INVESTIGATING HIGH SCHOOL STUDENTS' ENGAGEMENT AND PRESENCE IN FOREIGN LANGUAGE LEARNING USING VIRTUAL REALITY: A QUASI-EXPERIMENTAL STUDY

by

Nibras Clapp

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Philosophy

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APPROVED BY:

Laura Mansfield, Ed.D., Committee Chair

David Abraham, Ph.D., Committee Member

ABSTRACT

The purpose of this quasi-experimental, nonequivalent control group study was to determine if a statistically significant difference existed in the engagement and presence of high school foreign language learners who used virtual reality in their language learning and those who used traditional methods. This study seeks to add to the existing literature by bridging the gap of understanding related to increasing the proficiency of foreign language learners. A convenience sample of 158 high school students was drawn from a school district in the southeast of the United States. The study utilized the user engagement scale and the presence questionnaire, with a selected sample consisting of a treatment group (using virtual reality) and a control group (using traditional methods). The researcher conducted a one-way multivariate analysis of variance to assess the presence and engagement scores in the control and treatment groups. However, the results were inconclusive due to assumption violations. To overcome these limitations, future research should include performing a prolonged study, exploring different virtual reality applications, using appropriate instruments to the age group of ample used, and collecting qualitative data to better understand students' and teachers' opinions.

Keywords: engagement, presence, virtual reality, foreign language learning, language immersion

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Dedication

First and foremost, I dedicate this dissertation to God, who guided me to choose Liberty University to carry out this endeavor, and his continuous support throughout this journey. Second, my family's unwavering support and love, whose encouragement has served as the foundation of my academic journey.

My beloved [redacted], your faith in my abilities has been my source of strength. Your encouragement, understanding, and numerous discussions about the value of education and how to impact and serve others to learn have enabled me to pursue this educational endeavor. Your unwavering support has been my driving force, and I am eternally grateful for the love and inspiration you have brought into my life.

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This dissertation reflects the collective support and inspiration I have received from my family and professors. It is dedicated to everyone who has played an important role in my academic journey and contributed to the achievement of this milestone.

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CHAPTER ONE: INTRODUCTION

Overview

The purpose of this quantitative, quasi-experimental nonequivalent control-group study is to determine if there is a difference in the presence and engagement between high school students who are learning a foreign language using virtual reality (VR) and those who are not. Chapter One provides a background for the topic of immersion in a foreign language to increase students' presence and engagement, and foreign language proficiency. Included in the background is an overview of the theoretical framework for this study. The problem statement examines the scope of the recent literature on this topic. The purpose of this study is followed by its significance. Finally, the research questions are introduced, and definitions pertinent to this study are provided.

Background

The acquisition of foreign language proficiency necessitates the development of both internal and external proficiency (De Guerrero, 2018; Santos, 2022; Z. Zhang, 2020). Internal proficiency, as described by the authors, is the inherent process by which a learner develops language on an individual level before moving on to the external proficiency stage, in which the learner interacts with others using the acquired language. This acquisition is fostered through active engagement with the language (Z. Zhang, 2020). Facilitating language development is through three primary stages: the silent period, early production and experimentation, and communicative competence. Active engagement with the language is most successful when learners are immersed in environments where the foreign language is spoken. Immersing learners in authentic environments that reflect the foreign language and culture promotes emotional and cognitive involvement, resulting in improved language acquisition. In these authentic

environments where the foreign language is the only language spoken, learners make conscious efforts to interact with the language, using their cognitive and behavioral abilities to communicate effectively (Z. Zhang, 2020). The use of VR offers foreign language learners an affordable opportunity to immerse themselves in the language, opening new possibilities for exploration and growth (Deng & Yu, 2022; Dhimolea et al., 2022; Hua & Wang, 2023; Peixoto et al., 2021; Symonenko et al., 2020; Zheng et al., 2022) This evolving era of foreign language learning via advanced technologies, as discussed by the aforementioned authors, demands extensive research to examine the potential opportunities of such technologies.

Historical Overview

The application of technology in education in language education is nothing short of revolutionary, demonstrating a diverse set of technological tools that transformed teaching and learning practices. Rapanta et al. (2021) argued that the advent of the internet in the early 1990s ignited the spark for global access to information and online platforms, which marked an important turning point in the educational journey. Moreover, the authors claimed that this event was critical in this journey because it encouraged a wide range of interactions among educators and learners, allowing for global access to information and collaboration with others regardless of time or geographical location. Moreover, the authors highlighted that this revolution was accelerated by the recent COVID pandemic in 2020, resulting in an increase in the applications of technologies, which not only brought learning to learners wherever they were but also artificially transported them on an immersive journey to where learning is occurring in real-time.

In terms of language education, it is undeniable that technology merged as a practical solution to address the difficulties associated with immersing learners in foreign language learning environments where the foreign language is the only language spoken (C. Chen &

Yuan, 2023; Lan, 2020). This evolution in language education technology can be traced to the time when computer-assisted language learning (CALL) programs were used in language education to provide opportunities for language learners to practice vocabulary and grammar through drills and exercises (C. Chen et al., 2021). However, as the technological landscape evolved, so did the language education tools. In a review of literature related to educational technology and language education, Shadiev and Yang (2020) concluded that games and online videos that are made available on the internet were the most commonly used technologies in learning foreign languages by young adults. Some technologies, such as learning management systems, whiteboards, message boards, and ePortfolios, are no longer considered effective or have significantly impacted learning. In contrast, augmented reality (AR), VR, XR, e-Books, and robots appear to be increasingly used in foreign language learning today (Shadiev & Yang, 2020).

Replicating environments where a foreign language is spoken has always been a challenging task due to a wide range of factors, most importantly time and cost (Huang et al., 2021; Shadiev & Yang, 2020). The authors argued that although multimedia and audio-visual aids emerged as an important component of language education in the early 1980s, the need to immerse learners remains. Until the invention of the internet, which opened limitless possibilities, the authors claimed that the use of multimedia in language education has evolved to meet this need. Shadiev and Yang (2020), in a review on technology-enhanced language learning and teaching, emphasized that multimedia not only catered to different learning styles but also addressed the need for more engaging and interactive language instruction. Huang et al. (2021) stressed, however, that the recent move toward technologies such as VR has resulted in a

pedagogical shift toward multimedia-enhanced language education, laying the groundwork for future technological innovations in the field.

