progress, and guiding discussion after students complete the task at hand (Jong et al, 2020). Other scenarios might include a teacher forming groups and students taking turns using the equipment and making observations during station rotations (Jong et al, 2020).

Student-Centered Learning

The marked difference between using VR and using more traditional methods of teaching is that students are the leaders of learning in their classroom. More attention is paid to the lesson and experience, rather than the teachers themselves. The teacher becomes the facilitator and planner for instruction. Students explore and take ownership of their own learning. There are certain characteristics associated with student-centered pedagogy, such as a focus on personalized learning, while taking into account students' interests, needs, background, culture, and learning abilities to promote higher engagement and motivation (Lee & Hannafin, 2016). Outcomes of student-centered learning include students who through practice become autonomous, independent thinkers, free to pursue and research their own interests (Komatsu et al., 2021). However, other scholars claim that autonomy is not the same as independence, and that student-centered learning is pre-planned, highly structured, and guided by the teacher (Lee & Hannafin, 2016).

Features of Virtual Reality

Virtual learning environments should exhibit specific key features, although varied through choice of device, such as: level or degree of immersion physically and mentally, interaction between the student and the computer through an interface, through recognition of sensory feedback, and the presentation of content through tasks that require creative thought and

imagination (Huang, Rauch, & Liaw, 2010). This makes VR a viable resource for growth in problem-based learning and collaborative learning (Fowler, 2015; Huang, Rauch, & Liaw, 2010; Liu et al., 2020). The 3 I's: immersion, interaction, and imagination were shown in multiple studies to have a positive effect on student motivation to learn when compared to non-immersive control groups who were given text or video (Huang, Rauch, & Liaw, 2010; Liu et al., 2020; Makransky et al., 2021). Immersion, interaction, and imagination are facets of VR. These facets help shape the VR experience for students in varying ways according to the chosen format. Some formats are better suited to provide more imaginative, immersive, and interactive platforms while others are less immersive or interactive. Immersion, interaction, and imagination are discussed below in more detail to give a better understanding of what students might experience in the virtual world.

Immersion

Immersion is the level to which learners can see and touch images that are realistic, called representational fidelity, and the degree to which learners can interact and manipulate objects in the simulated experience (Fowler, 2015). Different VR formats have varying levels of immersive environments. VR environments can be so immersive that the person may not be able to distinguish between the virtual world and reality. There is a continuous discussion about the effects of highly immersive environments versus less immersive environments on student achievement (Lei et al., 2022).

Sense of Presence. Sense of presence is different from immersion, in that it is the psychological and emotional state that learners experience when they are involved in the immersive simulation (Fowler, 2015). The sense of presence can eliminate distractions, invoke

specific emotional involvement, and focus attention on the task at hand. It is a cognitive illusion and displacement from the real world into the virtual world (Huang, Luo, et al., 2020). Students using highly immersive formats of VR experience a sense of presence in that they are physically situated in the real world, but have perceptions into another- as themselves or in the form of an avatar (Huang, Luo, et al., 2020). The sense of presence can positively affect learning outcomes, but there is a cognitive threshold. Once learners begin to feel overwhelmed in the virtual experience, negative effects on learning outcomes may occur due to the increase of cognitive load and decrease in available working memory (Huang, Luo, et al., 2020; Lei et al., 2022). The level of immersion is connected to the level of interaction within the VR experience.

Interaction

There are three types of interactions in the VR learning environment. Different interactions students have in VR learning environments are learner-to-instructor, learner-to-learner, and learner-to-content. Students may be required to complete a VR lesson and report back to the instructor or be guided by the instructor through the process. Depending on how the teacher chooses to set up the lesson, students can interact with each other in groups while also gaining feedback from the instructor. All VR experiences allow each learner the opportunity to interact with the lesson's specific content. Students see, hear, touch, and manipulate objects in the virtual content. Learner-to-instructor, learner-to-learner, and learner-to-content interactions are pertinent to consider in creating pedagogically sound VR learning environments and elevating levels of engagement with the instructor and peers, not solely the VR content in the immersive experience (Huang, Rauch, & Liaw, 2010). Interactions are vital aspects of learner-centered instruction and social learning.

Learner-centered Instruction. The teacher is considered a facilitator in learner-centered instruction. This type of instructional design allows students to take agency in their education, explore new concepts, and the teacher helps students to correct misconceptions and share knowledge with opportunities for dialogue (Fowler, 2015; Huang, Rauch, & Liaw, 2010).

Students learning physical geography through VR using a curricular framework were appreciative for teacher guidance, orientation of the task, exploration, peer discussion, reflection opportunities, and revision of answers. This VR study allowed students to take the lead in their learning, which resulted in test averages being higher in the experimental group versus the traditional group with Cohen's *d* effect sizes ranging from 0.23 to 0.60 (Jong et al., 2020). The last feature of VR is imagination, which is essential in cultivating when designing a VR learning environment.

Imagination

Creativity is a crucial resource when cultivating critical thought and problem-solving. Students need opportunities to think outside of the box in more novel ways to compete in a globalized world. In a study analyzing the causal relationships between interaction, immersion, and imagination on collaborative learning, all were found to be predictors, of which, imagination was the key predictor (Huang, Rauch, & Liaw, 2010). Immersive VR environments are opportunities for students to enter into highly imaginative scenarios and serve as great practice for promoting problem-solving and critical thinking (Huang, Rauch, & Liaw, 2010). Highly imaginative and interactive environments have a large influence on student motivation to learn (Huang, Rauch, & Liaw, 2010).

Inquiry-based Learning. VR technology gives experiential learning opportunities for studying material that otherwise might be too dangerous in real-life, too far away, or help make conceptual knowledge more concrete through interaction in the VR learning environment (Allcoat & von Mühlenen, 2018; Huang, Rauch, & Liaw, 2010; Lei et al., 2022; Liu et al., 2020; Makransky & Petersen, 2021; Mateen & Kan, 2020). The concept of inquiry-based learning is similar to the concept of student-centered learning, but these are not both in the same. Pedagogy in student-centered learning focuses on student autonomy, scaffolding and authentic audience (Lee & Hannafin, 2016). Whereas inquiry-based learning focuses on active participation in constructing knowledge (Jong et al., 2020). The teacher and student roles are important to consider when looking at pedagogical models for inquiry-based lessons. For example, a recent model has been constructed by scholars to show how inquiry-based cycles may look. There are five phases including: communication, orientation, investigation, explanation, and reflection (Jong et al., 2020).

Role-play. Role-play is an affordance to VR learning experiences, especially for collaborative or multi-user scenarios. Teachers can create spaces digitally for students to interact with each other through avatars or personalized characters in the virtual world (Fowler, 2015). This allows students to express, think, and feel through these characters to build their social skills (Huang, Rauch, & Liaw, 2010). The task for creating multi-user experiences can be a challenge for teachers who lack the necessary design skills for creating VR learning environments (Huang, Rauch, & Liaw, 2010). Special attention must be paid to include intentional learning outcomes and activities, to situate role-play and task performance with

inclusion of avatars (Fowler, 2015). VR has a variety of formats available to schools that can be chosen to best fit their students' needs.

Virtual Reality Formats

As technology advances, the formats of VR expand to include more variety for use in the classroom according to cost and student needs. Some formats are more cost-effective and allow more students to participate at once. There are differences in each VR format in uses and levels of immersion and interactivity as listed below. Measuring learning outcomes for each format is difficult to analyze as it is hard to pinpoint whether the difference in achievement is due to the device itself, or the level of immersion that the device provides (Lei et al., 2022). However, in the study referenced, there are other confounding variables at play besides the delivery method, such as user interface, ease of access, and student learning preference (Lei et al., 2022).

Head-Mounted Displays

Head-mounted displays (HMD) are VR technology that individual students use one at a time. The student can wear a headset equipped with VR lenses, speakers, and user interface. Students may or may not have hand controllers, as some brands of HMD come equipped with gaze and gesture recognition (Ogden, 2019). This type of VR technology is associated with elevated levels of immersion and interactivity with the user as it uses two screens in front of each eye, thus eliminating the outside world and providing a fully immersive experience (Meyer et al., 2019). HTC VIVE Pro and Microsoft HoloLens are two such examples. A more cost-effective choice is the Google Cardboard, which uses a mobile phone as an insert, instead of a self-contained headset, sold online for about $6 in 2020. (Jong et al., 2020; Mateen & Kan, 2021) However, Google manufacturing was discontinued in March 2021 (Perrigo, 2021). Many of the

HMD require a separate computer workstation, constant connectivity, and a large space for students to spread out to move without interfering with others (Ogden, 2019). There are many options available for schools who lack space or budget allocations.

Spherical video based IVR

Spherical video-based immersive virtual reality (SV-IVR) is an alternative to the more expensive VR headsets and practical for education as it is VR recorded image using a 360-degree camera. This type of VR is accessible across many devices including desktops, mobile devices, and headsets. Students can explore the recorded places on the internet by manipulating the screen interface and using the mouse to click areas of interest, gather knowledge, watch embedded videos, or complete tasks (Jong et al., 2020; 360Schools, 2023). SV-IVR is a viable educational tool due to its cost effectiveness and ease of implementation by teachers without much training. Current research shows that using SV-IVR, situated in a pedagogical framework, can have a positive effect on student motivation to learn and student achievement on knowledge tests in comparison to the textbook-based physical geography curriculum (Jong et al., 2020).

CAVE Immersive Rooms

CAVE was invented at the Electronic Visualization Laboratory of the University of Illinois at Chicago to use a series of sophisticated speakers and projectors to show images on the walls of a room and transform the room into an immersive VR experience for multiple students at one time (Huang, Rauch, & Liaw, 2010). The CAVE immersive room technology is not used as often in educational contexts because of its costs and difficulty in using in classrooms (Huifen et al., 2021). According to a company called *Visbox* that produces such CAVE rooms, a series of projectors are needed to create the VR environment (Visbox, 2023). These are placed behind

screens, or projected onto walls. Tracking is available with the additional selection of specialized glasses, but are not required for immersion. Visuals can be experienced in a variety of resolutions, including 4K. Stereo projectors are also available in customizable set up options (Visbox, 2023). The CAVE room is a less flexible format for education in K-12 schools because they take up space, are costly, and require longer times for set up.

History of Virtual Reality

VR's history started as a vision and quickly became a practical object for use in decades. Some consider Morton Heilig the father of virtual reality with the invention of his *Sensorama* in 1957, a motorcycle-riding experience through a city using more senses than sight and sound alone (Mihelj et al., 2014). However, others consider the beginning of VR to start with the creation of the stereoscope, created by Sir Charles Wheatstone in 1838 (Cotton, 2021; Domini & Riva, 2023). Like the VR headsets, the stereoscope projected a different image on each retina, which blurred, creating the illusion of a three-dimensional object (Cotton, 2021). There are key inventions that paved the way for what VR is today. The names consistently mentioned in the literature review are Ivan Sutherland, Myron Kreuger, and Jaron Lanier (Cotton, 2021; Dzardanova & Kasapakis, 2023; Mihelj et al., 2014; Schroeder, 1993).

Key Innovation and Inventors

Sutherland published his concept of the *ultimate display* in 1965 to the International Federation of Information Processing Congress. He dreamt that a computer could create a display so realistic of the physical world that a person could interact by using only their senses. For example, the virtual world as seen in the film *Don't Worry Darling* (2022) would be like Sutherland's idea of the *ultimate display* because the main character has no inclination that she is

living in a virtual environment apart from the real world. Sutherland worked to communicate that head-mounted displays could be designed using position sensors and computer graphics to emulate a three-dimensional virtual environment (Schroeder, 1993). This *ultimate display* would be true physical transcendence (Cotton, 2021). Sutherland created the first head-mounted display in 1970. His headset tracked a person's head position, allowing them to tilt up or down 40 degrees. Sutherland's work sparked innovations in art, flight simulation and robotics, and military and aerospace research (Schroeder, 1993). Myron Krueger was also instrumental in the success of VR technology.

Krueger designed the precursor to the immersion rooms mentioned previously. He created a gallery in which people could interact with silhouettes of objects on screens and tracked them with cameras and floor sensors. Multiple people could also interact with each other in these projected worlds (Cotton, 2021; Schroeder, 1993). Krueger's work influenced the idea of VR interfaces (Cotton, 2021). Another innovator, Jaron Lanier, is credited for coining the term "virtual reality" in 1989 (Cotton, 2021; Mihelj et al., 2014).

In the 1980s, Lanier's terminology introduced a surge in interest and an industry was developed named Virtual Programming Languages (VPL) Research. Lanier and Thomas Zimmerman were the first to market VR technologies (hardware and software) to consumers, such as the *Body Electric*, *DataGlove, EyePhone,* and the *DataSuit* (Cotton, 2021). In 1992, VR seemed far from being used in homes and schools. For instance, "a prognosis made by Lanier in September 1991...that a high-quality VR machine for home use at $10,000 would only become available by the turn of the century" (Schroeder, 1993). New technological enhancements such

as high-speed internet capabilities, fiber optics and haptic feedback improvements launched VR into the 21st century (Schroeder, 1993).

Cognitive Affective Theory of Learning with Media - VR

The CATLM-VR theory serves as the foundation for this research study. The main concept regarding this learning theory includes three assumptions. They are the dual-channel assumption, the limited capacity assumption, and the active processing assumption (Sorden, 2013). These ideas work together to explain the methods that students use for information processing. Since there are limitations to the amount of information processed at any given time, the focal point of attention is extremely important to VR learners. The amount of extraneous processing completed by the mind is related to the amount of cognitive load experienced by the learner. This subtracts intellectual resources from essential and generative processing, both of which are required to successfully learn new material (Makransky et al., 2021; Sorden, 2013).

Extraneous Processing

Extraneous processing, or extrinsic load, happens when the learner is distracted by poor instructional design, user interface issues with technology, or irrelevant information (Makransky et al., 2021; Sorden, 2013; Sumardani & Lin, 2023). Studies have shown mixed results regarding the effects of VR on learning outcomes due to excessive extraneous processing when compared to textbook, video, and less immersive VR technologies because the increased sense of presence in a more immersive VR learning environment is linked to higher levels of extraneous processing and thus cognitive overload (Huang, Luo et al., 2020; Huang, Roscoe et al., 2022; Makransky et al., 2021; Sumardani & Lin, 2023). Extraneous processing increases cognitive load and may result in confusion or loss of quality instructional time.

Essential Processing

Essential processing, or intrinsic load, is the required mental effort to complete the learning task and pay attention to important, relevant information in the lesson (Makransky et al., 2021; Sorden, 2013). Decreasing the amount of cognitive load is important while designing tasks in VR learning environments because cognitive load subtracts intellectual resources from the ability to maintain cognitive engagement (Huang, Roscoe et al., 2022). A student may experience frustration when they cannot exert the amount of mental effort it takes to accomplish the learning tasks due to extraneous distractions. This concept has shaped this study as students are more intrinsically inclined to learn using VR because it is engaging, but VR could also distract a student to the extent they become frustrated when they cannot find relevant information in the virtual environment to complete the task.

Generative Processing

Using the limited capacity assumption, learners use the intellectual resources left for generative processing, also known as germane cognitive load, which is the mental effort needed to make sense of the material and incorporate it into their existing mental framework (Makransky et al., 2021; Sorden, 2013). Both essential and generative processing are requisites for learning to occur. It is important to note that recent studies have shown that highly immersive VR leads to high extraneous processing when compared with less immersive media because of VR design flaws and lack of guidance within the experience due to the effort learners have to exert in finding relevant material hidden in context of irrelevant objects (Makransky et al., 2021; Makransky & Petersen, 2021). Thus, educators and VR instructional design specialists should focus on reducing extraneous processing and cognitive load and increasing cognitive

engagement to allocate intellectual resources more towards the types of processing needed to learn the material (Makransky & Petersen, 2021).

Benefits of Virtual Reality in the Classroom

There are many benefits to students who use VR in the classroom. Research shows that students exhibit more positive emotions, better rates of motivation, and higher rates of learner satisfaction using VR instruction when compared to text or video methods using the same content (Allcoat & von Mühlenen, 2018; Huang, Luo et al., 2020; Huang, Roscoe et al., 2022; Makransky et al., 2021). Studies also report higher measures on learning outcomes because of increased cognitive, emotional, social, and behavioral engagement, especially when students were arranged in groups when compared with traditional teaching methods (Jong et al., 2020; Lei et al., 2022; Liu et al., 2020). Additional benefits come in the form of increased opportunities and engagement with content.

Shrinking Time and Space

The nature of VR lends itself to added benefits in providing students with experiences. For instance, risks are minimized when learning content that is inherently dangerous, to themselves or to others, as in simulated medical procedures (Cromley et al., 2023; Makransky & Mayer, 2022). Also, VR shortens time and cost for travel to specific places to see landmarks or geographical features (Cromley et al., 2023; Makransky & Mayer, 2022). Literature suggests that VR should be used because it allows equitable access to learning for students who otherwise would not have the opportunity (Cromley et al., 2023; Huifen et al., 2021; Makransky & Mayer, 2022). Researchers found that student learning outcomes were higher from a virtual field trip

than a physical field trip. The added benefit here is that students were not burdened by long travel times, fatigue, and the inability to replay the tour (Cromley, et al., 2023).

VR and Active Learning

The largest effect found on learning in VR is redesigning the lesson to include active learning engagement strategies. Learners using VR should be given a constructive task to complete while exploring the virtual environment to transform passive to active learning (Cromley et al., 2023). This could look like a think, pair, share, teach a peer activity, or quick write. Students should be able to pause and replay segments of material to construct meaning from the VR experience (Cromley et al., 2023; Huifen et al., 2021; Makranksy & Mayer, 2022). It is important to note that it is not the immersive technology itself that improves learning outcomes, but the instructional scaffolds and design that complements the technology which can improve student learning (Makransky & Mayer, 2022).

Learning Style Preferences

Special attention to students' preferred learning styles may also increase effectiveness of activities, as some learning preferences may benefit over others (Huang, Luo et al., 2020). VR supports and encompasses all learning style preferences including visual, auditory, and kinesthetic learning (Allcoat & von Mühlenen, 2018). VR facilitates active learning, rather than passive learning, and helps students learn through multiple modalities all within one virtual environment (Allcoat & von Mühlenen, 2018). Research shows that learning outcomes are increased when instruction includes immersive VR. For example, whereas traditional teaching methods produces an increase of 11% on assessment, use of VR instruction produces a higher rate of 26% improvement (Allcoat & von Mühlenen, 2018). In addition, students were more

motivated to learn and were more prepared to answer questions when they had experienced the lesson using VR activity versus traditional methods, like videos (Allcoat & von Mühlenen, 2018). However, learning style preferences have been critiqued in research because of the lack of empirical data (Allcoat & von Mühlenen, 2018). Despite this confliction, studies continue to use learning style preference as a theoretical framework to investigate rates of student participation, learning satisfaction, and retention of knowledge in VR activities compared to traditional methods (Huang, Luo et al., 2020).