The use of VR provides foreign language learners with an opportunity to be in authentic environments, which increases the learners' performance by enhancing their positive attitude and motivation (C. Chen & Yuan, 2023; Lan, 2020). Immersion, imagination, and interactions are the three Is of 3D learning that facilitate this form of learning, as highlighted by Lan (2020). The three Is are crucial components of foreign language learning, addressing learner active engagement, social interactions, and sense of reality and presence. The combination of 3D learning and foreign language learning in VR-enabled environment results in a learning experience in which learners have control over their learning and are motivated by specific goals, that result in increased performance and language acquisition (Lan, 2020).

Society-at-Large

The substantial research that probed various methods to increase foreign language proficiency raises the rationale for learning a second language exists (Huang et al., 2022). In today's world, learning a second language is becoming a crucial skill for any global citizen, facilitating global knowledge of cultures and regions, and promoting a flourishing economy and future peace in the world (Fox et al., 2019). Over the last three decades, a substantial body of literature has demonstrated the value of bilingualism and multilingualism in leading today's critical fields such as science, military, and education (Booton et al., 2021; Ramírez-Esparza et al., 2020; Tiv et al., 2021). Booton et al. (2021) argued for the noteworthy growth in the number of individuals with foreign language skills being sought by scientific and government organizations to form partnerships with other nations and regions to improve the world's well-being, safety, and security.

The benefits of learning a second language are numerous. Individuals who learned a second language exhibited an increase in cognitive ability, which results in improved academic achievement and communicative and intercultural skills, crucial in today's globalized world (Booton et al., 2021; Fox et al., 2019). Furthermore, scientists discovered that a multilingual person's brain is resilient to age-related neurodegeneration and may prevent the onset of diseases such as Alzheimer's (Heim et al., 2019; Pliatsikas et al., 2020). Nonetheless, the authors argued that simply knowing a foreign language is insufficient for demonstrating these attributes. Instead, the authors emphasized that ongoing active engagement and dynamic interaction with the language is an essential component. Moreover, the efficacy of bilingualism is contingent upon the individual's experience, immersion in an environment where the foreign language is spoken, and the frequency of language switching.

Theoretical Background

When the topic of foreign language acquisition using VR technologies appears in the literature, it is enriched by the insights of two major theorists, Vygotsky (1978) and Johnson (1989). Vygotsky's (1978) socio-constructivism learning theory and Johnson's (1989) embodied learning theory are two notable theories that have significantly shaped the landscape of language education using immersive environments such as the ones produced by VR technologies. These two theories provide a theoretical framework for considering the efficacy of using VR to improve the engagement and presence of foreign language learners. The interactive nature of VR while constructing knowledge is strongly based on socio-constructivism and fits with Vygotsky's major assertions, emphasizing the importance of social interactions and knowledge co-creation. The essence of this theory is the social component of learning, where learners collaborate to develop understanding. Immersive environments created by VR provide learners with a unique

platform for active participation and heightened engagement with the subject matter at hand (Horvat et al., 2022; Nisha, 2019). By modeling such situations, learners are provided with an atmosphere suited to interactive learning, building an effective and efficient link between learners and between learners and knowledge.

VR-enabled learning environments also offer an opportunity for learners to not only interact with knowledge but also embody the language itself via dynamic social interactions (Jusslin et al., 2022; Zhang et al., 2021). This all-encompassing engagement serves as a catalyst to improve learning effectiveness and proficiency development. The foundations of this embodiment-centric approach are found in Johnson's (1989) embodied learning theory, which emphasizes the critical importance of learners' bodily engagement in creating communication dynamics. By adopting this approach, learners harness their own bodily experiences to shape the foundations and structure of human communication.

In summary, the alliance between Vygotsky's socio-constructivism learning theory and Johnson's embodiment learning theory forms an effective lens through which to examine the integration of VR into foreign language education to increase foreign language learners' engagement and presence with the foreign language. Their insights shed light on the complex, internal cognitive processes and external social interactions that serve as the foundation of language education. The implication of immersing foreign language learners in an authentic environment to achieve foreign language proficiency cannot be overstated in the field of language learning and instruction. The use of VR offers a promising alternative that can lead to a high engagement in authentic environments, enhancing foreign language proficiency (Zhang et al., 2021). A need for further research is necessary to explore the potential of such an environment across a broad range of learner demographics, proficiency levels, and linguistic

contexts. Expanding the investigation to include a diverse range of learners is imperative to establish the robustness and applicability of VR in learning foreign languages.

Problem Statement

Although there is a growing interest in exploring the use of VR in developing immersive environments for learning foreign languages, research on the subject is sparse due to the related technology cost (Peixoto et al., 2021). In addition, literature reviews conducted by Huang et al. (2022), Parmaxi (2020), Peixoto et al. (2021), and Rojas-Sánchez et al. (2023) demonstrated that existing research primarily focuses on specific skills of language learning, including listening, vocabulary, and comprehension, with a strong theoretical orientation. Several factors, as the authors of these reviews elaborated, contribute to the limited research of such technologies by foreign language educational institutions. Cost, practicality, and the limited range of languages studied, such as English, Chinese, and Hindi, are among these factors. It is also worth noting that universities are the primary settings for most of the research, indicating the settings in focus. This limited research, in terms of settings, suggests further investigation of the topic as it underscores intriguing and broader opportunities to increase foreign language proficiency (Peixoto et al., 2021).

The current body of research on the effectiveness of VR at high school level is limited and demands further investigation, as highlighted by Luo et al. (2021) in their systematic review of literature spanning from 2002 to 2019 within K-12 learning environments. The findings of their study revealed possible opportunities to use VR but focused primarily on creating immersive learning environments in math, science, and educational safety. Although there has been an increase in interest in employing VR in K-12 settings over the last two decades, the adoption of these technologies has varied (Coban et al, 2022; Luo et al., 2021; Smutny, 2022).

The problem, as the authors concluded, is that the literature has not fully addressed the use of VR in K-12 settings for learning a second language, and how VR ties to learners' motivation and subsequent learning outcomes.

Purpose Statement

The purpose of this quantitative, quasi-experimental nonequivalent control-group study was to determine if a statistically significant difference exists between high school foreign language learners who used VR in their language learning and those who used traditional methods of foreign language learning. This study seeks to provide robust discourse and in-depth investigation into the engagement and presence of high school foreign language learning. The independent variable is the use of the VR Mondly application in learning a foreign language. Mondly is a well-known language learning platform that facilitates language acquisition and skill advancement in over 40 languages (Mondly, n.d.). The platform provides in-depth interactive exercises, quizzes, and scenario-based language practice sessions, all of which are easily accessible through its user-friendly VR, mobile, and web applications (Hajizadeh et al., 2023). The dependent variables are: 1) students' engagement, which O'Brien and Toms (2008) defined as "a quality of user experience characterized by the depth of an actor's cognitive, temporal, affective and behavioural investment when interacting with a digital system" (p.29), and 2) students' presence, which Witmer and Singer (1998) defined as "a multi-dimensional construct that describes a psychological state of being in the VE without being aware of one's own actual physical environment". (p.2)

The research participants were chosen from a public school system located in the southeastern United States, specifically from a high school within the Columbia County school district. Moreover, the high school sampled in this study stands as one of the largest within the

selected school system, with an enrollment of 740 middle school students and 1705 high school students. The sample is drawn entirely from a single high school in the selected school district and was divided into two groups: the treatment group and the control group. A control group was added to strengthen the internal validity of this experiment (Gall et al., 2007, p. 32).

Significance of the Study

Access to immersive environments in the field of foreign language learning enables learners to interact with native speakers of the foreign language and create a real-like experience of the target countries or cultures (Barrett e al., 2020; C. Chen & Yuan, 2023; Xie et al., 2021). The aim of the study revolves around the combination of active engagement and an immersive perception of reality and presence within VR-enabled environments in which it replicates and evokes real-life experiences, as essential elements of increasing foreign language proficiency (Lan, 2020). Moreover, this study seeks to add to the existing literature while attempting to further bridge the gap of understanding the difficulties of increasing the proficiency of foreign language learners due to the absence of these elements.

The influence of increasing foreign language proficiency goes beyond the increase of the well-being of K-12 learners in public school systems and the growth of their cultural and intercultural competencies in a globalized world (Abdullaev, 2021). This influence also extends to offer opportunities to students in high school to pursue a career as linguists or language analysts within the United States military (Hutton, 2020). Building a community of learners who share the commitment to the purpose of the United States military to preserve the country's national security against foreign threats is vital (Cutter, 2023).

Research Question

The following research question guides this quantitative study:

RQ: Is there a difference in high students' engagement and presence scores when using virtual reality to learn a foreign language?

Definitions

1. *Engagement* – "how actively involved a student is in a learning task and the extent to which that physical and mental activity is goal-directed and purpose-driven". (Hiver et al., 2021, p.3).
2. *Mondly*- a language learning platform that facilitates language acquisition and skill advancement in over 40 languages using interactive exercises, quizzes, and scenario-based language practice sessions, accessible through VR, mobile, and web-based applications (Mondly, n.d.).
3. *Presence* - "a multi-dimensional construct that describes a psychological state of being in the VE without being aware of one's own actual physical environment". (Witmer & Singer,1998, p.2)
4. *Virtual Reality* – "a technology that creates an artificial digital environment, an interactive computer-generated experience with the purpose to create a simulated environment". (Smutny, 2022, p.1).

CHAPTER TWO: LITERATURE REVIEW

Overview

This chapter is a review of the literature on the use of VR in foreign language learning, as well as an examination of the theoretical framework for the topic of the research. The review examines two major theories that could serve as theoretical foundations for the research topic. This chapter begins with the exploration of the theory of socio-constructivism by Vygotsky (1978). Subsequently, the review explores the theory of embodied learning by Johnson (1989). Additionally, this chapter provides insights into previous findings on the impact of VR on the engagement and presence of learners. Furthermore, this review identifies a gap in the literature regarding the effectiveness of using VR in increasing the engagement and presence of foreign language learners in high school language learning environments. Finally, this section concludes with a synthesis of the related literature and a summary of the chapter.

Theoretical Framework

Using VR in learning is a multifaceted approach supported by a variety of educational theories. In the realm of immersive language learning, within the dynamic landscape established by VR, however, learners become immersed not only in content but also in an interactive milieu where knowledge construction stems from the incorporation of novel experiences with existing ones (Horvat et al., 2022). This cognitive interaction is firmly based on socio-constructivism and fits with Vygotsky's major assertions (1978), emphasizing the importance of social interactions and knowledge co-creation. Moreover, these immersive VR environments broaden the instructional horizon by providing a comprehensive medium for learners to not only interact with but also embody the language itself via dynamic social interactions, creating a comprehensive

engagement that amplifies learning effectiveness and proficiency development (Jusslin et al., 2022; Zhang et al., 2021).

The foundations of this embodiment-centric approach are traced back to Johnson's (1989) embodied learning theory. The subsequent sections of this literature review will explore the definition, constructs, and application of the two primary theories in foreign language learning within immersive environments, particularly those created through VR. Again, these are the socio-constructivism theory, as discussed by Vygotsky (1978), emphasizing the consequence of social interactions in constructing foreign language proficiency, and the embodied learning theory, as explained by Johnson (1989), promoting a unique opportunity for learners to holistically engage with their surroundings, effectively embodying the language in social interactions.

Socio-Constructivism Theory

Socio-constructivism theory is founded on the premise that learners develop internal competence through social interactions by actively constructing knowledge and transforming knowledge into more complex knowledge (Iba & Burgoyne, 2019; Newman & Latifi, 2020; Wong et al., 2021). This theory derives from Lev Vygotsky's (1978) pioneering work, particularly in the field of language acquisition. Vygotsky's contributions expanded on Jean Piaget's constructivism theory, proposing that knowledge construction is inextricably linked to social engagement. Vygotsky proposed in his seminal work in 1978 that the early stages of language development stem from an innate capacity within the learner. He contended that as learners comprehend the purpose of the intrinsic speech, they engage in external speech, thereby laying the groundwork for future knowledge construction through social interaction.

Language, according to socio-constructivism theory, serves as a psychological tool, allowing individuals to communicate their experiences and establish individual practices (Iba & Burgoyne, 2019). Language development, according to this theoretical framework, is a systematic process that allows individuals to continually reconstruct language through daily interactions, eventually leading to more advanced and sophisticated linguistic proficiency. Wong et al. (2021) also emphasized the theory's ability to foster individual and collective inquiry, reflection, and knowledge generation, proposing that by embedding these learning principles within technologically rich environments, students and educators can take advantage of a variety of technological affordances to effectively apply newly acquired knowledge.

VR-enriched environments, for example, have emerged as powerful facilities to increase learner engagement and addressing critical aspects of learning (Hatzilygeroudis et al., 2021; Mystakidis, 2022; Rojas-Sánchez et al., 2023). Notably, these environments emphasize the importance of social interactions and internal motivation, which are key elements of Vygotsky's (1978) socio-constructivism theory. The alignment of VR-enabled learning and Vygotsky's theory emphasizes the pedagogical value of VR-enhanced learning environments, where learners frequently experience increased motivation in VR landscapes, resulting in increased attention, self-confidence, and a strong desire to participate in various social scenarios (Hatzilygeroudis et al., 2021).