Challenges with Using Virtual Reality in the Classroom

Some challenges cited in the literature discussed that even though students are now considered digital natives, they can have difficulties navigating task performance using the interface, which increases cognitive load and negatively impacts learning outcomes (Huang, Luo et al., 2020; Huang, Roscoe et al., 2022; Makransky et al., 2021; Sumardani & Lin, 2023). This higher cognitive load is caused by distractions, irrelevant material, or lack of learning objectives. Higher rates of agency in the virtual environment does not always mean higher test scores. More freedom to explore can be a distraction, increasing extraneous processing and lowering working memory and generative processing (Makransky et al., 2021). Studies recommend that students have pre-training before completing the learning task to successfully orient those who lack experience using VR or need guidance in completing the learning task (Makransky et al., 2021; Meyer et al., 2019). Schools may also lack the physical space necessary for VR boundaries to be properly drawn for a whole class of students (Huifen et al., 2021).

Cybersickness

Some students may exhibit symptoms of cybersickness when using highly immersive formats of VR (Huifen et al., 2021; Liu et al., 2020; Ogdon, 2019). Side effects of highly immersive technology include experiences of dizziness, motion sickness, headache, blurred vision, seeing double, nausea, and disorientation (Huifen et al., 2021). It is vital that teachers and program directors are aware of these side effects when scheduling students to participate in VR lessons (Allcoat et al., 2021). Any students who are apt to motion sickness should be excused from participation and allowed to contribute in other ways.

Lack of Teacher Support Systems

Several studies also explained the role of the teacher in designing effective VR learning environments. The required technical skill and lack of experience with VR is a challenge to using VR effectively in the classroom (Huang, Rauch, & Liaw, 2010). Technical support, training, and building-level support are vital for implementation. Gender, age, and experience were not significant indicators in predicting intention to use VR in the classroom. Research suggests that social influence is the most crucial factor in predicting teachers' intention to use VR. Principals, school leadership, and teacher colleagues are needed to give support and guidance to integrating VR activities into the curriculum (Boel et al., 2023).

Gaps in the International Standards for Technology Education

When designing the framework of this study, I researched other instructional tools such as technology standards. The International Society for Technology in Education (ISTE) publishes standards for educators and educator leaders to use as a framework to guide instruction using educational technology and ethical practices (International Society of Technology in

Education, 2023). The standards are broad in nature to apply to many technological tools. However, these standards showed obvious gaps when applied to the integration of VR in the classroom. A search of "virtual" in the standards resulted in only one mention of virtual environments. The standard reads, "manage the use of technology and student learning strategies in digital platforms, virtual environments, hands-on makerspaces and in the field" (International Society of Technology in Education, 2023). The standards are inadequate as they do not provide a clear picture to teachers on how to use VR in the classroom, only that it should be used.

Another technology standard states that educators "dedicate planning time to collaborate with colleagues to create authentic learning experiences that leverage technology" (International Society of Technology in Education, 2023). Standards provided by the International Society of Technology in Education will be used to inform and plan a collaborative environment in a portion of the professional development provided to teachers.

Instructional Coaching as Professional Development

Instructional coaching became popular after the passage of No Child Left Behind in 2002 to promote student achievement in schools (Desimone & Pak, 2017; Glover et al., 2022). Instructional coaches play a key role in a teacher's professional development. Often, coaches are required to deliver on-site, personalized, and relevant professional development to teachers in their building based on collected data (Glover et al., 2022; Kho et al., 2019; Knight, 2019). Although professional development is a multi-billion dollar industry in education each year, most interviews indicate that teachers have low confidence in professional development workshops, failed to see how the workshops met their individual needs, did not reciprocate the value and expertise that teachers brought to the table, and confessed that practices were rarely

implemented as a result (Knight, 2019). Studies show that professional development organized around shared learning experiences, collaboration, feedback, and active learning have more impact on rates of implementation and change (Desimone & Pak, 2017; Kho et al., 2019). According to best practices in andragogy, adults learn differently in that the *why* behind the learning should be explained, adults need to experience and complete tasks instead of being told, adults have more motivation to learn and are faster learners when the topic is relevant to their daily practice (Penland et al., 2019). These are all concepts to keep in mind when creating the teacher workshop.

Instructional coaching as professional development usually involve a step-by-step process in which the coach visits the teacher to help establish goals, schedules observation(s) in the classroom, and conducts a post conference to give feedback and promote reflection of the lesson afterwards (Desimone & Pak, 2017; Gallucci et al., 2010; Kho et al., 2019; Knight, 2019). This approach to professional development has produced elevated levels of implementation compared to professional developments without coaching (87% to 33%) and were more likely to continue use of the instructional practice in the future (96% to 35%) (Knight, 2019). This partnership approach to professional development helps teachers to take ownership in their own instructional practices, investigate different strategies to improve their craft, and use data to reflect, and revise ineffective attempts to reach students (Desimone & Pak, 2017; Gallucci et al., 2010; Kho et al., 2019; Knight, 2019).

Future Research

Based on the findings presented in the literature review, many studies have already shown connections between the use of VR in the classroom and higher levels of student

motivation and satisfaction. Studies have also focused on comparing immersive VR formats and less immersive formats such as text, video, and desktop applications. Continued research in this field is required to expand on which teaching strategies should be used alongside VR applications to ground the use of such activities in learning theory. Other directions could focus on how to support teachers in using VR effectively.

Summary of the Literature Review

In conclusion, the literature review is shaped by many topics surrounding the study such as: features and formats of VR, use of VR in classrooms, learning theory, benefits, and challenges to implementation in the classroom, as well as a brief history of the development of VR. Instructional coaching was also important to include based on the format of professional development planned for the methods section. The findings suggest there is a gap in research regarding the planning of VR professional development for teachers in the social studies classroom. No article specific to this topic was found in the literature search. Using this information, a research study on using instructional coaching as professional development to implement VR in social studies lessons will be the foundation for the methods section. Informed by the research above, this next chapter will explain a study that adds to the discussion and sheds light on how teachers are supported in implementing VR activities within their lessons using a partnership approach by designing active learning opportunities for professional adults.

CHAPTER 3: METHODOLOGY

Introduction

The purpose of this mixed-methods study is to design a theory-based framework for professional development intended for teachers in the classroom. The theoretical framework

informed the methods in each of the distinct phases of this study. The CATLM-VR theory was the foundational concept behind the creation of the presentation, the observation rubric, and the feedback provided to teachers in coaching conversations after their lesson. Participants in this study will have an opportunity to experience VR for themselves, design and collaborate on lesson planning using best practices, and better understand how students learn using VR with feedback on their lesson. In this chapter, I will discuss the sample, setting, and research design for this study.

Mixed Methods Exploratory Case Study

To best answer the research questions, a mixed methods exploratory case study was developed to provide VR professional development for social studies teachers. Data was collected first through a focus group interview to determine teacher needs for the workshop. A pre-survey was given to teachers to quantify these same needs. An identical post survey was given to teachers who participated in the VR professional development. This quantitative data was compared and triangulated with interview notes from coaching conversations to determine the influence of the workshop on teachers' knowledge and readiness to incorporate VR activities into lessons using a theory-based rubric. This methodology was chosen because it is useful in exploring a phenomenon with qualitative research then quantitative research (Creswell & Clark, 2006). The selection of a mixed methods design for the purpose of expanding the scope of the study allowed more choice because each research question could be answered by whichever method was most appropriate (Greene, 2007). The use of both qualitative and quantitative methods to assess program outcomes and program implementation has been a popular trend in mixed methods research (Greene, 2007). This methodology was chosen because beginning with

qualitative research can help identify patterns for further research in following phases of the study. The methods described below indicate how a mixed methods exploratory study helped to answer the following research questions.

Research Questions

There were three research questions guiding this study. These questions were designed to gather insight into what needs existed surrounding teacher implementation of VR in the social studies classroom. Additionally, this data was used to specially design a professional development to help teachers create VR lesson plans for use in their classrooms. Instructional coaching cycles were conducted with teachers to observe their lessons and provide quality feedback using a researcher-created rubric. Research questions include: 1) How do teachers in the school district currently use VR in the classroom? 2) What relationship exists between participation in the VR professional development and use of VR in the classroom? 3) What influence does VR professional development have on future VR implementation?

Sample and Setting

Context and Participants

The school district in which I conducted this study is one in which I work as the District Social Studies Curriculum Coach. I chose to conduct research in this district because I fostered trusting relationships with faculty members at each school. I have known and worked with many of these individuals, attended the same meetings when I was also a teacher in the department, and have known some individuals for the better part of ten years. The benefits of conducting this study within my own school district included the relevance of the study to the problem with a lack of professional development training for VR lessons. I knew this was a critical issue to our

social studies teachers. Also, because I have established relationships with the participants, they were able to feel more at ease in conversation and understood my mission for the study was to help, support, and inform using best practices in the workshop. The integrity of their answers was strong because of that established and trusting relationship.

Four teachers, one from each middle school in the district, volunteered to participate in this research study. These four participants responded to the email that was sent to 46 social studies teachers in the district. Three of these participants taught sixth grade World Civilizations, and one taught seventh grade Geography of World Regions and eighth grade South Carolina and United States History. There was also a wide range of experience between the four participants. Two teachers had between 22 and 25 plus years' experience. The other two had between 2 and 3 years' experience. Further studies on VR implementation in K-12 settings could focus on the relationship between years of experience and number of times implemented throughout the year. However, years of experience was not a variable for this study.

Ethical Implications of the Study

It was important to me as a trusted colleague to take all measures to ensure protection of privacy and confidentiality agreements. As such, I took precautions in talking about the study with other people besides the participants themselves or my committee members. This could potentially have damaged my relationships with the individuals completing the study. In addition to conversation, no emails were sent to other faculty, staff, or supervisors that detailed information pertaining to the study or the participants. All documents remained secure in my personal bag or my district computer, which has a Yubikey authentication device installed to provide extra protection. At the end of this study, it was also important to me as the researcher to

share any results found to all participants and member-check before the last version was published (Birt et al., 2016). This ensured that I minimized researcher bias and accurately painted a picture for others in the field about the topic of this study and the participants' experiences.

Incentives

No monetary incentives were used in this study. However, participants may have benefitted from gaining new knowledge about a current issue in education and received free professional development. The participants were told there were no repercussions for not participating in the study.

Research Design

Procedures

The study described below was created by me and consisted of many phases based on the CATLM-VR learning theory and five best practice VR lesson design principles (Moreno & Mayer, 2007). The first phase was designed to determine the background knowledge, experience, perceptions, and level of need of teachers encompassing the use of VR in the social studies classroom. The second phase was the presentation of the learning theory and guidance for teachers in exploring the VR headset activity and creating a lesson according to the rubric provided for implementation. The third phase was the conduction of observation rounds, and specific feedback provided using instructional coaching strategies to promote reflection. The fourth phase was designed to analyze growth in teachers due to their participation in the workshop.

Phase 1

The first phase in procedures was obtaining IRB approval from the school district and Coastal Carolina University. After approval for the study was obtained, an informative email was sent out by the Director of Assessment and Accountability to potential faculty members who taught social studies in grades 6-12, see Appendix A. Teachers who showed interest were able to contact me directly in email and obtain informed consent documents through Google Forms (see Appendix B). Teachers had ample time to talk over their participation with loved ones and ask questions of myself or my committee chair. Those who electronically signed the documents were contacted again by email and received a proposed schedule and a link to the pre-survey. The meeting for the focus group interview was planned and shared with the treatment group in the same follow-up email (see Appendix C).

Phase 2

The second phase consisted of analyzing the qualitative data from the focus group interview and quantitative data from the pre survey to gauge the level of need and teacher perceptions about using VR as a tool for education in the classroom. These patterns determined what was included in the teacher workshop. The professional development, created specifically for this group of teachers by analyzing focus group data and pre survey data, unmasked the CATLM-VR learning theory and explained to teachers how best practices look in VR environments according to how teachers reported data collected in the first phase. Teachers were given the opportunity to explore the headset and complete the VR guided tour themselves and were given a theory-based rubric to develop a VR lesson plan (see Appendix H). Researcher notes were compiled in a personal journal for reflection and data analysis.

Phase 3

The third phase started with confirming the dates for classroom observations. Another follow-up email (see Appendix E) was sent to the group with the dates for their scheduled observation. All observations occurred within one week. Data was collected in the research journal and by using the VR lesson rubric. These notes were then used to formulate guiding questions to get the teacher to reflect on the lesson and discuss improvements based on current challenges and their potential impacts on student learning. During the debriefing, participants used their copy of the rubric to self-assess. The teachers could express themselves, ask questions, or make inferences needed throughout the research study.

Phase 4

After completing the coaching conversations with teachers, the post-survey was sent out via Google Forms in a final email, see Appendix I, to gauge the growth of teachers from the initial survey before their participation in the VR professional development to completion of the study. All data from surveys, interview notes, rubrics, and the focus group interview were used to inform about teacher perceptions, changes, growth, and comfortability. These data were then used to answer the research questions listed above.

Creation of Survey Questions

I created survey questions in thinking about how teachers in the school district might view VR as an instructional tool. I was cognizant about how teachers in my department are currently using VR in the classroom. However, I did not know much about their personal knowledge or entertainment uses beyond the classroom. I tried to make statements that teachers could answer honestly, without fear of embarrassment. Each statement was created to provide

information about the participants' prior knowledge, lesson implementation, and previous professional development experiences or coaching cycles.

Prior Knowledge

Question 1 included the statement: *"I have experience using VR."* Teachers could self-report which of the Likert selections matches their current experience. Answer choices include five options from *strongly disagree* (1) to *strongly agree* (5). Question 2 stated: *"I can define what VR is."* This was an important aspect used to create the professional development. Teachers could also use the 1-5 selection that matched their level of understanding VR. This statement was chosen because VR has many different formats and types of experiences for learners, so definitions could vary depending on the participant. However, the selection of answer choices helped inform levels of confidence regarding the VR topic. The last question for this cluster was Question 3 which stated, *"I can describe how students learn in virtual environments."* Once again, participants could select items numbered 1-5 to communicate their knowledge about VR learning theory. Since the professional development uses learning theory as a framework, this statement in particular provided much needed information about the knowledge of participants in using VR in the classroom.

Lesson Implementation

For this cluster, two statements were created to indicate current practice and knowledge about the integration or willingness to integrate VR into lessons. Question 4 included the statement: *"I can design a lesson using a VR activity."* Participants used the Likert scale 1-5 to select the appropriate level of agreement according to how they currently feel about their ability to design lessons using VR. Part of the teacher workshop consisted of designing a lesson

incorporating the best practices of VR learning. Question 5 stated, *"I feel comfortable asking for support to use VR."* Participants indicated their level of comfortability and openness to coaching support by disagreeing or agreeing with the statement. Since a major component of this research study contained instructional coaching cycles, it was important to gauge how willing participants were to ask for help with VR. Question 7 was also designed to gauge confidence levels for lesson implementation. It stated: *"I feel confident using VR activities in my classroom."* Participants could select their choice using the Likert scale 1-5 to indicate their confidence level before the training. The second research question investigated the relationship between participation in training with the level of confidence for implementing VR into lessons. As a major part of research, this was an essential question to target.

Previous Training

Information regarding previous training was included in the third cluster. Question 6 on the Google Form included the statement: *"Professional development has helped me understand VR."* The logical reasoning behind using this statement was that teachers could indicate any attribution from previous professional development to their current understanding of VR. In the findings section, I hope to compare the participants' responses in the pre-survey to those on the post-survey, to see if teachers attribute any new learning with the professional development I have created for them. Question 8 contained the statement: *"My class was observed using VR."* This statement was answered with a *yes* or *no* choice instead of the Likert scale used in previous questions. This statement allowed insights into how many participants have already implemented VR with an instructional coach or school administration, or participated in a previous coaching cycle. It does not specify immersive or less- immersive VR, nor does it reference any specific

format. In the post-survey all participants will have experienced an observation in Phase 3, the coaching cycles. Question 9 is also a *yes* or *no* answer choice. This statement read*: "I received specific feedback about my VR lesson."* Answering *yes* would mean the participant was evaluated and given tips to improve. Specific feedback is being provided targeted information to help encourage certain practices and identify areas for improvement (Rhode Island Department of Education, 2024). It is the act of receiving valuable information to inform practice. In the post-survey, this statement indicated whether participants felt they received valuable information to improve practice, or not.

Creation of Focus Group Protocol

The focus group protocol was created to gain insight into the current level of experience with VR, what teachers wish to learn about VR, and their feelings about VR technology as a tool for education. This qualitative data was used specifically to gauge the level of entry needed for teachers. This informed me of what needs and goals teachers expressed to create a tailor-made professional development. This data also gave some insight for intentional grouping of participants based on experience level or goals.

The first question in the focus group was created in order to let participants introduce themselves and give some background information to others in regards to teaching experience and experience with VR. The second question was *"what do you wish to learn about VR in education?"* This question was created to target the participants' interests in VR for the creation of the professional development. The third question chosen *was "How does your school support VR in the classroom?"* I asked this question to understand from the teachers' perspectives the support provided from administration in using VR. It is important to understand if there was a

system in place or certain policies that schools followed in using VR. The fourth question created for the focus group interview was *"Has your school offered any VR training via the company that devices were purchased from?"* This was an important question to ask to see if there was any previous training done at schools with the teachers. Part of this research study is trying to understand the influence of the tailor-made professional development on future VR implementation and teacher confidence. The fifth question created was *"Is VR an educational tool that enhances learning or a distraction from learning and why?"* I wanted to discover teacher perceptions about VR before the teacher workshop. This way, I can uncover misconceptions and address them during the training. The sixth question focused on the engagement levels of students translated on an assessment versus more traditional teaching techniques. The question was, *"Do you think students would do better on an assessment using VR as instruction versus regular instruction to learn the content?"* I wanted to dive into their perceptions of VR engagement levels, and see if teachers thought VR would be more engaging than regular instruction and thus improve assessment data more so than traditional methods. The next question was *"Do you think a professional development for VR is needed in our district?"* This question centered on the need for training for teachers in integrating VR in their classrooms. It is important to understand if teachers think professional development is relevant to their practice. The last question was *"How are you using VR in your classroom, currently?"* Teachers may use other formats of VR, despite access to headsets, and I wanted to explore the ways in which teachers are using VR to answer the first research question. A *"last comments"* question was added to the protocol to collect any additional information participants wanted to share.

Creation of Feedback Rubric

I created the rubric to use as a guide for teacher feedback. During the professional development workshop, teachers received the VR feedback rubric, discussed what each section of the rubric means and how it might look in their class, then collaborated with each other to prepare a lesson using best practices as outlined in Moreno and Mayer (2007). These best practices derived from scholarly research using the CATLM learning theory, applied to VR and this study.

I also used my own professional experience in the classroom and as an instructional coach to create the feedback tool. I have observed many classes in grades 6-12 and was able to visualize what actions teachers can take to implement the principles outlined in Moreno and Mayer (2007) in three categories: *Approaching, Meeting, and Exceeding*. I first aimed to create what the *Meeting* category would look like, then described what would be close as *Approaching*, and what would be considered more than sufficient as *Exceeding*. There are no points included in the rubric because it was meant solely for feedback purposes and not for evaluative purposes.

After the teacher implemented their lesson, I used the same feedback rubric to guide the coaching conversation. The teacher took a few minutes to fill out their own rubric before the conversation began. This allowed the teacher to understand how they rated themselves thereby allowing for constructive feedback and metacognitive processes to improve on experience and future integration of VR technology in lessons.