Learners immersed in VR landscapes frequently experience amplified motivation, triggering a cascade of affirmative emotions such as increased attention, self-assurance, and an enthusiastic desire to participate in a variety of social scenarios (Hatzilygeroudis et al., 2021). This combination of elements promotes a more meaningful and powerful overall learning experience, which is consistent with the socio-constructivist emphasis on social interaction and

knowledge co-construction, and it strongly echoes Vygotsky's (1978) assertion that social interactions and collaboration are critical pillars of knowledge construction.

The immersive nature of VR environments, on the other hand, can elicit a variety of negative feelings, such as frustration, fear of failure, and periodic spells of boredom caused by incomplete tasks (Mystakidis, 2022; Rojas-Sánchez et al., 2023). Furthermore, beyond the immediate realm of learner experiences, the incorporation of VR may raise ethical concerns that have yet to be thoroughly investigated in existing literature (Rojas-Sánchez et al., 2023). This gap could be caused by biases resulting from funding sources and methodological influences (Mystakidis, 2022). Inadvertently these biases could impact the narrative surrounding the ethical aspects of VR applications. They could also result in a more complex interaction between immersive learning environments and established theories such as Vygotsky's socio-constructivism. Therefore, the pedagogical and ethical aspects of immersive learning environments and theories demands a thorough examination (Mystakidis, 2022; Rojas-Sánchez et al., 2023).

Although the use of socio-constructivism in VR-created immersive environments is limited, socio-constructivism offers a potential theoretical framework for constructing further knowledge and increasing learner proficiency through its premises of interaction in social contexts, and has the potential to improve learning outcomes, particularly if educators align these immersive learning experiences with various learning theories (Marougkas et al., 2023; Southgate et al., 2019). Socio-constructivism, which emphasizes social interactions, appears to be one of the most effective learning theories in VR learning environments (Marougkas et al., 2023). While these social interactions appear to be realistic, the authors determined they frequently fell short of reproducing the richness of face-to-face interactions (Southgate et al.,

2019). However, technologies such as VR continue to advance and rapidly improve their capabilities to deliver immersive and authentic environments that mimic real-life situations and interactions (Marougkas et al., 2023; Southgate et al., 2019).

While the practical application of socio-constructivism within VR-created immersive environments presents challenges, such as high equipment costs, limited physical classroom space, and constrained curriculum time, as discussed by Southgate et al. (2019), its theoretical foundation is gaining popularity. These constraints may exacerbate inequalities in access to modern technologies, potentially leading to poor academic performance and learning outcomes, particularly in low-income schools and communities. Educators are encouraged, however, to continue exploring VR technology while aligning it with established learning theories that have demonstrated effectiveness in improving learning experiences (Southgate et al., 2019).

Vygotsky's (1978) work has deep roots in socio-constructivism theory, which focuses on social interactions as a driving force behind knowledge construction. It has evolved over time to include language development and to facilitate the generation of individual and collective knowledge (Iba & Burgoyne, 2019). The alignment of socio-constructivism with social interaction and knowledge co-construction principles offers significant potential in VR-enhanced learning environments (Marougkas et al., 2023). Challenges such as ethical concerns and practical constraints (Mystakidis, 2022; Rojas-Sánchez et al., 2023). Educators are encouraged to continue researching VR technology because it has the potential to improve learning outcomes when combined with various learning theories and as VR technologies advance, more accurately replicating real-life situations and interactions (Southgate et al., 2019).

Embodied Learning Theory

In 1989, Mark Johnson, a professor at the University of Oregon, questioned the conventional approach of modern cognitive science, which focused on the structural analysis of acquiring knowledge. Johnson (1989) highlighted that this rigid analysis could limit the explanation of how to acquire knowledge, missing out on how humans experience information and "the way it implies, points, opens up, and transforms itself" (Johnson, 1989, pp. 150). This inquiry paved the path to the emergence of embodied learning which is identified as holistic learning, where learners are engaged in their physical and social environment (Jusslin et al., 2022; Lehtinen-Schnabel, 2022). Empirical evidence in the literature demonstrated a moderate significance on students' foreign language learning outcomes when embodied learning was utilized, promoting learning efficiency and academic performance (Lehtinen-Schnabel, 2022; Zhang et al., 2021). Furthermore, researchers have shown that embodied learning is an essential theory for describing language acquisition because language is a process based on a mix of symbols and sounds that allow users to think and communicate (Lehtinen-Schnabel, 2022; Macedonia, 2019; Zhang et al., 2021).

The use of physical movement in language learning is not a novel approach to language learning (Jusslin et al., 2022). Over the last three decades, foreign language educators have worked to include the human body as an intrinsic element of the language learning process, and numerous theories, such as total physical response, have emerged (Lehtinen-Schnabel, 2022). Since then, literature has supported the integration of such theories and recognized both verbal and physical modes of communication (Jusslin et al., 2022; Lehtinen-Schnabel, 2022). Recognizing this shift in ideas on learning in general, and language education in particular, resulted in what was referred to be a social turn in learning at the time (Jusslin et al., 2022).

Embodied language learning is a contextualized experience that occurs throughout the body, not just the brain. This perspective of language learning also shifted language acquisition from a communicative to a more physical-movement-oriented approach, resulting in a more holistic approach to learning known as embodied learning. Embodied language learning views learners as active participants in actual real-life scenarios in which they participate verbally and physically, stressing their role as social agents engaging in meaningful relationships (Jusslin et al., 2022).

Using gestures and movement to engage the entire body in foreign language acquisition allows learners to activate many senses, encouraging more authentic communication (Lehtinen-Schnabel, 2022). This multisensory physical learning allows the human mind and body to interact, resulting in greater comprehension and retention of the events that occur. This embodiment of foreign language learning enables learners to actively alter the learning environment, hence increasing the value of the learning experience. This physical, spatial, and multisensory learning emphasizes the promotion of various modalities of communication, providing a diverse spectrum of learning and teaching approaches (Lehtinen-Schnabel, 2022). This physical and multisensory approach, which is a key component of embodied learning theory, may be seen in the application of VR in foreign language learning, where learners participate in a physical, spatial, and multisensory learning experience in which they influence their environment and rely on visual and auditory aids found inside the VR-enabled content to communicate in a foreign language (Bahari, 2022).