Data Collection

Research Question 1

Data was collected to answer the research question regarding current teacher knowledge and practice with VR through a pre-survey and a focus group interview during the initial virtual meeting. The pre-survey consisted of questions regarding teacher readiness and knowledge of VR for education. Most items used the Likert 5-point scale ranging from *Strongly Disagree*-1 to *Strongly Agree*-5. Only two items offered a *yes* or *no* selection. The survey question link was sent in the virtual meeting and by email. Responses were collected via Google Forms, which summarized the data by bar graph and pie chart and listed percentages for each answer choice.

The focus group allowed for qualitative data collection during the initial meeting. A focus group interview method was selected to help build group dynamics and create a sense of solidarity (Krueger, 2022). The questions were built to allow participants to explain their current knowledge and perceptions regarding VR and explain how they used VR in their classrooms and schools. The focus group and pre-survey responses provided the data needed to fully answer the research question.

Research Question 2

Data was collected to answer the question regarding the relationship between self-reported rubric scores and post-survey data as a result of participation in VR coaching cycles. The researcher-developed rubric was created as a tool to observe and debrief teachers facilitating a VR lesson in class. This theory-based rubric helped guide teachers on best practices in using VR in the classroom and focused the debriefing conversation after the observation. Research notes were collected from the workshop, the coaching conversations, and from the rubric scores

after the lesson was observed. The participants were each asked to score their own rubric at the beginning of the conversation. These talks were not scripted and happened more organically. Participants sat next to me, and we talked about their experience. Instructional coaching techniques helped to explore ways in which teachers viewed their own lesson, how confident they felt, which led to questions concerning their intention to use VR again in the future based upon their experience. The post-survey was sent via email after I left the school for participants to fill out. This combined data helped to determine a more complete answer to the research question and determine if the way in which teachers scored their lesson on the rubric any relationship with their answers on the post-survey.

Research Question 3

Data was collected from the pre survey, post survey, and interview notes from the coaching conversations to answer the research question regarding the influence of participating in the workshop on future intentions to use VR in the social studies classroom. Coaching conversations were recorded with the participants' permission. During those coaching conversations, specific questions were asked to gauge the goals and intentions of teachers using VR in their lessons based upon their experiences with the professional development and instructional coaching cycle. Examples of questions were asked to guide the discussion such as, *"So, after your experience going through the workshop, do you think you would use VR again in your class? If so, what would you change? What would you do again that was successful?"* Further questions were asked to guide the participants to reflect and expand on reasons why they would or would not. Each coaching conversation was different depending on the person and the relationship established between educator and coach. These data points were collected, coded,

and analyzed to understand the influence of participating in the workshop on the level of confidence in using VR in the social studies classroom.

Data Analysis

Research Question 1

To find how teachers currently viewed and used VR in the classroom, a pre-survey and focus group protocol were developed to gauge how knowledgeable and comfortable teachers felt about implementing a VR lesson without any training. Qualitative data was coded *in vivo* and reported based on common themes and patterns developed during the conversation. Qualitative *in vivo* analysis is an inductive method that uses the words of the participants to highlight their experiences instead of summarizing them (Manning, 2017). Specific words or themes that emerged were chosen to be codes for the qualitative data collected in this research study. These codes became the foundation for developing the most appropriate professional workshop for teachers' needs. This helped keep the analysis as close to the data as possible, so as not to lose any of the connotation or meaning in translation. This data was also triangulated by comparing the focus group answers to the results of the pre-survey to select appropriate content and activities for the teacher workshop (Creswell & Poth, 2018). The data from the focus group and the pre-survey were used to develop appropriate objectives and levels of scaffolding for teachers as they learned about VR.

Research Question 2

The relationship between participation in the workshop and use of VR in the classroom was analyzed using the post-survey data and the VR Lesson Feedback rubric scores. Statistical testing will help determine if there is a relationship between scores on the rubric and self-

reported levels of confidence in the post survey data. The post-survey results and the rubric scores were analyzed in IBM SPSS software (version 28.0.1.1) using the Spearman correlation test. As both variables are ordinal data which can be ordered or ranked, the Spearman correlation test was the most appropriate to use to gauge relationship and effect size. According to Spearman's *rho*, a perfect positive correlation is 1, no relationship is 0, and a perfect negative correlation is -1 (Field, 2018).

Research Question 3

To analyze the influence that the VR professional development had on future VR implementation, it was necessary that participants filled out the pre-survey and post-survey. The answers were reported in a Likert-scale format. A paired samples *t*-test analysis was run in IBM SPSS software (version 28.0.1.1) to compare the pre-survey and post survey responses. A paired samples *t*-test was the best approach to understanding the before and after changes due to the treatment. This test allowed me to see the changes over time from one data point to a later point (Field, 2018). By comparing the responses, I saw how participation in professional development clearly influenced teachers during the VR implementation. Combining this data with the qualitative data collected from researcher notes and coaching conversations helped to form a more holistic picture of the intentions of participants to use VR headsets in the future.

Positionality

Personal Background

I identify as a White, cisgender female in the middle class socioeconomically. My personal background acts as a lens through which I view the world. As a researcher, I needed to

be mindful that participants in the research study may not have the same lenses or experiences as I do, and this would affect the ways in which we view education and VR in education.

Privilege

As a White, cisgender female I recognize that I have had privilege in this world. I have been selected as a participant in many professional developments by my school leadership, and molded to be what I am today. At an early age I was hired to become the district-level social studies coach. This privilege has provided me opportunities to study and gain economic freedom through work in my career. Throughout this research study, it is pertinent to recognize this and keep this in mind throughout the entire process to recognize researcher bias and mitigate it through member-checking.

Power and Workplace Relationships

I recognize that my position could affect the study. Although I am not an evaluator, or supervisor, I could be seen as such by some participants. This may affect their answers or their performance during the observation. It is important to reiterate that I am not an evaluator, and that at any time if a participant feels they would like to leave the study, the participants reserve the right to do so without any consequences to our existing relationship or position in the workplace.

Age, Gender, and Social Class

As a researcher, I have done extensive reading regarding the influence of age, gender, and social class on the use of VR in the classroom. As stated previously, it was concluded that age, gender, and experience were not statistically significant in predicting the use of VR in the classroom (Boel et al., 2023). Social class would determine experience with VR as it is more

affordable, but still rather expensive for most budgets. According to a recent interview, an instructional coach said that “the school bought fifteen headsets, which had a one-time cost of $465 per unit and a continual fee for software of $370 per headset per year, equated to about $5500 for upkeep each year, not counting repairs (C. Langford, personal communication, August 24, 2023).

Limitations of the Study

Time Limit

Due to a dissertation's nature, there was a stringent time limit on collecting and analyzing data. Research was completed according to the deadlines set forth by the dissertation committee and chair. This limitation required that the data collection and analysis occur at the same time. If more time were allotted for this study, I would survey more teachers and open the workshop to more teachers to increase teacher support for VR in the social studies classroom.

Study Size

The sample size for this study was limited because of the period allotted in completing the dissertation process. This limitation also affected the generalizability of the study results to a larger population. A small sample size also restricted the amount of diversity in the teacher groups, which could lead to lack of multiple perspectives or cultures in the qualitative and quantitative data.

Summary of Methods

This mixed methods study with exploratory design was the best methodology for answering the research questions because the design inherently allowed for more freedom in

collecting data to answer each specific question. The research study was designed to investigate how teachers are using VR currently in the school district. The collected qualitative data from focus group questions were triangulated with results from the pre-survey to develop an appropriate professional development according to teacher needs. Their collective answers allowed for patterns to emerge in the data, which was then used to pinpoint the needed objectives of the workshop and how to best support teachers. After the workshop, teachers who received the treatment implemented their lesson during an observation using a rubric based on the cognitive theory of multimedia learning. Teachers were then debriefed using instructional coaching techniques and conversation for reflection. After the rounds of observations and debriefs, teachers who completed the study were sent a post-survey indicating their readiness to use VR in the classroom. To determine the likeliness of future VR implementation, all qualitative and quantitative data were triangulated, prepared in a presentation, and delivered to all stakeholders relevant to the study in the school district and Coastal Carolina University. The next chapter discusses the findings of the study including the data collected from interviews and statistical testing.

CHAPTER 4: FINDINGS

Introduction

This study's methodology was sequential in that the focus group interview and pre-survey data were used to inform the preparation of the professional development for the participants. Furthermore, this data led to the creation of the focus of the training in VR technology for the social studies class. Personal notes from the workshop, along with coaching conversations and post-survey data, served to inform the answers to the following research questions: 1) How do

teachers in the school district currently use VR in the classroom? 2) What relationship exists between self-reported rubric scores and post-survey data as a result of participation in VR coaching cycles? 3) What influence does VR professional development have on future VR implementation? This chapter elaborates on the findings of the study in each of the phases.

Phase 1

This phase included preparation for the study and getting proper approval from Coastal Carolina University and the local school district. Four participants responded to the email and consented to the study via the Google Form provided through email. A date for the virtual focus group was set, and all four participants spoke in the discussion. One participant had trouble with audio, so they typed in the chat box, and I read their statements or questions aloud. At the end of the focus group interview, a link was sent in the chat for the pre-survey. All participants completed the pre-survey.

Phase 2

The second phase consisted of analyzing the qualitative data from the focus group interview and quantitative data from the pre-survey to gauge the level of need and teacher perceptions about using VR as a tool for education in the classroom. These patterns determined what was included in the teacher workshop. The following results were collected in the focus group interview and the pre-survey, followed by researcher observation and notes collected from the professional development day.

Focus Group

For clarity, the teachers who participated in this study will be called Teacher A, B, C, and D to protect anonymity. Teachers A and C have 22 and 25 plus years of teaching experience,

respectively. Teachers B and D have 2- and 3-years teaching experience, respectively. There was a wide variation in experience between the participants in this study. The conversation started very casually, and everyone was at ease. As stated before, I have established relationships with each of these individuals through my position as their district-level curriculum coach. During the conversation, a couple of themes emerged using *in vivo* coding techniques. The most prevalent themes from the participants' conversation were VR formats (23), VR as an educational tool (17), VR as a distraction (17), and VR experiences (both student and teacher = 28 combined or 14 each). These identified themes will be the focal points for the following discussion.

Teacher A. Teacher A started the conversation stating their years of experience was 22 years in public education. During this interview, Teacher A focused the conversation more on the ability of VR to extend the classroom and provide students the opportunity to explore history through VR as an engaging and motivating method of learning. Although no classes at Teacher A's school have the capability to provide immersive VR experiences currently, they are interested in learning how to use it as an educational and entertaining tool. Teacher A has used less immersive VR such as 360-degree videos in class "like that panoramic view where they get to go and look and see," but noticed that "students get really bored with it really quick." Teacher A said that "no class has the ability to use VR headsets. But I know they would really enjoy it. So that the kids, all kids to be able to use it and have that experience." This teacher is more concerned with preparing students to be able to navigate VR experiences to learn content more deeply. Teacher A was also a bit conflicted about the question of whether VR would improve assessment results or be a distraction to learning. Teacher A stated that, "And it's kind of is based on the kid. Because sometimes no matter what, some kids are just not going to listen... I

guess it's kind of, it's kind of up to the child, because some may enjoy it. And some may just be distracted and want to, you know, want to play the game or just want to go do that. But I don't know. It's gamified." Teacher A does not have a VR headset at home but was able to try it at an arcade once. They described the experience as, "it kind of puts you in whatever the situation is and for you and I guess not interactive, I wouldn't think... more of just being able to see." Teacher A believed that VR is an educational opportunity to travel to places students would otherwise not be able to access. Teacher A claimed that "instead of just hearing about Rome well, let's take this trip to Rome. And I know I've done the one on the board. But I think those VR glasses would be so much more educational and entertaining for the kids."

Teacher B. Teacher B is a young teacher in their second year of teaching and does not have much experience with VR headsets. This teacher has experimented with other formats of VR in the classroom, such as 360-degree videos in *Nearpod,* but their school does not have any headsets. Teacher B stated "I have used VR stuff in the classroom, when looking at *Nearpod*- I've done stuff with the Holocaust. I've done stuff with geography- we're getting to travel places, but with VR headsets, I haven't done anything." This person made a statement that others in conversation agreed with and referenced that VR will produce a significant change. They stated that, "I feel like it's going to change history is going to be one of those engaging classes. Once you have something where it can pull you in and show because you'll love it once it works out, and you can get all the kinks. It definitely makes it more interactive and engaging." Based on statements and agreement, participants feel that the study is timely, relevant, and interesting to their practice. Teacher B talked more about instructional experiences. They referenced that VR, like anything in education, could be a failure if proper steps were not used to scaffold and guide

instruction. The quality of instruction was important because, “if you don't have a person who knows how to facilitate...such as having things preloaded on it with certain sites, because you want to make sure that you're focusing on what's being taught versus, you know, the *Cookie Clicker* or whatever version it is for VR headsets.” *Cookie Clicker* is a game with no end, with hundreds of achievements, but no real purpose (Wikipedia, 2024).

Teacher C. Teacher C had audio difficulties and participated by typing their responses into the chat, which I read aloud to other group members. Teacher C has the most experience in public school, with over 25 years. Their school is also the only school in our district that has several VR headsets. Although Teacher C has never had VR experience before, nor taught using any VR formats, they have asked for training but were not able to get any. Teacher C said, “I don't have one at home and have asked to be trained at our school but only science has been allowed to use it.” They started off the conversation feeling like VR would be great for kids as an educational tool. Teacher C stated, “Sounds great to use in class... it definitely enhances if used correctly and is not a babysitter. Firsthand experiences will draw in reluctant learners.” Using VR as a babysitter was interpreted to mean lack of attention and possibly uneasiness due to changing roles as a teacher using VR. Teaching using immersive VR shifts the role from teacher-centered to student-centered and makes the teacher more of a facilitator. Teacher C harbored concern with students not utilizing VR time for learning. Teacher C brought up that, “evidently there were some issues with kids going to unauthorized sites.” Other teachers in the conversation agreed that issue was on their minds as well. Teachers asked if there was a lockdown browser for the headsets to mitigate off-task behavior.

Teacher D. Teacher D is a social studies teacher and a science teacher. This teacher has three years of experience, and their own children have an Oculus headset at home. Teacher D said they had previous experience with VR through their local library job. Teacher D stated, “So we actually had a VR program there. I did not run that program. I ran the gaming department for a while. So, I was just kind of in the room when the kids were doing it. So that's my limited experience.” While Teacher D does have a headset available at home, they have not used VR in their classroom. When asked, “What do you wish to learn about VR?” Teacher D responded with, “[students] have such a narrow view of the world. I really think that VR, because it is so realistic, it is almost like being there. And for them, where they don't have opportunities to go and travel and see the places that we are learning about, I really am hopeful to just be able to extend that experience to them.” This hope mentioned is one of the greatest benefits to using VR in the classroom. Places, people, and historical events become accessible to students who otherwise would not have the means to visit. However, Teacher D also expressed that VR learning could be a distraction to learning: “Yes, if it's engaging enough, and they were actively listening and participating. If they're using it as a game, or they're distracted in it, then no, it might do the opposite. Because if they're too distracted, and they're busy trying to figure out how to hack the system, they can go watch something on YouTube or whatever YouTube VR is. I mean, they're not going to learn anything anyway.” Interpretation of this statement centered on the point made that if the lesson is not engaging enough then it would leave time for off-task behavior, leading students to pursue other ventures instead of what the teacher has asked them to do during that time. The concept of gamification, mentioned in the quote above, was also

referenced in the literature review. Learning games can be an extra support to students; however, they may lose sight of the required learning for that task.

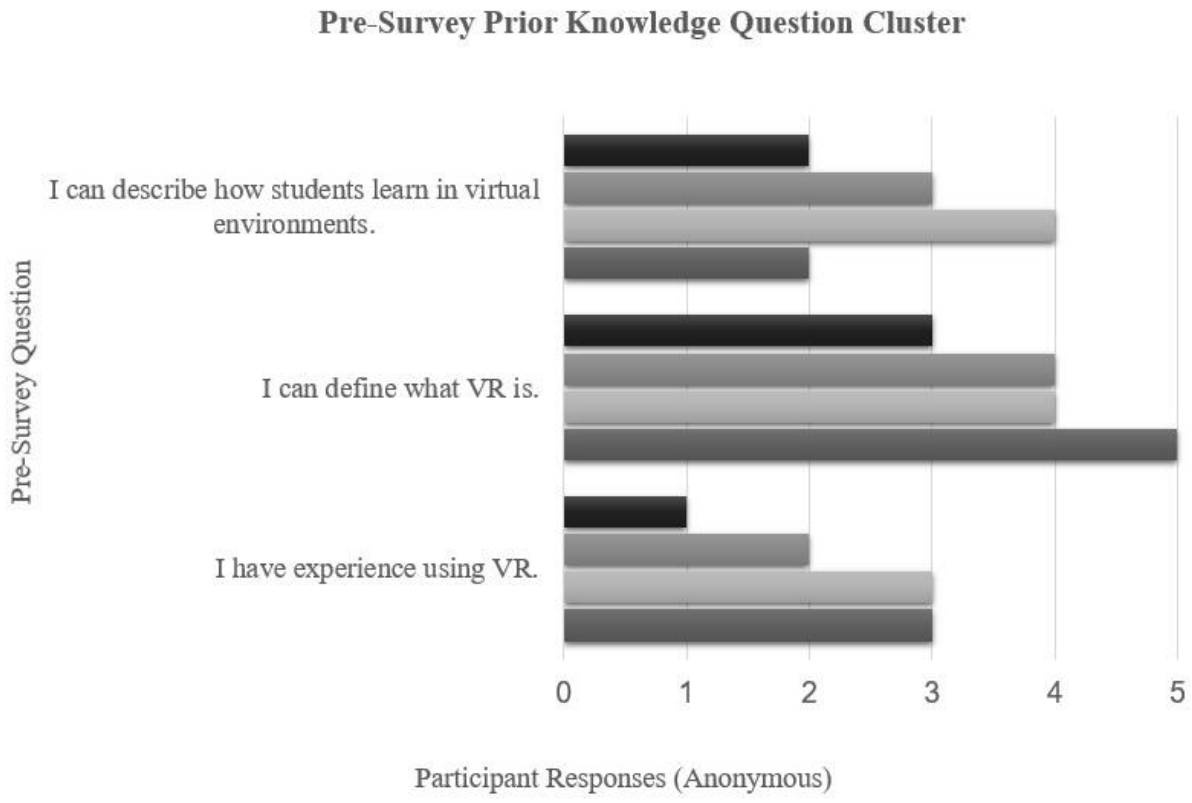
Pre-survey

Prior Knowledge. Participants were sent the pre-survey through email. After the focus group, I put the link in the virtual meeting chat to solicit more responses. All participants completed the survey. The data was collected, analyzed, and used to create the framework for the professional development day. The first two questions asked were about participants' VR knowledge. When responding to *"I have experience using VR,"* 0% of the participants *agreed* or *strongly agreed*. One participant *strongly disagreed* (25%), one participant *disagreed* (25%), and two claimed *neutral* (50%), see Figure 1. Although participants were not as confident in their experience, respondents indicated a stronger sense of ability when presented with the statement: *"I can define what VR is."* One participant *strongly agreed* (25%), two *agreed* (50%), and one participant was *neutral* (25%). This was corroborated with the information the participants gave in the focus group. VR formats were discussed extensively during the focus group with 23 instances of reference.