Embodied learning theory is directly employed in establishing the theoretical basis for incorporating VR in foreign language learning, as it enables the production of realistic interactions that replicate an immersive and authentic setting where a foreign language is spoken

(Al-Jundi & Tanbour, 2022; Bahari, 2022; Bian et al., 2023). Within these immersive environments, the users' body moves naturally, allowing users to manipulate objects through tangible interfaces (Bian et al., 2023). This embodied learning may be produced when two key premises exist. First, the vividness of the environment, which is supported by technology in establishing rich human-sensory interactions through visual, auditory, and kinesthetic aspects. Second, the environment's responsivness to user input. Increased vividness and responsiveness increase the user's engagement and presence with the environment and material displayed (Al-Jundi & Tanbour, 2022).

When using VR to learn a foreign language in conjunction with embodied learning, users develop a mental state in which they vividly remember VR encounters as if they were genuine experiences (Al-Jundi & Tanbour, 2022). This creates a sense of embodied cognition, in which the mind and body interact. Human contact with virtual worlds extends across multiple domains, including the concept of virtuality in our perception of reality. When we interact with virtual scenarios through avatars as personal digital representatives, we develop cognition. This interaction has tangible effects in the virtual world. These digital technologies, like avatars, have the ability to influence behavior outside of VR. Moreover, embracing embodied learning through VR strengthens learners' connection to the educational process by introducing two critical elements: a sense of presence within the virtual realm and a strong personal connection. In essence, virtual reality and embodied learning combine to produce a comprehensive mental environment, facilitating significant learning experiences and altering behavior beyond virtual boundaries (Al-Jundi & Tanbour, 2022).

Studies such as those conducted by Bahari (2022), Bian et al. (2023), and Zhang et al. (2021) added to the assertion that the theory of embodied learning has a wide range of

applications within VR immersive environments. Several popular categories, in these studies, incorporated real-life body movement and physical engagement with the surroundings. They also utilized avatars to portray users, resulting in improved focus, increased environmental awareness, and intense physical presence (Bahari, 2022). The physiological measurements measured by pulse and skin conductance devices corroborate these results and showed lower cognitive load and more fluid and captivating communications that resulted in increased concentration and awareness (Bahari, 2022; Bian et al., 2023; Zhang et al., 2021). This highlighted physical motion in VR substantial) boosted the overall educational experience, as stated by these studies. They also concluded that this could enable individuals to become completely involved and deeply immersed in instructional materials.

Although the theory of embodied learning in general applies to various age groups, it exhibited a stronger effect on learners in kindergarten and university, demonstrating a moderate effect at the elementary, middle, and high school levels, and the outcomes were inconclusive with graduate learners (Zhang et al., 2021). The author asserted, however, that the theory of embodied learning applied to multiple subjects, when technology facilitates it, demonstrated a moderate impact on engineering, science, mathematics, and language. Like numerous other technologies that follow a cycle of being introduced, experimented with, applied, and then widely used, educators must extensively experiment with VR in learning various subjects and evaluate its outcomes before applying it and widely using it (Bian et al., 2023). Educators must also focus on the learner's inner motivation and social interactions, leveraging the features that VR provides in catering to the diverse needs of today's learners and further strengthening the potential of embodied learning in education (Zhang et al., 2021).

In summary, the integration of VR into learning is a multifaceted approach and appears to be grounded in various educational theories. In the field of immersive language learning within VR, learners engage not only with content but also in an interactive environment, constructing knowledge from novel experiences. In accordance with Vygotsky's (1978) work, social interactions, within VR-enabled environments, drive internal competence and language development. Johnson's (1989) embodied learning theory is another significant theory that highlights the theoretical framework of VR-enabled learning environments. According to embodied learning, holistic learning within VR is promoted, leveraging physical movement for authentic communication, and challenging traditional cognitive science.

Related Literature

The subsequent sections of this literature review will explore the existing body of research on the use of VR in educational contexts, with a particular emphasis on its role in increasing learner engagement and presence. This review of literature will delve into the areas of user engagement and presence in VR-enabled environments, with a focus on their application in the field of language acquisition. The innovative integration of VR applications in language learning will be highlighted, with a particular focus on the Mondly VR application. It will also highlight the immense difficulties that educators face when teaching foreign languages in secondary school settings. Importantly, it will investigate the promising opportunities that arise from the use of VR technologies as powerful tools.

User Engagement

Engagement in education encompasses a wide range of learner behaviors and attitudes, including attention, effort, active involvement, curiosity, interest, and enthusiasm demonstrated by learners throughout their learning journey (Chiu, 2021). In the field of education, the concept

of engagement is inextricably linked to Vygotsky's (1978) socio-constructivist theory, which emphasizes the critical role of social interaction and the socio-cultural context in the learning process. Learning, according to Vygotsky (1978), is a collaborative, socially facilitated activity rather than an isolated, individual endeavor. Moreover, the theorist asserted that learners construct knowledge by interacting with more knowledgeable peers or instructors within a cultural context that provides learning tools and resources. In technology-enabled environments, where technology facilitates the process of learning, such as the one in VR, the definition of engagement is no different. O'Brien and Toms (2008) explained user engagement as a state of user experience distinguished by the depth of a user's involvement while interacting within the virtual environment. Regardless of the specific learning context within a VR environment, whether users are interacting with avatars, participating in gamified scenarios, engaging in physical exercises, attending virtual business meetings, or embarking on language learning adventures, the common thread is the significant elevation of user engagement (Chen & Kent, 2020; Irshad & Perkis, 2020; Pyae, 2021b; Singh et al., 2022; Zelenskaya & Harvey, 2019). As discussed in these studies, this increased engagement, characterized by increased attention, sustained effort, active participation, and heightened interest, positions VR as a potent educational tool, creating an optimal environment for immersive and effective learning experiences.

The use of VR in the field of education has the potential to transform the learning experience and the teaching practices (Mystakidis, 2022; Rojas-Sánchez et al., 2023). This potential is driven from the effectiveness of VR in generating authentic, realistic, and stimulating two-way social interactions (Rojas-Sánchez et al., 2023). This is attributed to the immersive nature of VR, wherein learners often actively participate in collaborative problem-solving,

negotiation of meaning, and knowledge co-construction through dialogue with peers or with technology-enabled tools. These observed characteristics harmonize with the principles of Vygotsky's (1978) socio-constructivist theory, highlighting the pivotal role of social interaction in the knowledge construction process. Moreover, when learners are immersed in VR environments, they frequently experience heightened motivation, which stimulates favorable emotional states such as increased attentiveness, positive self-affirmation, and increased social interactions, resulting in more profound, comprehensive, and effective learning (Mystakidis, 2022; Rojas-Sánchez et al., 2023).