When given the statement, *"I can describe how students learn in virtual environments,"* participants did not select any *strong* choices. Two selected *disagree* (50%), one selected *neutral* (25%), and one participant *agreed* (25%). This indicated that none of the participants felt very confident but had some idea about how students learn using VR. However, this statement is vague in nature, and it is not clear whether participants related this to classroom management or classroom procedure or learning theory.

Figure 1

Pre-Survey Prior Knowledge Question Cluster Responses



Note. Participants were presented with statements and used Likert scale responses from 1 (*strongly disagree*) to 5 (*strongly agree*).

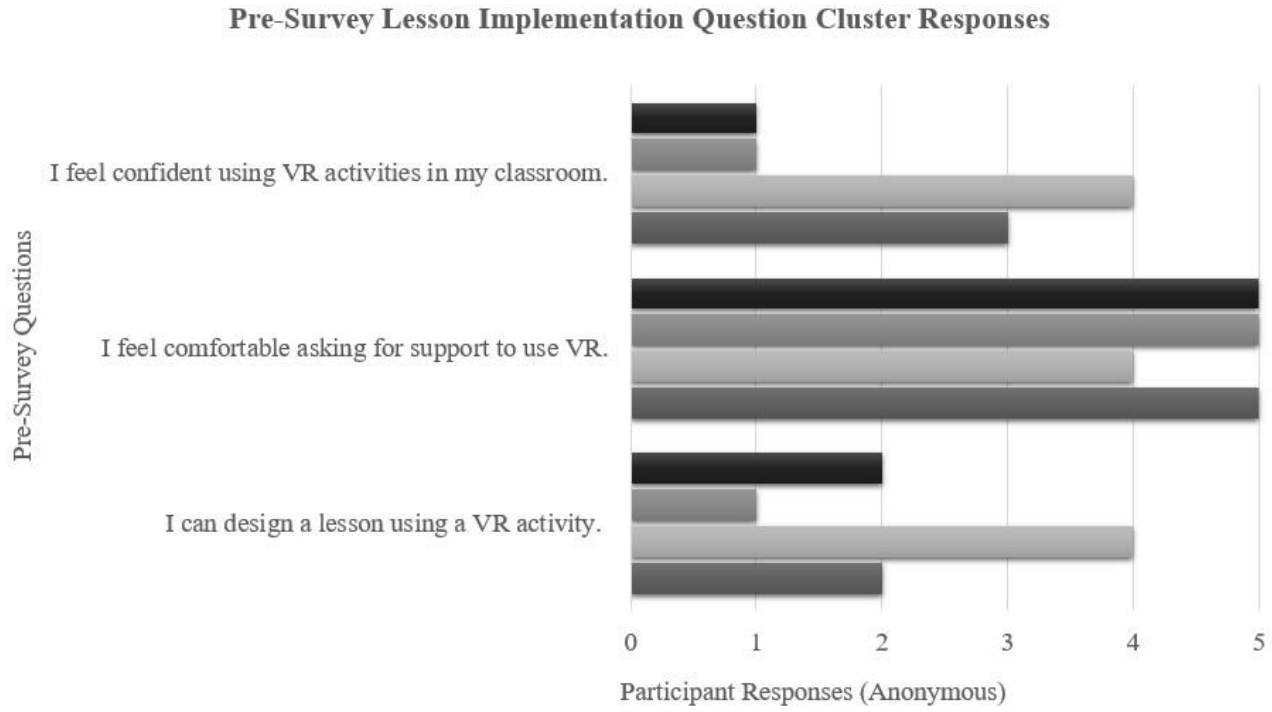
Lesson Implementation. Participants responded to the statement *"I can design a lesson using a VR activity"* mostly in disagreement. One participant chose *strongly disagree* (25%), two chose *disagree* (50%), and only one participant chose *agree* (25%), see Figure 2. This indicated a need for support in the teacher workshop for collaboration in designing lessons using VR activities. None of the participants chose *neutral* or *strongly agree.*

When presented with the statement *"I feel comfortable asking for support to use VR,"* all participants *agreed* (25%) or *strongly agreed* (75%). This indicated that teachers who volunteered to be a part of this study were very open to receiving help in integrating VR into their classroom lessons. Participants were very willing to ask for support. This corroborated with the discussion from the focus group. Many teachers do not have VR headsets at school, but if they did, they would find value in district-provided training.

When asked, *"Do you think a professional development for VR is needed in our district,"* Teacher C stated, "yes." Teacher B elaborated and expressed, "I feel like if the district is looking to invest in VR headsets, like with every school that would be a worthwhile investment." Teacher A agreed and claimed that currently, "it wouldn't be any reason for me to go if I know I don't have access to VR headsets. But if every school or the district were to purchase, you know, I think it will be good to have that type of workshop, if everybody has access." Participants agreed that if more schools in the district purchased headsets, then a virtual reality workshop would be beneficial for the district.

Figure 2

Pre-Survey Lesson Implementation Question Cluster Responses



Note. Participants were presented with statements and used Likert scale responses from 1 (*strongly disagree*) to 5 (*strongly agree*).

Previous Training. Participants responded to *"Professional development has helped me understand VR,"* in disagreement. Three participants selected *strongly disagree* (75%) and one participant selected *neutral* (25%). According to pre-survey results, professional development has not been helpful to teachers in understanding VR. However, this is a vague statement. It is unclear if participants felt that previous professional developments were poor quality training or if participants were communicating a lack of training overall, see Figure 3 for reference.

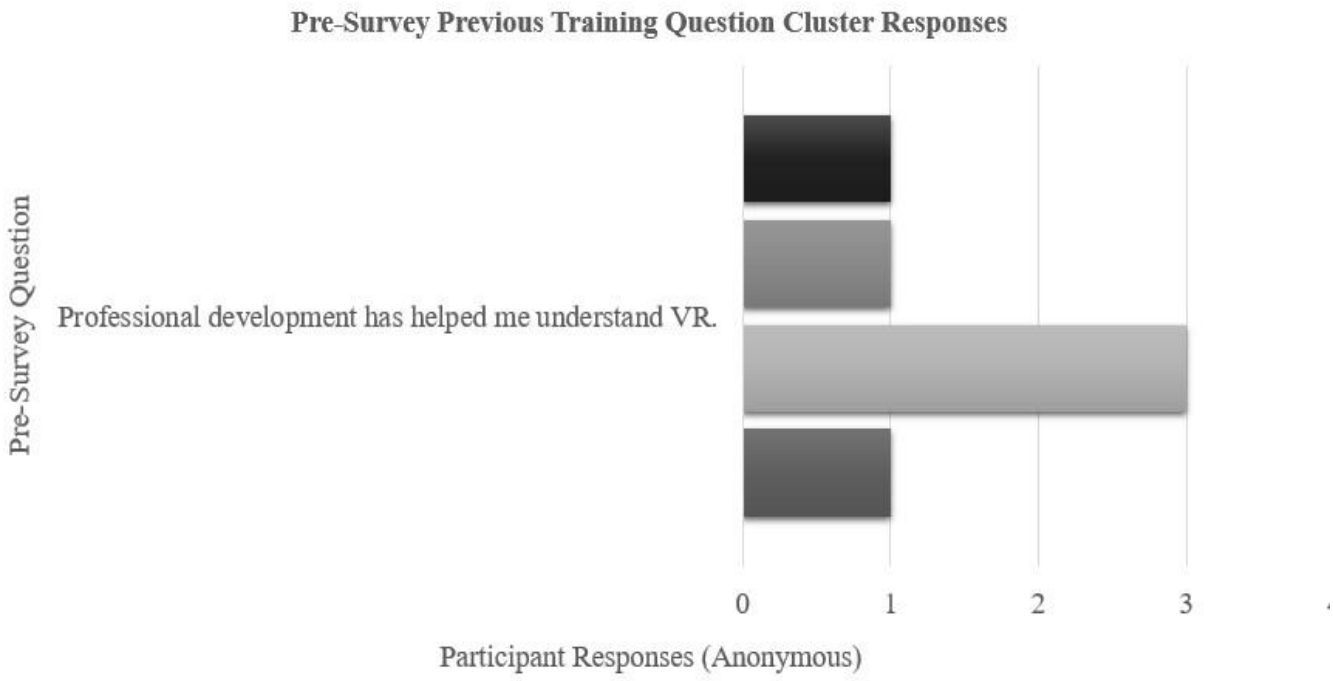
The next question in this cluster contained the statement*, "My class was observed using VR."* According to responses, only one participant (25%) selected *yes* and had a person observe their classroom while using VR. The other three participants (75%) replied *no*. This showed that VR lesson observations were a novel experience for most teachers in that an instructional coach will be in their room as they implement VR using immersive headsets. However, it is unclear which format the one participant was using during that observation. It could have been a less-immersive format of VR, such as the 360 degree videos mentioned in the focus group interview. A couple of teachers similarly stated during the interview that, "we've also used something like a 360, where like that panoramic view, where they get to go and look and see." Refinement in future studies should focus the statements on which particular format was used and offer selections of various formats to participants for clarification. For the purpose of this study, it was not necessary to focus in on specific types of VR. The information provided by the survey gave insight on if the teacher experienced previous training or received coaching support.

When presented with the statement, *"I received specific feedback about my VR lesson,"* all four participants (100%) selected *no*. Receiving specific feedback was an integral part of this research study because instructional coaching techniques as professional development centered

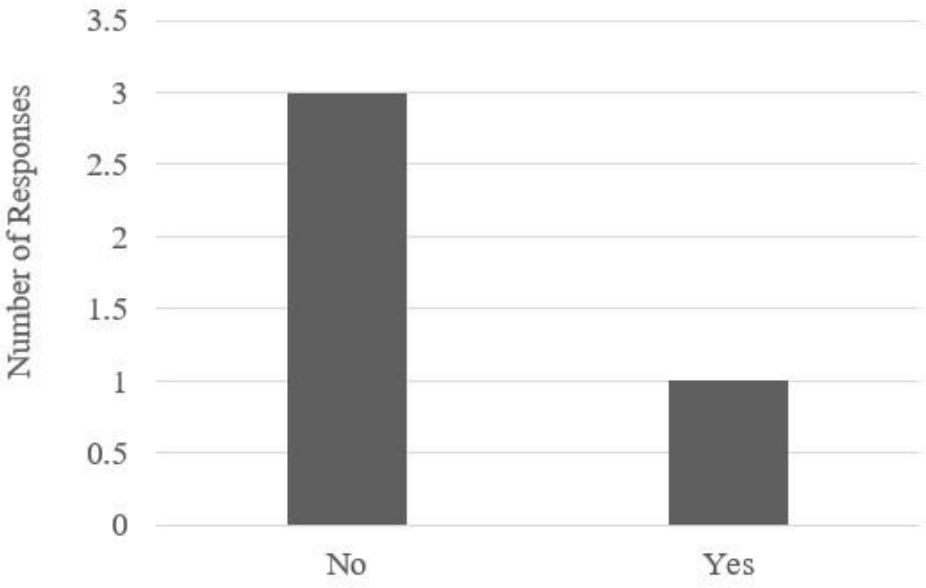
on providing feedback to participants. A VR lesson feedback rubric was created to provide participants with quality information regarding their lesson in order to reinforce best practices and identify areas for refinement. The coaching conversations also provided teachers with time for self-reflection, another form of specific feedback.

Figure 3

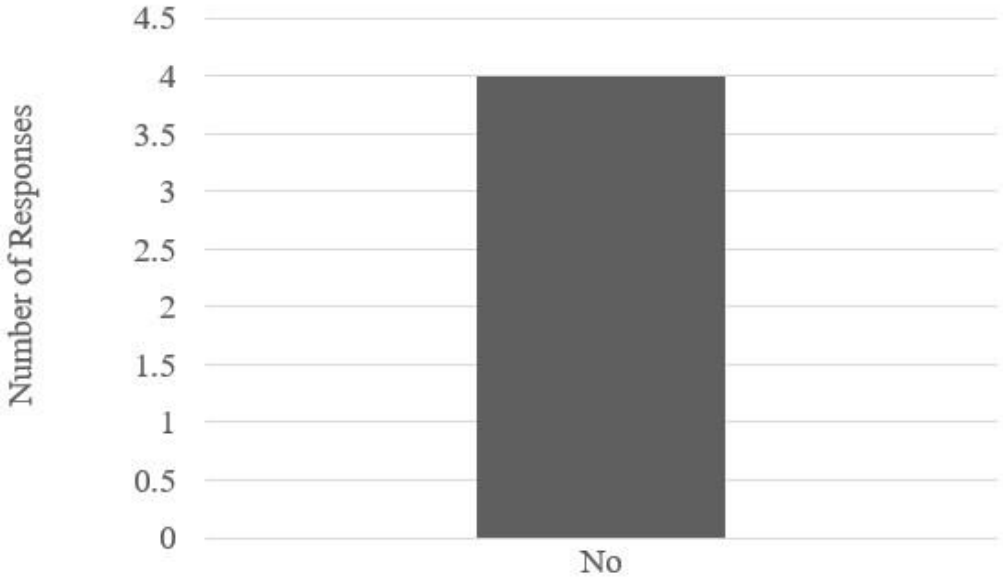
Pre-Survey Previous Training Question Cluster Responses



"My class was observed using VR."



"I received specific feedback about my VR lesson."



Creation of the Teacher Workshop

The pre-survey questions were used to help identify which areas were needed for focus in developing the teacher workshop. It was decided, based on the data collected from the focus group and the pre-survey, that teacher experiences and lesson design would be the focal points of the three hour workshop. Teachers would have the chance to see the virtual environment for themselves, as well as have time to collaborate together and create a lesson to give context around the VR experience. Using the literature from best practices in professional development, as well as instructional coaching, a teacher workshop was created using Google Slides after analyzing the data collected. An additional one page handout was created to complement and guide discussion on the assumptions and principles of the CATLM-VR learning theory (see Appendix J).

Professional Development Day

The professional development was set to last three hours on a district established, full staff development day. Principals were notified beforehand that a teacher from each middle school would be attending the virtual reality workshop. Each teacher showed up around 8:30am and sat at a circle table together. They had all met previously during the focus group interview. The virtual reality workshop began when all participants were ready to do so. Each teacher was supplied with a copy of the presentation with lines for note-taking, a one-page handout of the assumptions and principles of the CATLM-VR learning theory and a copy of the VR Lesson Feedback Rubric (see Appendices H and J). As teachers progressed through the presentation, breaks for thoughtful reflection were taken to integrate parts of the learning theory with personal and classroom experiences. These reflection pauses were designed as a formative assessment to

gauge how well the teachers were understanding the learning theory and applying it to the use of VR in the classroom.

Researcher notes indicated that teachers agreed with the assumptions of the learning theory. Dual channel, limited capacity, and active process of integration were referenced using past experiences in the classroom. Each participant shared out an experience that occurred in the past that reminded them of one of these assumptions. Teacher C shared that they noticed a big difference in learning when students could read and also hear audio for book reads in the classroom, emulating the dual channel assumption. Teacher D noted that students often feel frustrated and overwhelmed when teachers give too many directions at once, representing limited capacity and cognitive overload. Teacher A agreed with this statement and explained that the class intended to be observed are her "low-babies," who require more "brain breaks" and chunking of instruction to prevent cognitive overload. This prompted a discussion on the "*Tik-Tok* generation." Teacher D explained that the learning theory applied to the classroom experience, but not to personal experience. They went on to say that generational differences were very large. Teacher A stated in agreement that coming up, they were expected to learn and be taught in different ways, such as note-taking during classes for hours. Teacher B brought up that homework levels were different not so long ago. The generational homework gap was about three to four hours after school and has shifted to about twenty minutes per class per night. All of this was described to explain the differences in learning for students in current times. It was agreed upon that what worked back then does not work now due to these generational differences. Students need more creative and immersive experiences, something that VR is

capable of doing for this generation of learners. Teachers in the workshop also discussed key takeaways about learning using VR, and summarized the gist of the theory.

Overall, teachers summarized the learning theory with details from the presentation. It was evident that they understood what to be cognizant of when planning a lesson using VR. Participants established that the theory meant that teachers need to be purposeful in planning, recognize when students feel overwhelmed, understand how the brain processes the information visually and auditory. Then, teachers were able to wear the headsets and explore the virtual field trip following the footsteps of Martin Luther King, Jr. There were some technology issues with launching the content to the headsets that were available, but teachers took turns and were able to write down notes to share out at the end of the experience. After sharing out their notes regarding each of the sites included in the virtual field trip, teachers were allowed the remainder of time to collaborate and create a lesson plan to use for their VR class visit. Teachers were rapid-firing questions and ideas at each other, creating directions and expectations for students as well as guided questions to alleviate some cognitive load by helping students identify relevant information (see Appendix K). The end result was shared with all of the teachers, and each agreed that they would allow edits to fit their students' needs. The participants agreed that they created a lesson that would meet the best practices outlined in the VR Feedback Rubric.

Phase 3

The third phase consisted of the classroom observations and coaching conversations. Data was collected using the VR Feedback Rubric before conversations began (see Appendix L). Each conversation was recorded directly after the lesson ended. I sat next to the participant as we talked. All teachers were asked similar questions using instructional coaching techniques. Due to

the nature of these conversations, discussion was more organic and not scripted. Similar questions were asked to encourage teachers to reflect on their experience and use that reflection to target areas of strength and areas for refinement, such as*: "On a scale of 1-10, 10 being the best, how would you rate your lesson and why?" "What would you change about your lesson?"* Or, *"What have you learned about using VR in your class?"* Other questions included: "*Based on your experience in the teacher workshop, are you interested in using the headsets again?" "How were your students impacted by the lesson?" "If your school were to purchase headsets today, would you use them more frequently now?" "What advice would you give to other teachers who are interested in using VR in their classrooms?"* After recording the conversation, I used *Otter.ai* to transcribe conversations and *Delve* software to create *in vivo* codes to analyze the data. A few themes became prevalent in the coaching conversations. A sample transcript is included for reference (see Appendix M). Teachers tended to discuss the importance of the experience for themselves and their students, the level of student engagement while using VR headsets, the requirement for pre-planning and structure in lesson implementation, and the relevance of the learning theory to the lesson.