There are numerous VR applications that demonstrate the added value of constructing knowledge through social interactions, such as Second Life, a multi-user virtual reality environment and an adaptive platform, where learners interact with each other in an immersive environment, coupled with the use of task-based instruction to enhance second language learning, as indicated by (Chen & Kent, 2020). The authors argued that this can be attributed to the simulation of real-life events, which stimulates spontaneous language use, allowing meaningful collaborative activities, resulting in higher engagement with the content and enhanced oral communication. This interactive learning echoes Vygotsky's (1978) emphasis on the critical role of social interaction in knowledge construction. When learners are engaged in an active interaction negotiating meaning and co-constructing understanding, they gain a deeper and more comprehensive understanding of the target language (Vygotsky, 1978). Moreover, to consistently enhance user engagement and foster advancements in foreign language proficiency, educators must align task-based practices with available VR applications and technologies, a perspective emphasized by Chen and Kent (2020), who also noted that learners often prefer anonymity provided by avatars in VR, enabling them to practice foreign languages without

anxiety. Furthermore, virtual learning environments such as the one found in Second Life, when combined with task-based training, enable educators to challenge learners, presenting a viable method for language teaching and learning (Chen & Kent, 2020; Lim et al., 2022).

A substantial body of literature emphasized a direct correlation between user engagement and improved learning outcomes, particularly within various learning environments that harness VR technology (Boffi et al., 2023; Katz et al., 2021; Lamb et al., 2022; Lei et al., 2022; Li et al., 2022; Tai et al., 2022). This positive correlation, as argued by these authors, can be attributed to VR's adaptability in crafting a wide range of tasks across various academic disciplines. By incorporating engaging multimedia tools and interactive scenarios, the authors believed that users are encouraged to interact with virtual objects, fostering sensorimotor embodiments that significantly contribute to heightened engagement levels and, consequently, more favorable learning outcomes. Moreover, learners embody their learning experiences by manipulating objects, navigating virtual spaces, and engaging in interactive sensorimotor encounters (Boffi et al., 2023; Katz et al., 2021; Lamb et al., 2022).

Navigating the virtual environment, manipulating objects within the virtual setting, and engaging in sensorimotor encounters are learning attributes aligned with Johnson's (1989) embodied learning theory. According to the theory, learners' physical interaction with the learning environment fosters a more profound and meaningful comprehension of knowledge. A positive correlation between user engagement and learning performance in VR scenarios exists with a few limitations. Of these, most notably are the relatively small sample sizes involved in the examination, suggesting that future research should aim to involve more diverse and larger populations to strengthen the robustness of these findings. Doing so would allow researchers to have a broader scope to investigate how various factors, such as gender, age, academic

discipline, and economic and social backgrounds, influence the effectiveness of VR learning environments (Boffi et al., 2023; Katz et al., 2021; Lamb et al., 2022; Lei et al., 2022; Li et al., 2022; Tai et al., 2022).

User Presence

Presence in virtual environments refers to the realistic sense of physical presence experienced by users through their interactions and immersion within these environments, encompassing a psychological state where users feel as if they are truly present in one environment despite physically being in another (Bilgin & Thompson, 2022; De Paolis & De Luca, 2022; Parong et al., 2020; Seedhouse, 2022; Varela-Aldás et al., 2020; Wang et al., 2023). This immersive nature of VR environments is strongly correlated with the level of user presence, resulting in a feeling that is often expressed through self-reporting tools, where users express their sense of being fully immersed in the virtual environment (Varela-Aldás et al., 2023; Wang et al., 2023). This established feeling of presence is facilitated by the integration of sensory information, interactions, and manipulation of the VR environment (Parong et al., 2020; Seedhouse, 2022).

In line with Vygotsky's socio-constructivism, the concept of presence in virtual environments is important for learning facilitation (Bilgin & Thompson, 2021). The constructivist theory of Vygotsky (1978) emphasizes the importance of social interaction in the learning process to construct knowledge. Users can engage in social interactions, exchange ideas, and construct knowledge both individually and collaboratively in virtual environments, thus aligning with Vygotsky's socio-constructivist tenets (Parong et al., 2020; Seedhouse, 2022). The sense of presence, which evokes a sense of “being there,” has the potential to enhance the authenticity of these social interactions, potentially enriching the educational experience in

virtual environments (Bilgin & Thompson, 2021). Similarly, users in VR-enabled environments physically interact with their surroundings, manipulate objects, and engage in activities that go beyond mere mental engagement (Tai et al., 2022). As a result, the enhanced sense of presence in virtual environments complements Johnson's (1989) theory by intensifying the embodiment of the learning experience, providing a holistic and immersive learning environment.

The concept of creating a strong sense of presence in VR-enabled environments has been the topic of several studies such as those conducted by De Paolis and De Luca (2022), Parong et al. (2020), and Varela-Aldás et al. (2023). Achieving the state of "being there" in VR typically involves two essential steps, as addressed by these studies. First, users need to genuinely believe that the VR environment they are in is realistic and plausible. Second, users should feel that they have the agency to interact and make choices within this environment. Effective language learning happens when users perceive and respond to visual and auditory cues within VR, which enhances their sense of presence (Parong et al., 202. Furthermore, there are several factors that play a critical role in increasing user presence in VR environments (De Paolis & De Luca, 2022; Parong et al., 2020; Varela-Aldás et al., 2023). Among these factors, first, the degree of control users have over how they react to what they encounter and how quickly their actions generate responses. Second, the sensory richness of the VR world, as achieved through engaging visuals, immersive soundscapes, and tactile interactions. Third, the consistency of the VR environment and the absence of distracting elements. Taking these three factors into consideration within VR-enabled environments results in more immersive environments and more user experiences that offer a more profound sense of presence, making their virtual adventures even more captivating and engaging (Varela-Aldás et al., 2023).

Incorporating VR into foreign language learning facilitates the development of realistic interactions that authentically replicate immersive and authentic linguistic environs, immersing learners in settings where a foreign language is spoken and thereby offering an unprecedented opportunity for experiential language acquisition (Al-Jundi & Tanbour, 2022; Bahari, 2022; Bian et al., 2023). Importantly, users in these immersive VR worlds engage with the environment through tangible interfaces, resulting in natural bodily movements (Bian et al., 2023). Drawing on Johnson's (1989) embodied learning theory, this technological advancement provides learners with a dynamic and vivid learning environment that promotes rich human-sensory interactions encompassing auditory, visual, and kinesthetic modalities (Al-Jundi & Tanbour, 2022). The effective increase in the vividness and responsiveness of the learning environment, in turn, draws learners into a heightened state of presence with both the virtual environment and the educational content, thereby amplifying the potential for effective language acquisition

The increased use of technology in education has garnered significant attention within the academic community regarding user presence in VR learning environments. Calvert and Hume (2023), Checa et al. (2021), Chiquet et al. (2023), Maclean et al. (2019), and Selzer et al. (2019) highlighted the immersive nature of VR environments as a catalyst for increasing user presence. These studies asserted that the more immersed users feel in a VR setting, the more effective their learning experiences become. They also emphasized that this heightened sense of presence cultivates an environment where learners are deeply engaged and connected with the educational content, fostering enhanced knowledge acquisition and retention.