Student Experience

Student and teacher experience was referenced in every coaching conversation. Teacher A saw that, "the students were engaged in the entire lesson…and were very excited about the experience." At first, students were hesitant about putting on the headsets, but soon the students started working together to help each other navigate the experience and meet the expectations of the lesson. Teacher A said that "students were serving as helpmates for the ones who never had any experience." Teacher B saw some shyness in their students as well due to lack of experience

with the headsets. Teacher B explained, “I do feel like some students who had never used the headsets before were a little bit more timid and shy about it because they were afraid they weren’t doing it correctly, or weren’t getting the right thing. They didn’t want the partner who was more excited and knew how to use it.” Teacher C also noted that many students raised their hands in class when asked if they have previously used headsets. However, this proved to be less reliable as a measure of experience. Many students in the class seemed very inexperienced, but may have reported experience to fit in with others in class. In the coaching conversation, Teacher C said, “I was amazed at how many of them said they’ve used them before, but they hadn’t used them before.” Teacher D talked about observations with some of the students who frequently exhibit off task behaviors in class. When talking about student experiences, Teacher D exclaimed that “I was so shocked because I really kind of expected that this was the assignment that was going to see the off task behaviors…yeah, complete opposite. That student specifically was interacting with the activity and talking to his partner. The excitement in his voice when he was talking, his body language when he was moving, how engaged and excited he was to be in that experience talking about the content.” Student experiences were a major component of the lessons and coaching conversations. Based on conversations with each of the teachers, this access to technology and experiencing the tour really brought the student into the content and had an impact on students that would last. Teacher A excitedly shared that, “they probably can’t tell me what happened in class yesterday, but a week from now they will be able to tell me, ‘remember when we were on that bridge, you know, with Martin Luther King!’” Overall, the teachers expressed their desire to use VR again to provide more than one class the VR headset experience. Teacher C said that, “and the way I would do it if it were up to me, I would do

maybe two classes a day." It was a common trend that students who were not in the classes selected would come to ask the teacher or myself about the headsets and their opportunity to use them. From my understanding in the conversations, many of the teachers were going to "hear it" from students in other classes that were not selected for the VR experience. I was invited back to the classrooms with the headsets for future lessons, in order to provide more experiences to more students.

Teacher Experience

Teacher experience was often cited as the most valuable part of the professional development. Each participant said that going through the experience themselves helped them to understand how students were progressing and how to help guide students through the VR lesson. When asked which part of the training was most helpful to them, Teacher A stated, "I guess being able to experience it myself, being that I've never had any VR, like, I don't own one. So, just being able to put myself in the situation to see what the kids will be going through, and also learning how the VR allows children to learn." Teacher B shared, "I think having hands-on experience. I think if you would have showed up today and then like this is the VR headsets, this is what we're doing, I would have been like I don't know how to even push the start button. So having the hands-on experience getting to understand what they're doing and viewing it myself... I don't want to go into anything blind with my students not having prepared at first." Teacher C replied to the question with a similar response. Teacher C stated that the most helpful part of the training was "experiencing it myself. There was no way I could describe what to do or how to do it otherwise you didn't understand what they're going through." Teacher D listed two parts of the training as most helpful to preparing for the lesson. Teacher D said, "Definitely the collaboration

part, working with other teachers getting the experience, and then just the rundown of how VR works, what we needed to do with it, what expectations that the kids needed to have, and what policies we should be following." The policies Teacher D was referencing were the best practices shared from the VR Feedback Rubric. Understanding what to expect from the experience and the collaboration with others were the two parts of the training referenced by Teacher D. Based on observations made during the VR lessons, the teachers were just as excited to use VR headsets in their classrooms as were the students.

Engagement

Student engagement was another theme present in coaching conversations. Each teacher was able to express how much engagement they saw in their students while participating in the VR experience. Teacher A explained that they "saw one group was doing a lot of discussion about where they were because I think they kept going back. And they were trying to compare what you saw and what I saw." Teacher B claimed that the class period was "student-led versus me telling them and that was very exciting to see with them getting excited about history, and also figuring things out. So I saw students who are typically disengaged, get engaged. So that was really awesome to see." Teacher C and D made observations about the details that students were able to recall from their experience due to increase in engagement with the VR environment. Teacher C stated that "it made them talk. It was unusual as some of them were talking while they still had their headsets on. They're like, what do you see? Or when one of the girls said, 'Wait a minute. Stop. Yeah, you've got to write this down.' You know, things like that which you normally don't see when they're watching a video." When completing the reflection part of the lesson, Teacher C said that "when we were discussing it at the end and wrapping up, I

was impressed with some of their answers…I noticed they were picking out very specific details." Students were able to recall the 52 mile march, that President Johnson sent the National Guard to enforce the laws, and the name of the Lorraine Motel in Memphis. Teacher D stated similar observations on student engagement. Teacher D said, "The first thing they said coming back to the classroom was that they noticed how bright it was in the scenes. And I noticed how some of the kids were like, I can read these license plate numbers on these vehicles. And so they were really taking in their environment and noticing these little, tiny details." Engagement was one aspect of immersive VR headsets that made teachers want to try headsets again in the near future.

Pre-planning and Implementation

During the coaching conversations, teachers discussed with me the need for pre-planning and structure for successful lesson implementation. One aspect of this pre-planning was lesson sequence. Lesson sequence was important to help build students' background knowledge, therefore strengthening their ability to process and integrate new information with their preexisting mental framework. Teacher A explained that they would have tried to do this particular lesson more towards the end of the year when students would have more exposure to the Civil Rights movement. Teacher A said, "Whenever it comes up in my standards, where they can get more involved in that they have the past knowledge and then be able to do the experience at the end." Teacher B shared that the proper set-up time was necessary to incorporate into pre-planning. They said "that's key because to make sure everything flows well within the lesson." Teacher C stated that "I think if I had more time to prepare them, it would have gone more smoothly. Definitely going over procedures because I skipped that slide about going over

expectations." Also, it is important in pre-planning to reserve a quiet space. Teacher C was not able to secure the media center on such short notice and had to deliver the lesson in half of the gym. The other half of the gym was physical education, and they were playing flag tag. It was noisy as a result. Teacher C agreed that "we could do it in the gym, but it would have to be just us." Teacher D discussed pre-planning and lesson implementation as well in the coaching conversation. Teacher D said, "I feel like I would integrate a little bit more content in the front. I would have restructured the activity a little bit better, where we would have maybe done the five minute timer, let them do the activity, pause everything, and try to do more like turn and talk to your partner." Teacher D also discussed using VR lessons for incentives at the end of each unit as a virtual field trip day. These conversations helped teachers reflect on their experience in delivering the lesson and gave insight to how they would change or implement another in the future. This insight was indicative that each participant grew from their participation in the VR training and coaching cycle.

Relevance of the CATLM-VR Learning Theory

The coaching conversations also focused on the aspects of the CATLM-VR learning theory. Each teacher referenced back to what was an essential part of the professional development. Teacher A added that "learning about the mental processes and how kids process the information that was one of the key points of the lesson." Teacher B reflected on the learning theory dual channel assumption and how it applied to the lesson. They stated, "Well, looking at how it works, understanding how the headsets, like what's going on in your retina, and kind of getting the theory behind it and why VR is so helpful within the classroom. I think that's important for teachers to understand." Teacher C referenced generative processing by stating,

"The prior knowledge they had going into it was the 'I Have a Dream.' So they had something to kind of base their new knowledge and kind of integrate in." Teacher D explained that pacing is a struggle with that group because they often need extra time to process information and complete tasks. Teacher D said, "My biggest struggle with timers is saying no, you have to move on, because I like them to spend as much time as they need to understand something." It was evident from the lesson observations and the coaching conversations that teachers understood the learning theory and were able to identify and apply it in their own lesson.

Researcher Observations during Lessons

In all of the lessons, a few themes emerged from notes collected in the research notebook. Physical space, set up, and troubleshooting were consistently issues that teachers had to face and overcome. For instance, the participants' classrooms were too crowded and did not provide sufficient space for the class to use headsets in pairs. Therefore, teachers had to arrange beforehand to use a different space, either the neighboring empty classroom with desks stacked in a corner, or the gym. Another observation made during lesson implementation was that teachers needed help to set up the headsets. Since the participants are novice VR headset users, there was a need for a facilitator to help turn on the headsets and draw the boundaries beforehand. This was also because I had to travel with the headsets and they were not located at the school for teachers to access before the lessons. The headsets also required troubleshooting, since some had difficulty connecting to the Wi-Fi or some glitched at times. Students requested help from their teachers and myself, and some adjustments were made either by using a different headset or splitting the students to join other groups.

Phase 4

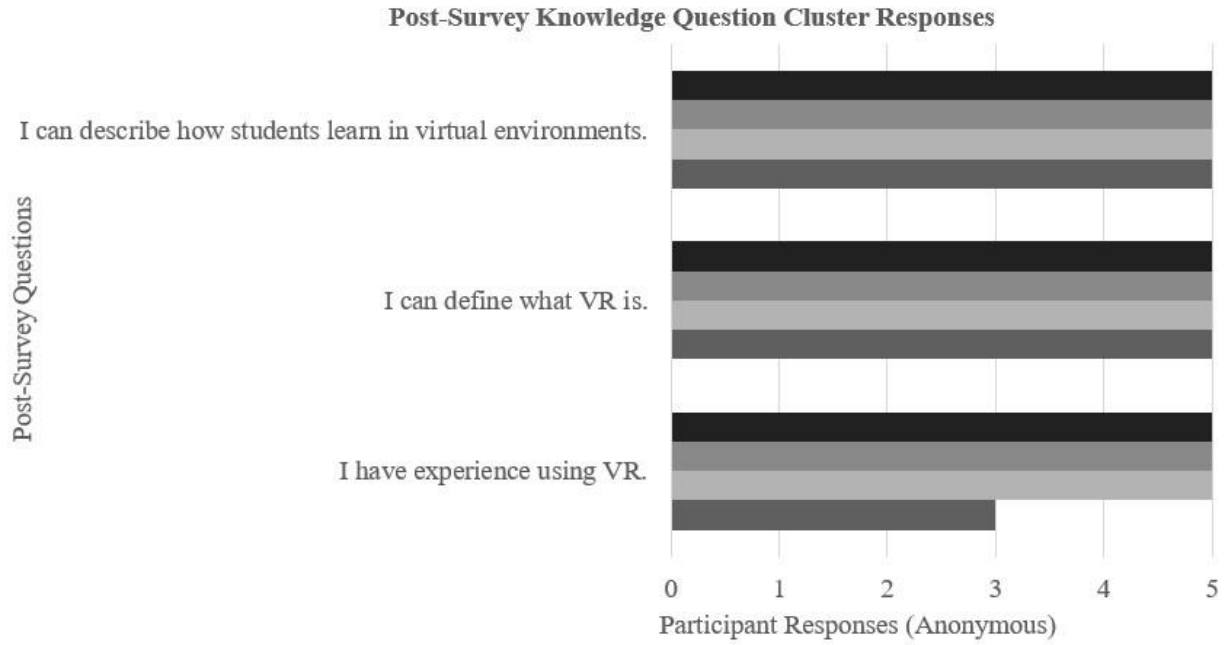
The fourth phase consisted of the post-survey and final debriefing of the study's findings. The post-survey was sent via email through a link to Google forms very shortly after I left the classroom. This was intentional because I did not want to pressure the participants to fill it out a certain way because of my presence. Each teacher filled out the post-survey in a timely manner. Finally, each teacher received a copy of their self-reflection rubric and a virtual copy of Chapter 4 to look over. They would also receive a copy of the dissertation after successful defense and publication.

Post-survey

Knowledge. The questions in this cluster included statements that were measured previously using the pre-survey. Participants answered the same nine questions. Seven used the Likert-scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Two of the questions required a *yes* or *no* response. When presented with the statement *"I have experience using VR,"* one participant selected *neutral* (25%) and three selected *strongly agree* (75%). All participants selected *strongly agree* (100%) to the second statement*: "I can define what VR is."* All participants selected *strongly agree* (100%) to the statement *"I can describe how students learn in virtual environments."* Overall, there was an increase in teacher confidence levels associated with the knowledge gained from the pre-survey to the post-survey responses, see Figure 4.

Figure 4

Post- Survey Knowledge Question Cluster Responses

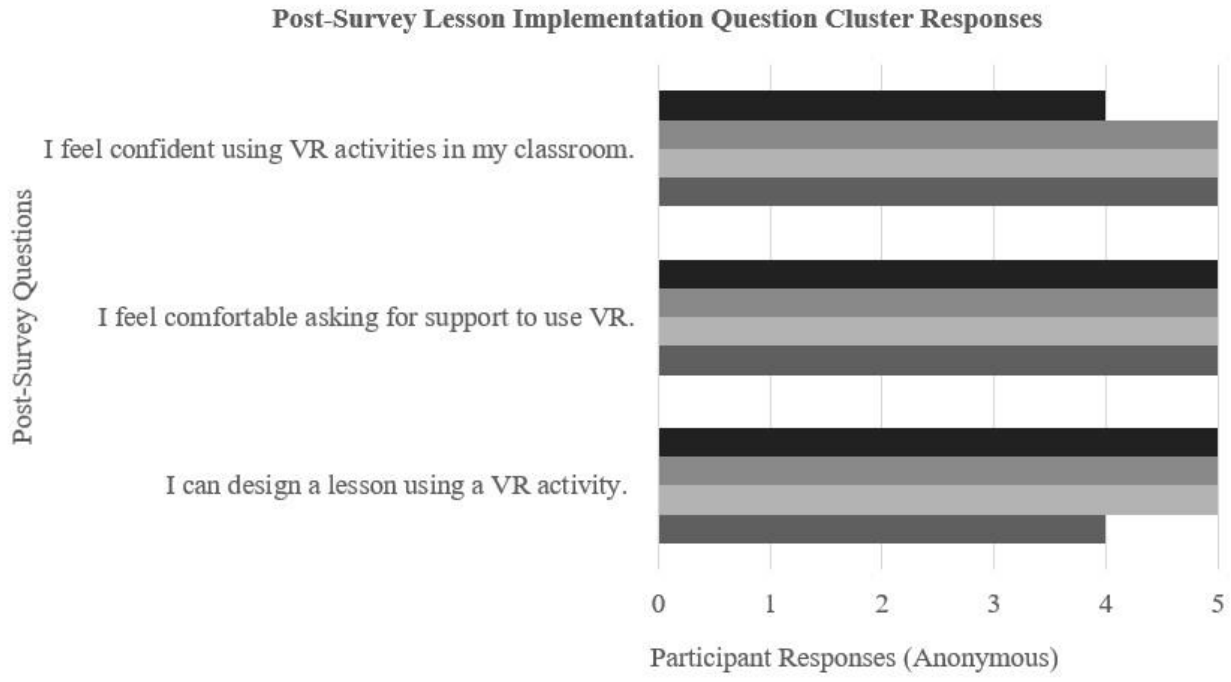


Note. Participants were presented with statements and used Likert scale responses from 1 (*strongly disagree*) to 5 (*strongly agree*).

Lesson Implementation. Questions in this cluster contained statements regarding the confidence and ability to implement a lesson using a VR activity. When presented with the statement: *"I can design a lesson using a VR activity,"* one participant selected *agree* (25%) and three selected *strongly agree* (75%). All participants (100%) selected *strongly agree* to the statement *"I feel comfortable asking for support to use VR."* The results, shown in Figure 5, to the statement *"I feel confident using VR activities in my classroom,"* were one participant selected *agree* (25%) and three participants selected *strongly agree* (75%).

Figure 5

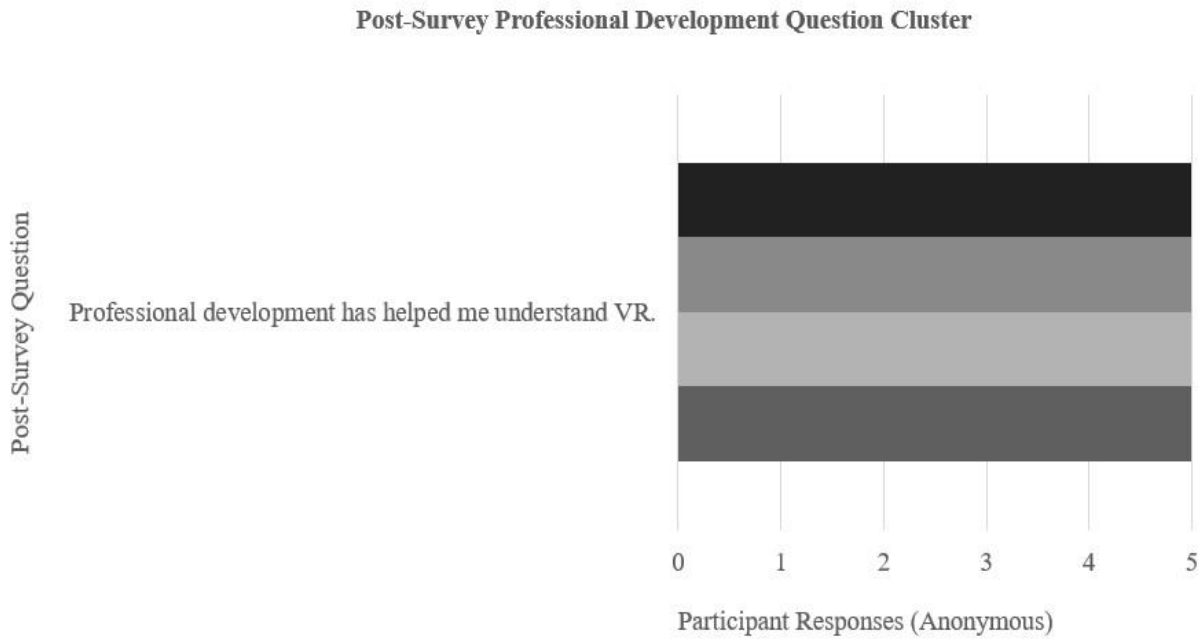
Post-Survey Lesson Implementation Question Cluster Responses

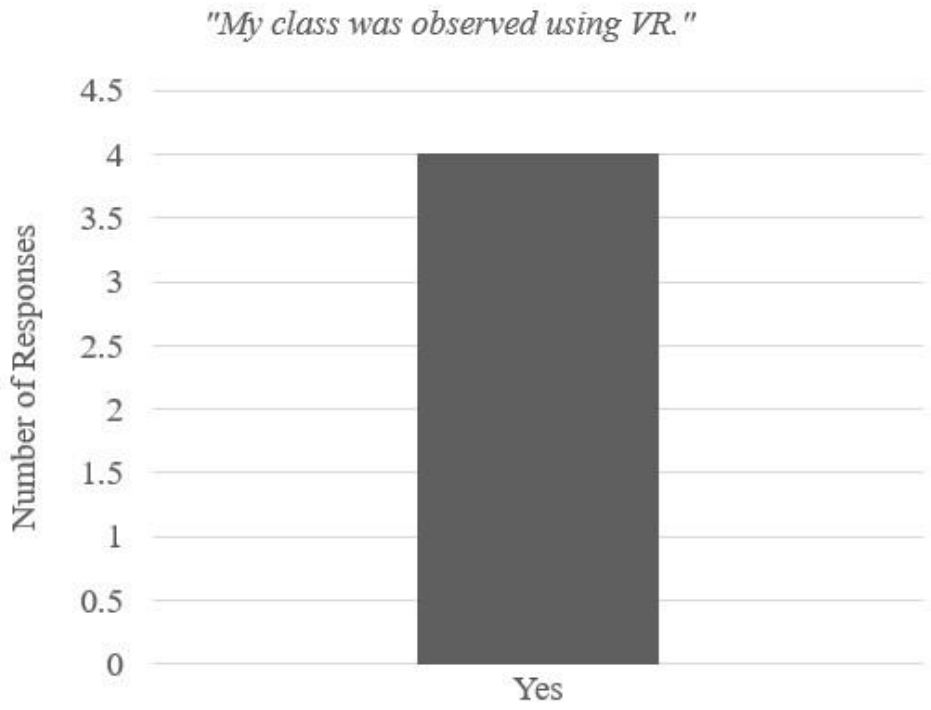


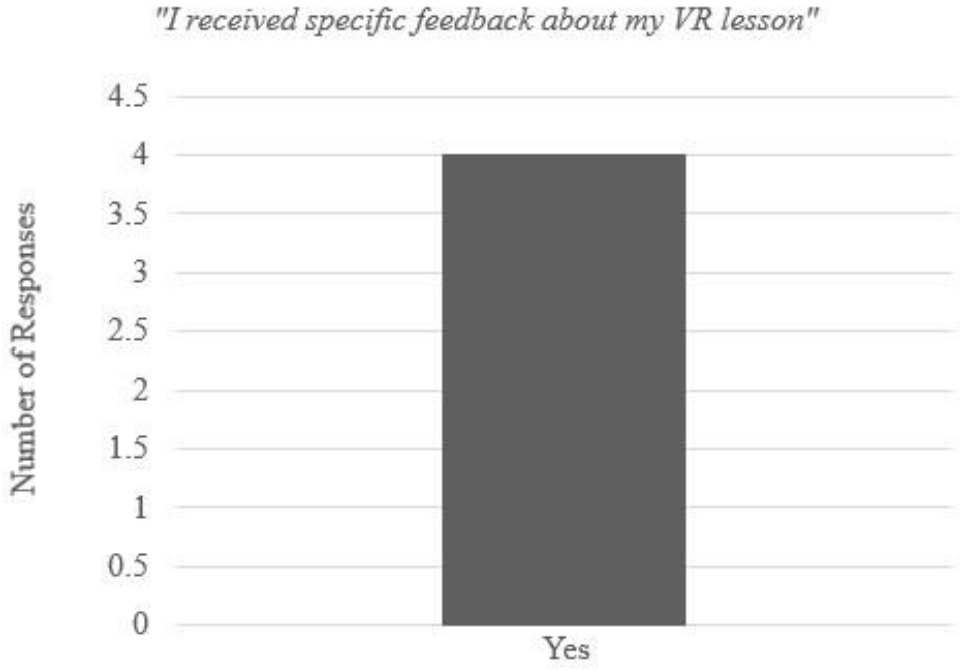
Professional Development. The questions in this cluster gave insight to how effective the professional development training was, in the sense that the training accomplished what it was designed to do. In response to the statement *"Professional development has helped me understand VR,"* all participants (100%) selected *strongly agree*. All participants (100%) selected *yes* to *"My class was observed using VR."* All participants (100%) selected *yes* in response to the statement: *"I received specific feedback about my VR lesson."* These responses are shown in Figure 6.

Figure 6

Professional Development Post-Survey Question Cluster Responses




"My class was observed using VR."
Number of Responses
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Yes

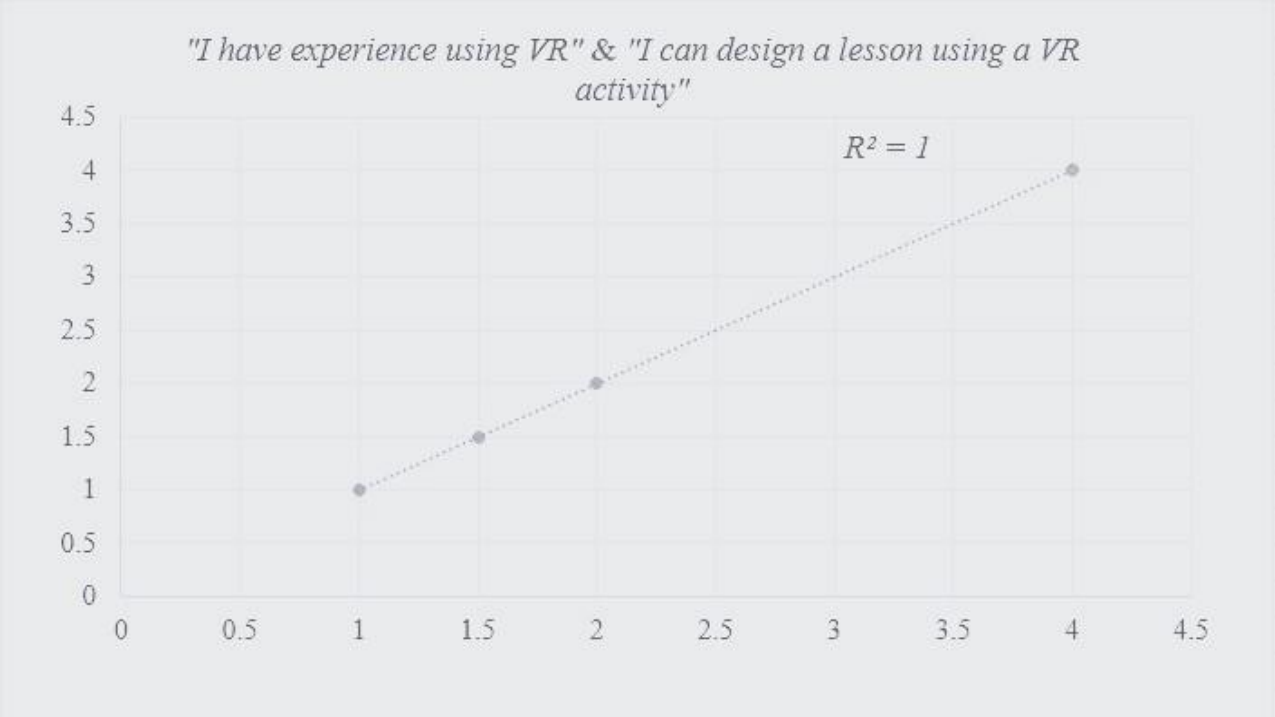

"I received specific feedback about my VR lesson"
Number of Responses
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Yes

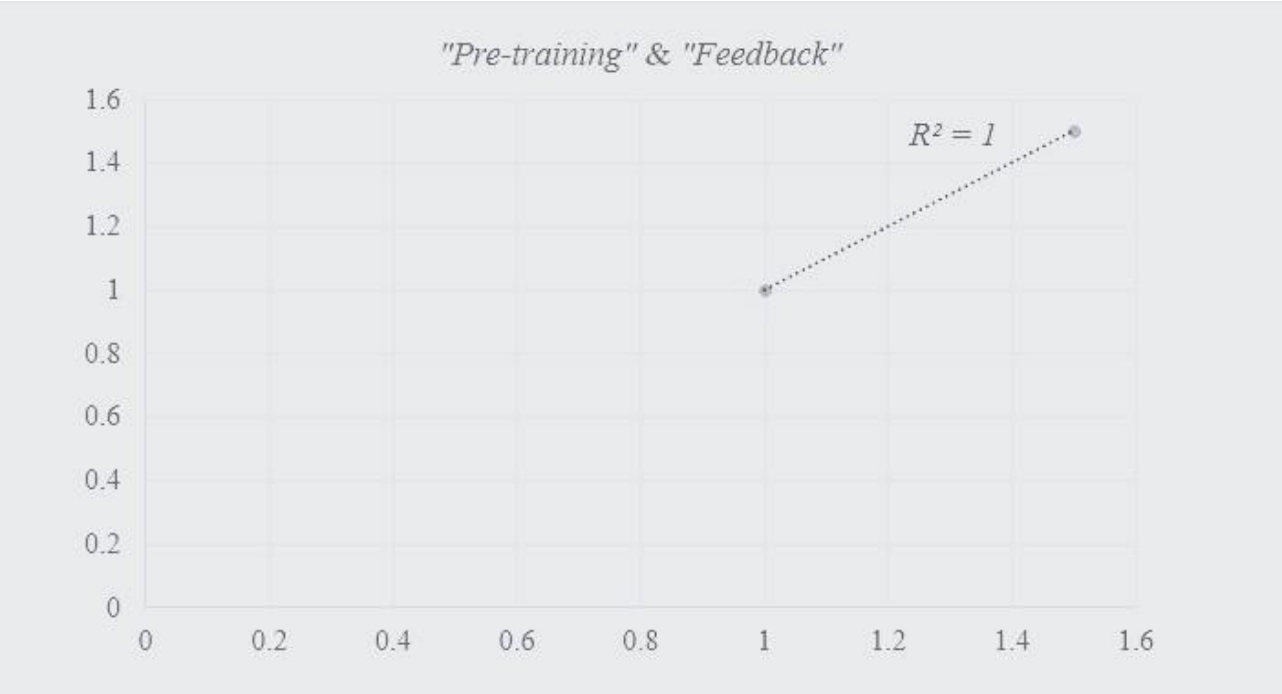
Statistical Testing Results

Spearman's *rho*. This test measured ordinal data collected from participants' self-reported rubric scores and ordinal data from the post-survey. The results indicated that there was a significant relationship on the post-survey between the statements indicating experience using VR and confidence designing a lesson using a VR activity $r_s(2) = 1.000, p < .001$. Results also showed a significant relationship between scores on the self-assessment rubric in the sections of Pre-training and Feedback, $r_s(2) = 1.000, p < .001$. See Figure 7 for reference. However, there were no statistically significant results showing a relationship between scores on the self-assessment rubric and post-survey.

Figure 7

Spearman's rho Results





Note. Both graphs show the significant results produced in the Spearman's rank correlation test using the rubric and post-survey data.

Paired Samples *t*-test. With all assumptions tested, there were no outliers in the data. Reported data from the pre-survey was paired and measured with the data collected from the post-survey. With a small sample size (N=4), I decided to perform bootstrapping based on 1000 samples with a 95% confidence interval to see how these results would have looked with a larger sample size. There are only seven pairs, due to those seven being ordinal data and the *yes* or *no* selection questions are nominal. In Table 1, the bootstrapped results of the paired samples *t*-test and Cohen's *d* effect sizes are communicated.

Table 1

Bootstrapped Paired Samples t-test Results

Pair	*df*	*p*-value	Cohen's *d*
I have experience using VR.	3	.069	1.317
I can define what VR is.	3	.059	1.225
I can describe how students learn in virtual environments.	3	*$p < .05$	2.350
I can design a lesson using a VR activity.	3	*$p < .05$	1.936
I feel comfortable asking for support to use VR.	3	.061	.500
Professional development has helped me understand VR.	3	*$p < .05$	3.500
I feel confident using VR activities in my classroom.	3	*$p < .05$	1.936

Note. These are bootstrapped results based on 1000 samples with a 95% confidence interval. Degrees of freedom are labeled *df* (N-1) in the second column. The **p*-value represent two-tailed significance, and Cohen's *d* communicates the effect size.

Based on the data from the paired samples t-test, the increase in experience using VR was not statistically significant, $p = .069$. The increase in the ability to define VR was not statistically significant, $p = .059$. The knowledge gained from the teacher workshop about how students learn in virtual environments was a significant increase, $p < .05$ with a large effect size (2.350) which indicates an increase of more than 2 standard deviations. Teachers' ability to design lessons using VR activities was statistically significant, $p < .05$ with a large effect size (1.936) as a result of the professional development. Results indicate that comfort levels in asking for support to use VR was not statistically significant, $p = .061$. Data results also showed that the professional

development created for these teachers has helped them to understand VR and was statistically significant, $p < .05$, with a large effect size (3.500). Teacher confidence to use VR increased as a result of participation in the workshop. The results were statistically significant, $p < .05$ with a large effect size (1.936).

Debriefing

Each participant was provided a copy of their self-graded rubric and a copy of findings for member-checking purposes. It was important to involve the teachers in evaluating the findings and agreeing with the statements I selected and reported to minimize researcher bias. After the participants had an opportunity for feedback regarding their statements, I informed them that all of their information will remain confidential and all recorded data would be erased upon successful defense and publication of this dissertation. A copy of the dissertation would be provided to all stakeholders for their records.

Conclusion

Upon completion of collecting and analyzing data, results give insight to answering the three research questions: 1) How do teachers in the school district currently use VR in the classroom? 2) What relationship exists between self-reported rubric scores and post-survey data as a result of participation in VR coaching cycles? 3) What influence does VR professional development have on future VR implementation?

Research Question 1

How do teachers in the school district currently use VR in the classroom? Only one middle school in our district has purchased VR headsets. The majority of middle social studies teachers are not using immersive VR due to lack of access, but sometimes use less immersive

formats, such as 360 degree videos and *Nearpod*. Three out of four participants do not own a headset at home, and only two participants had ever experienced VR headsets before this research study. The professional development was created to focus on the actual experience of the VR field trip and lesson design as a result of analyzing data from the pre-survey and focus group interview.

Research Question 2

What relationship exists between self-reported rubric scores and post-survey data as a result of participation in VR coaching cycles? The data from the Spearman's *rho* correlation test did not indicate any significant relationship between how teachers rated their own lesson and how they reported measures of confidence in knowledge or lesson implementation on the post-survey. Although, data did indicate a significant relationship on the post-survey between the statements regarding teachers having VR experience and being able to design lessons using a VR activity, $p < .05$.

There was also a significant relationship on the feedback rubric between the best practices of Pre-training and Feedback. As teachers were able to provide context and explain the learning target to students, they were also able to provide feedback to students during the activity regarding their progress towards that goal, $p < .05$.

Research Question 3

What influence does VR professional development have on future VR implementation? According to the data collected and analyzed from the professional development, the coaching conversations, and the *t*-test measuring pre-survey and post-survey data, the teachers who participated have expressed their desire to use the VR headsets again in the near future. They feel

that the training is informative and helps them to understand how students learn using VR, helps give guidance on best practices, and provides experiences to students who otherwise would not have access. As a result, teacher confidence to use VR increased, which stimulated the desire for future implementation. Professional development for teachers before VR implementation in the classroom with students was necessary to facilitate this growth and provide teachers with the experience they needed to feel supported during their lesson.

CHAPTER 5: DISCUSSION

Introduction

This chapter discusses an overview of the research study and answers the guiding research questions. In this chapter, implications of the findings, next steps, and recommendations for future studies are provided. Researcher reflection and discussion of bias or possible extraneous influence on the answers to the research questions follow in the conclusion of this chapter.

Overview of Research

The beginning of the research study started a year ago because of a conversation I had with an instructional coach at a district middle school. I was interested in learning about the methods in which professional development was provided to teachers at this school to implement VR activities into their lessons. There seemed to be a gap in professional training for teachers. As I began to research, I found that there was a need to discover what kind of professional development would benefit and support teachers in using VR. I targeted social studies because of my position in the district. As a district coach, I have fostered relationships with the individuals and have had coaching conversations with them previously about other topics. The research

questions guided the methods, and so a feedback rubric was created to share best practices with teachers. With that, a focus group and pre-survey were created to investigate how teachers currently use VR and where I needed to focus the teacher training. The focus group interview was recorded, transcribed, and coded using *in vivo* coding techniques. After the professional development day, teachers were able to implement the VR lesson and receive specific feedback. These conversations were recorded, transcribed, and coded. Researcher notes were captured in the research notebook and analyzed as well. Teachers also filled out a post-survey in order to measure growth in knowledge, lesson implementation, and confidence in using VR in their classroom.

Research Questions

The following research questions were instrumental in guiding the methods of the research study: 1) How do teachers in the school district currently use VR in the classroom? 2) What relationship exists between self-reported rubric scores and post-survey data as a result of participation in VR coaching cycles? 3) What influence does VR professional development have on future VR implementation? These questions led me to create a mixed methods exploratory case study, in which I investigated using phases of research with a Pragmatist approach. Each phase of the research study and methods used were created to investigate different aspects of the professional development using both qualitative and quantitative methods. Phase 1 consisted of obtaining proper consent from the school district as well as Coastal Carolina University and the four participants. Phase 2 began with data collection through a focus group interview and a pre-survey. This data was used to create a teacher workshop, in which teachers were able to learn about the CATLM-VR learning theory in depth, explore using the headsets themselves, and

collaborate with each other to create a lesson plan. Phase 3 consisted of lesson implementation and coaching conversations. Lastly, Phase 4 concluded with a post-survey, study debrief, member-checking, and dissemination of the findings. Throughout the study, data was collected and analyzed, using both qualitative and quantitative methods concurrently. A Spearman's *rho* correlation test was performed on the data from the teacher self-graded rubrics and self-reported growth on the post-survey. A paired samples *t*-test was bootstrapped and performed on the data from the pre-survey and post-survey.

Summary of Findings

Social studies teachers in this school district have limited access to VR headsets. Teachers often lack their own experience with VR headsets and have limited physical space at school. Their classrooms are not able to accommodate the amount of space needed and thus a virtual lab should be considered if schools plan to purchase a class set of headsets. Teachers will need someone to help facilitate the experience by turning on the headsets and creating the boundaries before the class begins, while still learning to use immersive VR. Also, teachers do not have logins to the desktop software that pushes to the headsets. This means that school administration or instructional coach will have to help teachers understand what modules are available according to the standards and push them to the headsets for the teachers. Teachers have limited time to complete set up in between classes if more than one class is to experience VR on the same day. Therefore, it would be beneficial to make plans for no more than two classes a day. However, teachers are very interested and excited to use VR in their classrooms, but must feel supported in learning the best practices. With a learning theory embedded into the teacher workshop, teachers feel like they have guidance on how to implement best practices,

what the lesson should look like, and how students learn using immersive VR. Teachers also find professional development before implementation with students extremely helpful, so they can preview the module before students have access to it, and create a guiding activity to accompany the module. This also helps the teacher to provide helpful feedback to students and facilitate discussion and reflection at the end of the lesson.

Experience, pre-planning, lesson sequence, and learning theory were key elements of the coaching conversations. Teachers should have their own experience in order to know how best to structure the VR lesson. There was a gap between the VR field trip with Martin Luther King Jr. and the standards currently being taught in the classroom. Teachers have not reached the point of the Civil Rights movement yet. This was noted in the coaching conversations, as Teacher A, C, and D felt like the students need the prior knowledge usually learned in lessons leading up to such an activity. Mentions of future use indicate that teachers would like to use the VR activities at the end of the lesson as a summative experience, instead of a formative experience, in order to provide students with a strong mental framework to understand what they are seeing and aid students in identifying relevant information while immersed in the VR activity.

Although there were no statistically significant relationship between how teachers scored their lesson using the VR feedback rubric and how they reported growth on the post-survey, there was a statistically significant relationship between teacher experience using VR and the ability to design a VR lesson, $p < .05$. This shows that as teachers have the chance to use the headsets for themselves, their confidence increases and helps them to create a lesson designed for that specific module. There was also a statistically significant relationship between two sections on the feedback rubric, Pre-training and Feedback, $p < .05$. With an increase in teacher

confidence due to participation in the teacher workshop, teachers are able to provide relevant background information to students on what they will encounter during the experience, provide a learning target, and explain procedures and directions. Teachers also feel more confident in providing feedback to students because they have experienced the module for themselves beforehand. Participants notice the shift from teacher-led to student-led activity, which also prompts higher rates of student motivation and engagement.