It is important, however, to consider sensitivity to physical movement, as many studies have reported issues related to vection, which is the perception of rotational movement induced by visual stimulation as discussed by Arcioni et al. (2019), Curry et al. (2018), Li et al. (2018),

Munsinger et al. (2023), and Weech et al. (2018). These studies explained that sensitivity to vection varies among individual users and does not exhibit consistent correlations with factors such as age or gender. Emphasizing the significance of addressing these motion-related factors is crucial to enhance the overall efficacy and user experience of VR-based learning environments. This, in turn, allows educational institutions to strive towards greater inclusivity by ensuring that the benefits of VR learning are accessible to a diverse array of learners, while also mitigating potential discomfort or negative effects associated with motion sensitivity.

User Engagement and Presence in Foreign Language Learning

Evidence that employing VR to increase the engagement of foreign language learners results in greater learning outcomes is limited (Cowie & Alizadeh, 2022; Klimova, 2021; Peixoto et al., 2021). The relatively small body of research in this domain can be attributed to several key factors, with the most important being the significant financial investment required for the development and deployment of VR learning environments, which deters many educational institutions from incorporating such technology into their language programs (Cowie & Alizadeh, 2022; Klimova, 2021). Furthermore, there is a scarcity of specialized expertise required to create effective VR language learning experiences, resulting in the incorporation of VR in foreign language education remains primarily the domain of corporations and commercial entities, with educational institutions frequently experimenting with its use in higher education contexts (Klimova, 2021; Peixoto et al., 2021). Nonetheless, these limitations contrast with the broader landscape of VR adoption in other fields, as discussed by Cowie and Alizadeh (2022), Klimova (2021), and Peixoto et al. (2021), particularly in the healthcare and engineering domains. In these areas, the use of VR to create simulated environments has proven successful. The tangible benefits included improved learning outcomes, increased workplace productivity,

improved job safety, and cost and time efficiencies for remote learning initiatives. The potential inherent in carefully applied and effectively resourced VR technologies provides a compelling argument for further research into VR's utility in foreign language education. Despite current constraints, with the right investment and expertise, VR has the potential to reshape foreign language learning experiences, mirroring the successes seen in other specialized fields where its integration has resulted in tangible benefits (Peixoto et al., 2021).

Similarly, literature on the user presence in VR-enabled foreign language learning appears to be limited, with many of the current studies, such as those conducted by J.C. Chen (2018), C. Chen et al. (2021), Huang et al. (2021), and Parmaxi (2020), arguing that research on the user presence in VR-enabled foreign language learning is experimental in nature, showing promising outcomes that call for further exploration and investigation. Parmaxi (2020) asserted that efforts must be made to advance research in this field. The author discussed named a few including the alignment of the capabilities of VR technology with effective learning and teaching strategies, conducting collaborative and cross-disciplinary research, and sharing experiences among educators, to name a few. These are some of the strategies that can provide valuable insights to promote a more comprehensive and continuous exploration of this topic beyond isolated experiments). Furthermore, although the existing exploration of VR in foreign language learning indicates promising outcomes, most of the research on the user presence in VR-enabled foreign language learning is conducted at the classroom level (Lan et al., 2018). The authors argued that these investigations are not on a large scale. Conducting an all-encompassing investigation, as the authors asserted, would provide a more comprehensive understanding of its true impact and potential for widespread implementation, emphasizing the need for further research to bridge this gap

In recent years, a growing number of researchers have investigated the educational and behavioral impacts of VR in foreign language learning. They studied the effectiveness of VR applications by designing and evaluating various instructional models. Educators and researchers have also attempted to harness VR's potential for augmenting learners' linguistic proficiency and accuracy in the context of foreign language acquisition, particularly in the context of applications like Mondly (Di Natale et al., 2020; Hamilton et al., 2021; Radianti et al., 2020; Repetto et al., 2021; Tai & Chen, 2021). Mondly, a versatile language learning application, facilitates language acquisition in VR environments as well as across conventional platforms such as laptops, desktop computers, and smartphones (Mondly, n.d.). Immersive applications like Mondly have contributed to learners improving their language skills significantly (Radianti et al., 2020; Repetto et al., 2021). This significant improvement was primarily focused on improving listening and speaking skills. The authors argued that the appeal of these applications stems from their ability to create scenario-based educational landscapes with rich audiovisual elements, which has resulted in highly engaging and immersive learning environments. Furthermore, the interactive features of these VR applications allow users to actively participate in the learning process, allowing for a higher level of engagement and presence within these virtual settings. These critical characteristics are consistent with Vygotsky's socio-constructivism (1978) and Johnson's embodied learning theories (1989), both of which emphasize the role of social interaction and physical engagement in knowledge construction and acquisition.

The use of VR-enabled foreign language learning is part of a growing and promising body of literature, demonstrating the potential benefits of immersive environments. Several prominently featured studies in foreign language education collectively bring clarity to the significant increase in engagement and presence that learners experienced when exposed to

immersive VR settings for foreign language instruction (Deng & Yu, 2022; Dhimolea et al., 2022; Hua & Wang, 2023; Peixoto et al., 2020; Symonenko et al., 2020; Zheng et al., 2022). This concept of presence, that aligns with Vygotsky's (1978) socio-constructivism, fosters an environment wherein learners not only interact with the virtual environment but also with peers or instructors. This interaction thereby facilitates interactive foreign language construction that aligns with Vygotsky's (1978) socio-constructivism learning theory. This alignment highlights the role of social interaction in knowledge construction, and further underscores VR's capacity to intensify social engagement, ultimately augmenting foreign language acquisition. Furthermore, the noted increased engagement and presence in VR foreign language learning experiences aligns with Johnson's (1989) embodied learning theory, which states that knowledge acquisition is a physical, sensory and cognitive process. Learners can engage physically and emotionally with the language they are learning because VR-enabled environments are immersive (Jusslin et al., 2022). They can take part in scenarios that simulate real-life language usage, such as ordering food in a restaurant or conversations in everyday situations. This engagement facilitates physical and sensory interactions that improve language acquisition by providing a holistic learning experience. This approach capitalizes on Johnson's theory of the mind-body connection, as discussed by (Jusslin et al., 2022).