There were some pairs from the pre-survey and post-survey that show statistically significant differences between the means of scores. The pair, *"I can describe how students learn in virtual environments"* indicates a significant change from pre-survey to post-survey data, $p < .05$ with a large effect size, $d = 2.350$. Teachers feel that as a result of participating in the teacher workshop, they have the ability to understand how students process and integrate information into their pre-existing mental framework. The CATLM-VR learning theory is not the only learning theory applicable to immersive VR. However, it was chosen because it can also apply to various multimedia, such as video, something in which the teachers are familiar with. Teachers can apply the learning theory to their own experiences, as referenced in Chapter 4.

The statement *"I can design a lesson using a VR activity"* showed significant increase from pre-survey to post-survey, $p < .05$ with a large effect size, $d = 1.936$. Participants feel that the teacher workshop was instrumental in helping them understand best practices in designing lessons surrounding VR activities because they were able to experience the module themselves and then create a guiding activity based on the module for students to complete as they progressed through the VR activity. Teachers were also able to assign roles to students who were not using the headset, such as the recorder of information on the sheet provided.

Another pair that showed statistically significant results was *"Professional development has helped me understand VR," p* < .05. All participants communicate increased desire to use more VR activities, and have given standing invitations for another VR experience for their students. This pair had the largest effect size, *d*= 3.500, which indicates a difference of over 3 standard deviations, as referenced in Chapter 4. The research used to design the professional development was one in which focuses on teachers' needs, allows them to have hands-on experience, and also reserves some time for teacher collaboration, all of which are best practices for adult education and professional learning opportunities.

The last pair that shows significant results is *"I feel confident using VR activities in my classroom," p* < .05. This also had a large effect size, *d* =1.936. Teachers before the professional development had very little experience with headsets, some never having any experience, and some never having used it for educational purposes. Many teachers in this study have used a different, less immersive format of VR, such as 360 degree videos, virtual field trips on the desktop, or through software such as *Nearpod*. As a result of participation in the coaching cycles and the teacher workshop, teachers received specific feedback and guided reflection on their own professional practice using VR in the classroom. As a result, teachers previously did not feel very confident, but now they are excited about using the headsets again. They understand better how a VR lesson can look in their classroom, but have also requested other examples for how it may look differently than what was experienced, as referenced in Chapter 4.

Discussion

Research Question 1

How do teachers in the school district currently use VR in the classroom? Teachers are currently using less immersive formats of VR in attempts to provide students with more opportunities to see the outside world. Participants were not experienced with VR headsets and most do not own a headset at home. Only one participant owned a headset and it is used for gaming rather than educational use. Using the pre-survey and focus group data, I constructed a teacher workshop based on the knowledge, lesson implementation, and prior training of the participants. I researched the best practices in professional development and adult learning to make sure that the training would be informative and valuable, provide moments for reflection and application to real life experiences, provide hands-on tasks, and allow time for collaborative planning. The teachers were able to understand learning theory and use it to create a lesson incorporating a VR activity.

Research Question 2

What relationship exists between self-reported rubric scores and post-survey data as a result of participation in VR coaching cycles? There is no statistically significant relationship between how teachers rated their own lesson using the feedback rubric versus their self-reported data on the post-survey as a result of participation in VR coaching cycles. However, a statistically significant relationship were discovered on the feedback rubric using Spearman's *rho* correlation test between two sections: Pre-training and Feedback. Using the same statistical measure, a significant relationship between teacher experience using VR and confidence in

designing a VR lesson emerged. Data suggests that teachers, as they gain confidence from experiencing the teacher workshop and module, become better equipped to provide pre-training and feedback to students because they have experienced the VR module themselves and created the guided questions for the activity before the students gain access to the headsets. This allows the teacher to be able to provide the pre-training and feedback to students needed to facilitate the VR activity and provide intentional structure and instruction during the experience.

Research Question 3

What influence does VR professional development have on future VR implementation? Professional development is critical in building capacity in teachers to use headsets during instructional time, in accordance with the district pacing guide and state standards. As a result of the professional development provided in this study, participating teachers reported a large increase in confidence levels in knowledge and lesson implementation after the training. Teachers still face obstacles in using VR, such as access to headsets, access to desktop applications to preview and push out modules to the headsets, and the time needed to set up the headsets before class. However, with support, the teachers in this study all plan to use VR headsets again in the future. If their school were to purchase headsets, participants would intend to use them at the end of every unit of study, if currently available and purchased modules align with state standards. Participants found value in the workshop, and would recommend it to schools that plan to purchase headsets in the near future. Professional development, such as the kind provided in this research study, can serve as a model to help fill the void across the district, state, and nation for support and training for teachers in the use of VR for the classroom.

Implications of Findings

VR Access and Experience

Students are motivated to learn in novel ways and highly engaged during lessons incorporating immersive VR. Students and teachers were excited about the access to the headsets and having the opportunity to get the VR experience. Teachers saw a difference in their students and notice the change in roles. Students were the authors of their learning, with help from the teacher facilitating the lesson with structure, guided activity, and reflection discussions. Students were eager to use the headsets and teachers who receive training feel more comfortable to use them after experiencing the modules for themselves and pre-planning for the lesson. This aligns with previous research that also found that providing teachers with opportunities to experiment with new instructional methods builds competence and confidence for implementation and is a critical part of teacher growth (Dunbar & Yadav, 2021). This way, teachers can provide critical feedback throughout the lesson and students can trust their teacher to be knowledgeable enough to help them when they ask questions. In order to increase the amount of experiences, schools and districts must prioritize the purchase of at least one class set of headsets, and invest time into training teachers via a learning theory- based workshop before lesson implementation with students. Teachers who use VR for education comfortably can help train and support other teachers on the grade level team in order to provide wide-spread support beyond the means that the school administration or instructional coaches can provide (TWI Institute, 2024).

District Professional Development

Currently, only one middle school has purchased a class set of VR headsets. At this stage, there is not a need for district-provided professional development or teacher workshops for VR. However, in the near future, more schools may wish to purchase or the district may wish to purchase such headsets due to the increasing demand for VR in education (Business Wire, 2022). When this occurs, it is important to note the success of the professional development as described in this study. Hands- on experience and time for collaboration is necessary for teachers to successfully design their own lesson based on best practices. This specific study uses Moreno and Mayer (2007) as the foundation for the VR Feedback Rubric. The principles described in the rubric provided a roadmap for teachers to design a lesson using a VR activity, which was observed and debriefed. It was clear from teachers' interviews that instructional coaching cycles were instrumental in the success of this professional development, because each teacher was supported and provided specific feedback for future implementation. Conversations were mainly reflective. The coach should use a variety of questions to help teachers dig into what really worked and what needed improvement without "telling" or "fixing" the teacher's issues. This allows more growth and accountability for the outcomes of the lesson on the part of the teacher.

School-Level Implications

School-level administration and instructional coaches can facilitate the implementation of coaching cycles for teachers throughout the school year. Starting with a select group of interested teachers, regardless of age or experience, and training them using this model will establish a group of VR lead teachers that can also help support the use of purchased equipment. It is not possible to use VR for every class period in the same day without help setting up. I would

recommend that teachers backwards-plan their unit of instruction and select different days for each class period. This way the teacher does not become overwhelmed and continues to desire to use VR in the classroom. The teaching product has to outweigh the teaching costs. Essentially, it takes significant resources to pre-plan, set up, and troubleshoot issues during the activity. If it costs too much, then teachers will not want to expend the resources to implement. As teachers become more familiar with using the technology, they will have better chances of successfully troubleshooting issues. Until that level of comfortability persists, it is important to have someone capable to help when needed or recommend various adaptations to the lesson in cases where the headsets cannot be reset or exchanged.

Instructional Coaching Implications

The instructional coach at the school site can help support teachers using the model for professional development provided in this study. Teachers do not have access to the desktop portion of the software and need information regarding the modules available for their standards according to their district pacing guide. I would recommend posting a newsletter digitally each month with various modules that fit each content area in order to educate teachers on what possibilities exist to help teachers plan in advance for reserving the headsets and securing the physical space for the experience. If teachers have the means to reach out for support, the instructional coach can create a schedule for coaching cycles to help support teachers and facilitate the lessons on a monthly basis. A system that works and is transparent to teachers will address some of the obstacles currently present in using VR headsets and encourage use for instruction. Building capacity in teachers is important for the school instructional coach. A coach

should focus efforts in training a few teachers at the school in the beginning, who can learn to support others and regularly model VR experiences during staff development days.

Recommendations

District Next Steps

Based on the data collected and analyzed from this research study, I recommend that if plans are made to purchase district headsets, or more schools purchase headsets, that considerations are made to train instructional technology coaches to use VR headsets and help support individual teachers at schools. These tech coaches would need to be comfortable enough with VR headsets to understand the software, connect the headsets to Wi-Fi, and troubleshoot issues. Training would be easier to accomplish if the headsets were purchased from the same supplier, as to lessen the amount of headset hardware the coaches would need to be familiar with, as each is different. This is also true for each company that provides software via the modules. Each software publisher provides different content. Efforts should be made early to streamline and purchase similar items, so as training is more efficient. The market for VR in education is large, and expected to grow exponentially in the near future.

School Next Steps

Schools should consider creating a system for training and supporting teachers using VR for education. I strongly recommend that schools which have purchased, or plan to purchase, VR headsets also allocate a physical space on campus for such activities. The headsets cannot be used outdoors, and most classrooms are too crowded to provide the needed space for setting up virtual boundaries. A virtual lab that can be reserved by teachers throughout the year would benefit teachers and students and make physical space an obstacle no longer faced by teachers.

Another suggestion is to train a few teachers as VR lead teachers, so that teachers have a variety of support options to choose from. This also takes the burden off of one person. If district tech coaches are trained, they can also be booked to assist teachers. The administration or instructional coach at the school will need a system to let teachers know which modules could fit in their units of study. I recommend a digital newsletter, poster, or pacing guide with listings of modules for each content area per month or grading quarter. Teachers could plan their units of instruction ahead of time and reserve the virtual lab and have the modules pushed to headsets and set up beforehand. I would recommend targeting at most two classes per day. On the days in which the class period is not in the virtual lab, they can complete the lesson in class, and it can be cycled through until all classes complete classwork and have the VR experience to ensure equitable instruction for all students.

Recommendations for Future Study

In future studies, researchers should explore which types of professional developments work best to support teachers in VR implementation. Studies could also focus on comparing assessment scores from classes whose teachers participated in professional development for VR and those teachers who did not. For instance, this study could be designed to investigate if teachers continue to implement if they received pre-training, as seen in this research study, or did not. This study can easily be adapted to look at teacher confidence levels in both groups additionally. Future research studies should also focus on program evaluations for systems in place for supporting VR implementation. For example, one school's system versus another's method for VR activities. Other studies could include using professional developments that apply different learning theories to VR. There is a need for research in this area, as many companies,

schools, and districts have yet to establish professional development for teachers using VR in their lessons. Research could investigate which professional development programs work the best from the perspective of the teachers and the perspectives of the students.

Conclusion

Reflection on the Research Experience

Now I reflect on my experience organizing the research study, collecting the data, and analyzing the data to come to a conclusion. The research was born from identifying a need within the school district. I noticed there was a need for supporting teachers in how to use VR in their classrooms. Not only did I think that the physical experience needed to happen, but I also thought about lesson structure and learning theory. This led me to dive into current research regarding professional development for VR, and to my surprise there were no found articles. Many studies focus on student motivation and engagement, how students learn using VR, and testing student learning outcomes against method of instruction: VR versus traditional. However, I was more interested in how to support teachers. I read studies related to VR, learning theory, professional development, formats of VR, and instructional coaching. It was my desire to create something that could be used in my school district to meet the needs of students and teachers. While only one middle school has purchased headsets, I know others are forthcoming. I have discussed this in the hallways with administration as I left classrooms with the headsets.

Overall, there were many phases to this research study, but each was significant and irreplaceable. Without the different phases, each step of the research would not have informed such a complete picture to answer the research questions. This is the rationale behind researching several methods and choosing a mixed methods study. As an exploratory case study, I was able

to pragmatically construct methods to specifically and completely answer each of the research questions with both qualitative and quantitative data. The qualitative data helped me to understand the position of teachers and their journey along the way. I was able to have organic discussions about their experiences, their thoughts, and their desires to explain why training for VR is so relevant and important to the future of education. Using quantitative data, I was able to analyze to what extent the workshop influenced teacher confidence and promoted future VR implementation in the classroom. The completion of this research intrinsically motivated me as a district coach and is useful to the school district of which I am employed. It is my intention to share this research study and results with district and school leadership. This body of work contributes to the future of research in education, because VR is the future of education.

Possible Biases

As a researcher, I realize that there are some possible biases that may have affected the research study. As a colleague and employee in the district, my work could have influenced teachers to rate themselves and their post-survey in accordance with that they thought might benefit me the most in my studies. I have known the participants for years, and I talk with many of these participants weekly. I have been in their classrooms many times before as their district curriculum coach. However, I stressed and communicated with participants that honest answers are more important to me as a researcher. I also made sure that I was not physically present when teachers filled out their post-survey, but this may not have reduced all biases. For this reason, I am interested in replicating the study with a group of teachers in a different content area. In order to further reduce bias, I did not collect emails or names when participants filled out the pre-

survey or post-survey. The statistical tests were conducted using only the participants responses in accordance with the results produced on the Google Forms.

Final Statement

I have presented a mixed methods exploratory case study investigating a specialized professional development with a focus in supporting teachers in using VR in the social studies classroom. If students are to have the best curriculum and instruction, it is imperative that school and district leaders promote the use of VR for the classroom, regardless of discipline. The students are highly motivated and energized when using VR activities. Teachers can work to structure these opportunities for their students to expose them to experiences all around the world. Using best practices to tailor professional development and coaching cycles is a model that school leaders can use to inform policymaking and the creation of systems within the district or school to provide full support to teachers as they learn and refine VR instructional practice.

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APPENDICES

Appendix A

Hello, my name is Lindsay Weirich, and I am a doctoral candidate at Coastal Carolina University. The purpose of this email is to announce a professional learning opportunity regarding virtual reality (VR) lessons in social studies grades 6-12. Anticipated participation time is attendance of two meetings and a coaching observation.

The first meeting will be a quick group interview lasting around thirty minutes. Then, a professional workshop including hands-on experiences with VR headsets will be scheduled to last about three hours. Participants will get the chance to go on a virtual tour and see the journey of Martin Luther King Jr. from Selma to Memphis. Teachers will have time to collaborate and create a lesson incorporating best practices. Teachers will also receive feedback after their observation about their VR lessons using a rubric. A pre-survey and post survey of 10 questions will help me understand the value-added of the professional workshop.

If you are interested in learning how to create lessons using VR, please respond to this email. Participation is voluntary and no repercussions will occur if you do not select to participate. If you have questions about this study, you can contact me by email at lnweiric@coastal.edu or my committee chair, Dr. Anthony Setari, at asetari@coastal.edu.

Appendix B

Consent Forms

You may select whether or not to participate in the research program providing a professional learning opportunity to 6-12 Social Studies teachers in using VR in the classroom. No prior experience is necessary.

1.Email*

2. INFORMED CONSENT FOR HUMAN SUBJECT RESEARCH PARTICIPATION

Introduction

My name is Lindsay Weirich, and I am a doctoral candidate at Coastal Carolina University.

I would like to invite you to take part in our research study entitled, “Teacher Support for Virtual Instruction in the Social Studies Classroom.” You are free to talk with someone you trust about your participation in this research and may take time to reflect on whether you wish to participate or not. If you have any questions, we will answer them now or at any time during the study.

Purpose

The purpose of this mixed-methods study is to design a theory-based framework for professional development intended for teachers in the classroom. Research questions include: 1) How do teachers in the school district currently use VR in the classroom? 2) What relationship exists between participation in VR professional development and use of VR in the classroom? 3) What influence does VR professional development have on future VR implementation?

Procedures/Duration

During this research study, you will be asked to voluntarily participate in a professional learning opportunity focused on VR in 6-12 Social Studies. The initial meeting will be a focus group lasting approximately 30 minutes and the workshop will last approximately 3 hours. A coaching observation will be scheduled, and specific feedback will be shared with the teacher for support in using VR headsets. A pre and post survey will be required that consists of 10 questions ranked on a 1-5 scale.

Rights

You do not have to agree to participate in this research study. If you do choose to participate, you may choose not to at any time once the study begins. There is no penalty for not taking part or withdrawing from the study at any time. If you are a CCU (Coastal Carolina University) student, your decision to take part or not will have no effect on your grade.

Risks

During this research study, no risks or discomforts are anticipated.

Benefits

By agreeing to participate in this research study, you may benefit by/from gaining insight on student engagement in virtual reality activities. This research may also help others gain a better understanding of the use of VR in the community or society as a result of finding an answer to the research question.

Confidentiality

Unless you provide consent to the contrary, the confidentiality of your participation in this research study, your responses, or any individual results will be maintained by the PI and all members of the research team.

Note that confidentiality will only be violated when required by law or the ethical guidelines of the American Psychological Association. This usually includes, but may not be limited to, situations when your responses indicate that you, or another clearly identified individual, is at risk of imminent harm or situations in which faculty are mandated reporters, such as instances of child abuse or issues covered under Title IX regulations. For more information about Title IX, please see the University's webpage at: https://www.coastal.edu/titleix/.

Sharing the Results

As the principal investigator on this research study, I plan to share the results of this study by email.

Contacts

If you have any questions about this research study, please feel free to contact me at 843-240-7771 or lnweiric@coastal.edu. The faculty advisor on this study is Dr. Anthony Setari and he can also be contacted by email asetari@coastal.edu.

The Institutional Review Board (IRB) under the Office of Sponsored Programs and Research Services is responsible for the oversight of all human subject research conducted at Coastal Carolina University. If you have any questions about your rights as a research participant before, during or after the research study, you may contact this office by calling (843) 349-2978 or emailing OSPRS@coastal.edu. This research study has been approved by the IRB on [insert

date of approval letter]. This approval will expire on [insert expiration date from approval letter] unless the IRB renews the approval prior to this date.

****

Consent I have read this form and have been able to ask questions and/or discuss my participation with someone I trust. I understand that I can ask additional questions at any time during this research study and am free to withdraw from participation at any time.

Mark only one oval.

Yes, I would like to participate in this research study

No, I would not like to participate in this research study

This content is neither created nor endorsed by Google.

Appendix C

Good morning, everyone,

Thank you for volunteering to participate in my research study. I have included a link to a pre-survey about VR in the classroom. Please also find the date, time, and place for our focus group meeting below. If you have any questions, please reach out to me or my university supervisor, Dr. Anthony Setari, at asetari@coastal.edu.

Thank you,

Lindsay Weirich

Appendix D

Introduction

Good afternoon, everyone, thank you for your participation in this study. This research study's purpose is to design a theory-based framework for professional development intended for classroom teachers using VR as a tool for instruction. I want you to know that your participation is voluntary, and you may feel free to excuse yourself from the study at any time without any consequences to your professionalism or relationship with me. I am taking off my "district coach" hat and putting on the "doctoral student" hat. Our mutual respect in this group will allow us to explore the ways in which we think about VR, how we have used it in the past (if at all), and what concerns we have about used VR in the classroom. To develop a program for our training that best fits our group's needs, I will first need to ask you all a few questions. A few ground rules will help us stay on track and give everyone a chance to voice their experiences and thoughts. Please answer honestly and ask questions when they arise for the good of our group. Remember to let everyone finish their thoughts before adding to the conversation. I will need to record this conversation for data collection but all names or names of places that come up will be disguised. Feel free to address each other as normal.

That's it. Are we ready to get started? Any questions before we start?

Focus Group Questions

Question 1: Let's introduce ourselves to the group. What is your name, school, years of teaching experience, and experience level with VR?

Question 2: What do you know about VR, and do you have a personal VR at home?

Question 3: What do you wish to learn about VR and education?

Question 4: How does your school support VR in the classroom?

Question 5: Has your school offered any VR training via the company the devices were purchased from?

Question 6: Is VR an educational tool that enhances learning or a distraction from learning? Why?

Question 7: Would students do better on an assessment using VR compared to regular instruction to learn content?

Question 8: Do you think that a VR professional development for our district is needed?

Question 9: Specifically, how are you using VR in your classroom currently?

Question 10: What have we missed here, is there anything we missed that you would like to add?

Conclusion

Thank you all again for taking part. I am excited to get to work creating a specialized professional development for VR in the classroom using learning theory as a framework. I will be in touch through email to set up the time and place for the workshop soon. If at any time you have questions about this study, you may contact me or my university supervisor, Dr. Anthony Setari, at asetari@coastal.edu

Appendix E

Likert Scale 1-5

1=strongly disagree
2= disagree
3=neutral
4=agree
5=strongly agree

Pre-Survey Questions

Directions: Please rate each statement on a scale of 1-5 (1 being strongly disagree to 5 being strongly agree)

1. I have experience using VR.
2. I can define what VR is.
3. I can describe how students learn in virtual environments.
4. I can design a lesson using a VR activity.
5. I feel comfortable asking for support to use VR.
6. Professional development has helped me understand VR.
7. I feel confident using VR activities in my classroom.
8. I feel comfortable helping other teachers learn about VR.
9. I received supportive feedback about my VR lesson.

Post-Survey Questions

Directions: Please rate each statement on a scale of 1-5 (1 being strongly disagree to 5 being strongly agree)

1. I have experience using VR.
2. I can define what VR is.
3. I can describe how students learn in virtual environments.
4. I can design a lesson using a VR activity.

5. I feel comfortable asking for support to use VR.
6. VR is a tool used by teachers to enhance learning.
7. VR is a distraction in the classroom.
8. I feel confident using VR activities in my classroom.
9. I feel comfortable helping other teachers learn about VR.
10. I received supportive feedback about my VR lesson.

Appendix F

Good morning, everyone,

I want to thank you for participating in the focus group. It helped me understand how teachers in our district are currently using VR in the classroom. I have scheduled a place, date, and time for our workshop. We will experience a virtual tour about Martin Luther King Jr. and his journey from Selma to Memphis. After this, we will learn about best practices and create a lesson plan using a rubric. I cannot wait to see you all there! I will bring snacks and drinks!

If you have any questions, please feel free to reach out or contact my university supervisor, Dr. Anthony Setari, at asetari@coastal.edu

Thank you,

Lindsay Weirich

Appendix G

Good morning, everyone,

Thank you for attending the research study workshop! I hope you had fun using the VR and learning how to incorporate these fun activities in your lesson using best practices. I am excited to see your lesson in action. Please find our coaching observation schedule below. Remember that I am using the lesson rubric only to provide essential feedback and not to evaluate you for any matter! We are learning together.

If you have any questions, please reach out to me or my university supervisor, Dr. Anthony Setari, at asetari@coastal.edu

Thank you!

Lindsay Weirich

Appendix H

Theory-based Design Principles	Approaching	Meeting	Exceeding
Pre-training Students learn better when they receive focused pre-training that provides or activates relevant prior knowledge	Discusses the purpose of the VR activity but does not communicate the learning target to students.	Discusses the context around the VR activity and communicates the learning target.	Discusses the context, background information, and communicates the learning target with success criteria.
Guided Activity Students learn better when allowed to interact with a pedagogical agent who helps guide their cognitive processing	Pauses students and attempts to guide students but lack meaningful timing or thought-provoking questions.	Pauses students to check for understanding at meaningful times and asks thought-provoking questions about the VR lesson.	Pauses students at meaningful times to ask thought-provoking questions and encourages student discourse.
Pacing Students learn better when allowed to control the pace of presentation of the instructional materials	Does not explain how students can rewind or pause their virtual lesson.	Explains how students can rewind and pause their virtual lesson.	Encourages students to practice pausing and explains the reasons for doing so.
Feedback Students learn better with explanatory rather than corrective feedback alone	Provides corrective feedback only to students about procedures, but not content related.	Provides explanations to students about the learning target and procedures.	Provides explanations to students about the learning target, procedures, and success criteria.
Reflection Students learn better when asked to reflect upon correct answers during the process of meaning making	Does not provide a moment for reflection at the end of the activity or was rushed.	The moment for reflection at the end of the activity was meaningful and produced a summary of the lesson.	Reflection was meaningful and thought-provoking. Prompted students to connect the lesson to their pre-existing knowledge.

Appendix I

Good morning, everyone!

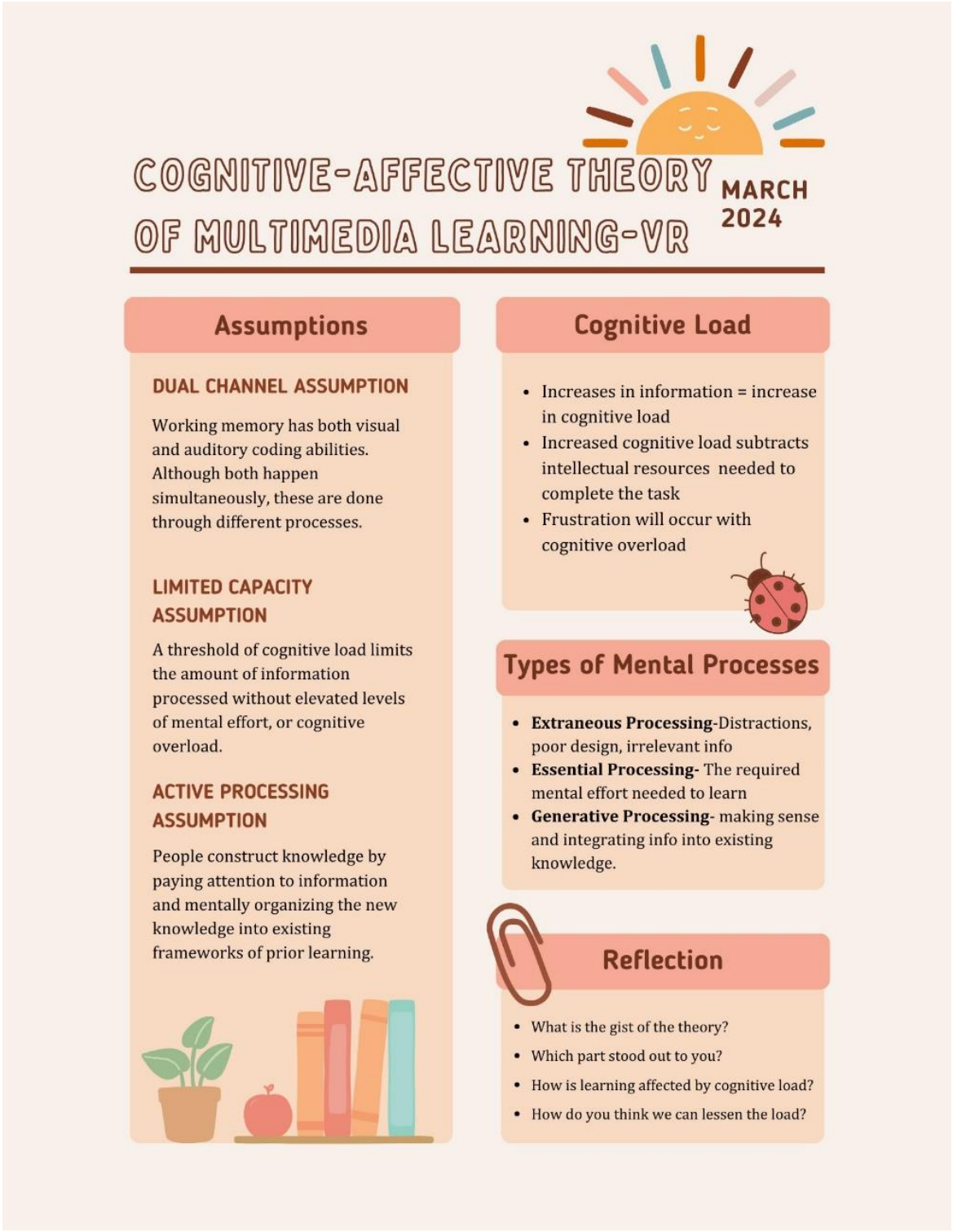
It has been a pleasure working with you all and learning about VR in Social Studies class! Please find the link to the post-survey. Thank you for taking part! Results will be shared through email later.

If you have any questions or concerns, please reach out to me or Dr. Anthony Setari asetari@coastal.edu

Thank you so much,

Lindsay Weirich

Appendix J


COGNITIVE-AFFECTIVE THEORY OF MULTIMEDIA LEARNING-VR
MARCH 2024
Assumptions
DUAL CHANNEL ASSUMPTION
Working memory has both visual and auditory coding abilities. Although both happen simultaneously, these are done through different processes.
LIMITED CAPACITY ASSUMPTION
A threshold of cognitive load limits the amount of information processed without elevated levels of mental effort, or cognitive overload.
ACTIVE PROCESSING ASSUMPTION
People construct knowledge by paying attention to information and mentally organizing the new knowledge into existing frameworks of prior learning.
Cognitive Load
Increases in information = increase in cognitive load
Increased cognitive load subtracts intellectual resources needed to complete the task
Frustration will occur with cognitive overload
Types of Mental Processes
Extraneous Processing-Distractions, poor design, irrelevant info
Essential Processing- The required mental effort needed to learn
Generative Processing- making sense and integrating info into existing knowledge.
Reflection
What is the gist of the theory?
Which part stood out to you?
How is learning affected by cognitive load?
How do you think we can lessen the load?

Appendix K

Civil Rights Movement

Instructions: Read each station first before starting the station. After the station, answer the questions.

Station 1 - Ebenezer Church Atlanta

- What did you notice? (List three)
- What is the significance of Ebenezer Church?
- What impact did the Ebenezer Church have on MLK?

Station 2 - Selma Bridge

- What did you notice? (List three)
- What event prompted MLK Jr to get involved in the march?
- Summarize the importance Selma Bridge had on the Civil Rights Movement?

Station 3 - Capitol Building (Montgomery, Alabama)

- What did you notice? (List three)
- What principle of government was emphasized in the march?
- Why did Civil Rights Activists march to Montgomery, Alabama?

Station 4 - Lincoln Memorial

- What did you notice? (List three)
- What did you learn? List three)

- Predict how the “I have a dream” speech impacted the Civil Rights Movement?

Station 5 - Lorraine Motel (Memphis, Tennessee)

- What did you notice? (List three)
- What did you learn? List three)
- Why was MLK Jr. assassinated?

Civil Rights Movement - Exit Ticket

Explain the significance MLK Jr. had on the Civil Rights Movement.

Appendix L

Teacher A

Appendix H- VR Lesson Feedback Rubric

Theory-based Design Principles	Approaching	Meeting	Exceeding
Pre-training Students learn better when they receive focused pre-training that provides or activates relevant prior knowledge	Discusses the purpose of the VR activity but does not communicate the learning target to students.	Discusses the context around the VR activity and communicates the learning target.	Discusses the context, background information, and communicates the learning target with success criteria. *
Guided Activity Students learn better when allowed to interact with a pedagogical agent who helps guide their cognitive processing	Pauses students and attempts to guide students but lack meaningful timing or thought-provoking questions.	Pauses students to check for understanding at meaningful times and asks thought-provoking questions about the VR lesson.	Pauses students at meaningful times to ask thought-provoking questions and encourages student discourse. *
Pacing Students learn better when allowed to control the pace of presentation of the instructional materials	Does not explain how students can rewind or pause their virtual lesson.	Explains how students can rewind and pause their virtual lesson.	Encourages students to practice pausing and explains the reasons for doing so. *
Feedback Students learn better with explanatory rather than corrective feedback alone	Provides corrective feedback only to students about procedures, but not content related.	Provides explanations to students about the learning target and procedures.	Provides explanations to students about the learning target, procedures, and success criteria. *
Reflection Students learn better when asked to reflect upon correct answers during the process of meaning making	Does not provide a moment for reflection at the end of the activity or was rushed.	The moment for reflection at the end of the activity was meaningful and produced a summary of the lesson. * I wish I had more time to discuss @ the end.	Reflection was meaningful and thought-provoking. Prompted students to connect the lesson to their pre-existing knowledge.

* The schedule hinder the activity process of reflection, NO fault of anyone.

[redacted] Teacher B

~~Appendix H~~- VR Lesson Feedback Rubric

Theory-based Design Principles	Approaching	Meeting	Exceeding
Pre-training Students learn better when they receive focused pre-training that provides or activates relevant prior knowledge	Discusses the purpose of the VR activity but does not communicate the learning target to students.	Discusses the context around the VR activity and communicates the learning target.	Discusses the context, background information, and communicates the learning target with success criteria.
Guided Activity Students learn better when allowed to interact with a pedagogical agent who helps guide their cognitive processing	Pauses students and attempts to guide students but lack meaningful timing or thought-provoking questions.	Pauses students to check for understanding at meaningful times and asks thought-provoking questions about the VR lesson.	Pauses students at meaningful times to ask thought-provoking questions and encourages student discourse.
Pacing Students learn better when allowed to control the pace of presentation of the instructional materials	Does not explain how students can rewind or pause their virtual lesson.	Explains how students can rewind and pause their virtual lesson.	Encourages students to practice pausing and explains the reasons for doing so.
Feedback Students learn better with explanatory rather than corrective feedback alone	Provides corrective feedback only to students about procedures, but not content related.	Provides explanations to students about the learning target and procedures.	Provides explanations to students about the learning target, procedures, and success criteria.
Reflection Students learn better when asked to reflect upon correct answers during the process of meaning making	Does not provide a moment for reflection at the end of the activity or was rushed.	The moment for reflection at the end of the activity was meaningful and produced a summary of the lesson.	Reflection was meaningful and thought-provoking. Prompted students to connect the lesson to their pre-existing knowledge.

Teacher C

~~Appendix H~~ VR Lesson Feedback Rubric

Theory-based Design Principles	Approaching	Meeting	Exceeding
Pre-training Students learn better when they receive focused pre-training that provides or activates relevant prior knowledge	Discusses the purpose of the VR activity but does not communicate the learning target to students.	Discusses the context around the VR activity and communicates the learning target.	Discusses the context, background information, and communicates the learning target with success criteria.
Guided Activity Students learn better when allowed to interact with a pedagogical agent who helps guide their cognitive processing	Pauses students and attempts to guide students but lack meaningful timing or thought-provoking questions.	Pauses students to check for understanding at meaningful times and asks thought-provoking questions about the VR lesson.	Pauses students at meaningful times to ask thought-provoking questions and encourages student discourse.
Pacing Students learn better when allowed to control the pace of presentation of the instructional materials	Does not explain how students can rewind or pause their virtual lesson.	Explains how students can rewind and pause their virtual lesson.	Encourages students to practice pausing and explains the reasons for doing so.
Feedback Students learn better with explanatory rather than corrective feedback alone	Provides corrective feedback only to students about procedures, but not content related.	Provides explanations to students about the learning target and procedures.	Provides explanations to students about the learning target, procedures, and success criteria.
Reflection Students learn better when asked to reflect upon correct answers during the process of meaning making	Does not provide a moment for reflection at the end of the activity or was rushed.	The moment for reflection at the end of the activity was meaningful and produced a summary of the lesson.	Reflection was meaningful and thought-provoking. Prompted students to connect the lesson to their pre-existing knowledge.

Teacher D

Appendix H- VR Lesson Feedback Rubric

Theory-based Design Principles	Approaching	Meeting	Exceeding
Pre-training Students learn better when they receive focused pre-training that provides or activates relevant prior knowledge	Discusses the purpose of the VR activity but does not communicate the learning target to students.	Discusses the context around the VR activity and communicates the learning target.	Discusses the context, background information, and communicates the learning target with success criteria.
Guided Activity Students learn better when allowed to interact with a pedagogical agent who helps guide their cognitive processing	Pauses students and attempts to guide students but lack meaningful timing or thought-provoking questions.	Pauses students to check for understanding at meaningful times and asks thought-provoking questions about the VR lesson.	Pauses students at meaningful times to ask thought-provoking questions and encourages student discourse.
Pacing Students learn better when allowed to control the pace of presentation of the instructional materials	Does not explain how students can rewind or pause their virtual lesson.	Explains how students can rewind and pause their virtual lesson.	Encourages students to practice pausing and explains the reasons for doing so.
Feedback Students learn better with explanatory rather than corrective feedback alone	Provides corrective feedback only to students about procedures, but not content related.	Provides explanations to students about the learning target and procedures.	Provides explanations to students about the learning target, procedures, and success criteria.
Reflection Students learn better when asked to reflect upon correct answers during the process of meaning making	Does not provide a moment for reflection at the end of the activity or was rushed.	The moment for reflection at the end of the activity was meaningful and produced a summary of the lesson.	Reflection was meaningful and thought-provoking. Prompted students to connect the lesson to their pre-existing knowledge.

Appendix M

That's that's with everything, even though YouTube video. Is there anything you think I should add to the training to help future teachers?

I would. With the training, I would have. If it was compiling software that you have where you get to choose a lesson, I would actually is it possible let them log in and to get to preview to see and then they create it based off their student needs and where they're at and their content material. And so you have at first you have their login id they get to choose the software with it and so it fits their student needs where they're at to make it seamlessly intertwined within the curriculum when they're pacing. I think that would help. When looking at training, I think you did a really wonderful job on talking about possible sick motion sickness. Well Looking at how it works, understanding that how how the headsets, like how they actually like it's going on your retina is and kind of getting the theory behind it and why VR is so helpful within the classroom. I think that's important for teachers to understand. I think I would definitely keep that. I think um talking about possible problems within and how you will have to monitor and just talking about the Wi Fi, I think is important that there's a specific Wi Fi, the like, this is the code you need. If something happens because two hands is quicker than one this is true to look at. But overall, I think it was a really great activity.

Learning theory | Teacher experience | Troubleshooting

If your school were to purchase headsets today, would you feel comfortable using them more frequently?

Yes, I was trying to probably use it once or twice a unit because then it'll probably be competitive to use within the school. Oh, yeah. But I think I would definitely try to use it within, especially with geography because yeah, get out. As I told them starting off, I'm not Ms. Frizzle. I can't take you on my magic school bus. But with your headset on and take you to Alabama to see the civil rights movement and look at where MLK advocated for it for rights. So

Access | Teacher Implementation