VR-enabled language learning in literature appeared in specific languages such as English, Chinese, Spanish, and German, primarily drawing participants from university-level foreign language learners, indicating an experimental rather than an evaluative approach to language education (Peixoto et al., 2020; Symonenko et al., 2020; Zheng et al., 2022). This recurring trend in language learning research indicates that research on the topic has operated outside of the established curricular framework, frequently disconnected from the specific

learning objectives of formal language courses. Despite this trend, research has collectively yielded insights into the increased engagement and presence of learners when exposed to VR-driven language learning environments (Peixoto et al., 2020). This increased sense of engagement and presence highlights VR's immersive potential, though it has not consistently translated into demonstrable improvements in learners' foreign language skills (Peixoto et al., 2020; Symonenko et al., 2020; Zheng et al., 2022). Several factors have contributed to this fluctuating improvement, including the brief duration of these studies, limited sample sizes, the experimental nature of the interventions as opposed to their alignment with established pedagogical objectives, and apparent scarcity of collaborative efforts or the utilization of prior research findings (Peixoto et al., 2020). Nevertheless, despite their experimental nature and methodological limitations, several studies on the topic have highlighted VR's promising potential as a tool capable of reshaping language learning experiences by fostering immersive engagement and prompting learners to bridge the gap between virtual language interactions and real-world communication (Peixoto et al., 2020; Symonenko et al., 2020; Zheng et al., 2022).

Virtual Reality Language Application

Employing VR in language education emerged as a 21st-century learning tool, and the potential for its application in various disciplines, has garnered substantial interest from businesses seeking to invest in innovative educational technologies (Berns & Sánchez, 2020). In a thorough examination of available VR applications, the authors identified a diverse range of tools designed to improve users" listening, reading, and speaking skills while fostering social interactions, with careful consideration of various critical factors guiding their selection process. Among the 17 applications examined, Mondly stood out as a prominent platform offering foreign language instruction in 16 languages, providing learners with an immersive experience that

transcends traditional textbook learning by transporting them into real-life scenarios and delivering immediate corrective feedback to enhance the learning process. Despite acknowledging several challenges inherent in using these applications, Berns and Sánchez (2020) underscored the notable increase in user engagement and presence within these applications, as evidenced by user interactions and the immersive nature of the technology.

A robust body of literature investigates the use of the Mondly VR application in enhancing foreign language learning. This literature indicates that the Mondly VR application is a viable teaching method that harnesses the potential of digital tools reality (Hajizadeh et al., 2023; Kawasumi and Ishii, 2023; Tai and Chen, 2021). The authors argued that Mondly empowered students with language skills at their convenience, providing users with a multimodal environment. The application engages learners through interactive scenarios with the ability to immerse them in a state of reality (Hajizadeh et al., 2023; Kawasumi and Ishii, 2023). This sense of reality allowed users to feel as if they were present in these scenarios. In these scenarios, virtual presence was also effective in reducing cognitive load and anxiety associated with speaking a foreign language, according to the authors. Although the use of the Mondly VR application demonstrated a higher level of engagement and presence with the language, as well as the creation of a student-centered learning experience, the application has a few limitations (Hajizadeh et al., 2023; Kawasumi and Ishii, 2023). Among these limitations is the inability to connect with other users to create collaborative learning opportunities, and the limited number of scenarios available within the application, which can limit learning opportunities.

Mondly VR application includes a mobile version in which users can complete lessons offered in the VR version using a smartphone or a browser (Mondly, n.d.). Several studies, including those conducted by Jensen and Cadierno (2022), Nicolaidou et al. (2021), and Tai et al.

(2020), pointed in different directions regarding the effectiveness of the VR application versus the mobile version. In a study that Jensen and Cadierno's (2022) conducted, students learning vocabulary showed a slight positive difference in learning outcomes when using VR versus the mobile version. These findings were to the intervention design. It allowed learners to use the VR version without restricting attempts to go over the content, potentially allowing learners to repeat the process (Jensen & Cadierno's, 2022). Similar interventions produced comparable results with learning vocabulary when using the Mondly VR application versus the mobile version of the application. Tai et al. (2020) attributed these positive outcomes to the fact that the VR version of the application provided learners with an immersive environment, allowing for real-time interactivity and immediate feedback. Moreover, the authors argued that this potentially led to an increased knowledge construction. On the other hand, Nicolaidou et al. (2021) found unfavorable results and concluded that, while the VR version of the application provided learners with immersive environments, the use of the mobile version produced similar results, indicating that both VR and mobile versions are relatively effective in increasing learners' vocabulary of the foreign language. These findings are consistent with those of J.C. Chen (2018), C. Chen et al. (2021), Huang et al. (2021), and Parmaxi (2020), demonstrating that the research in this field is experimental in nature. They do, however, show promising results that warrant further exploration and investigation.

ImmerseMe and Virtual Speech are two other language learning applications that literature addresses. ImmerseMe, the VR language application, is an immersive application that provides 360-degree video scenes in nine languages and allows the learner to interact with a person via automatic speech recognition to carry out conversion in a real-life scenario while receiving immediate feedback, allowing learners to simulate being in these culturally authentic

environments (Berti, 2020). The Virtual Speech application, on the other hand, is a language application that allows users to communicate in more than 40 VR 360-degree video scenarios, allowing them to practice speech and receive feedback based on eye contact and speed (Berns & Sánchez, 2020). ImmerseMe helped users increase their word order structure, lexicon, grammar, and spelling found an improvement in their performance and an improvement in their foreign language proficiency (Pitarch & Gong, 2021). Limited research exists on these applications, including Mondly VR application due to various (Huang et al., 2021; Peixoto et al., 2021; Shadiev & Yang, 2020; Southgate et al., 2019). Among these factors is the lack of subject matter expertise in this area.

Mondly, ImmerseMe, and VR Speech all share two characteristics that have been demonstrated in recent research, which are the increased engagement with digital avatars and the creation of a sense of presence within realistic virtual environments that mimic real-life situations (Jensen & Cadierno, 2022; Nicolaidou et al., 2021; Tai et al., 2020). These characteristics are consistent with foundational educational theories, particularly Vygotsky's (1978) socio-constructivist framework and Johnson's (1989) embodied learning theories. Both theoretical perspectives emphasized the importance of social interaction and physical engagement in knowledge construction and acquisition processes. The interactive nature of these language learning applications, which involve interaction with digital avatars, corresponds to Vygotsky's (1978) essential principle that knowledge is constructed and solidified through social interaction. Interactions with virtual language avatars guide learners in these applications (Peixoto et al., 2021). Johnson's (1989) embodied learning theories, on the other hand, expanded on this viewpoint by emphasizing the significance of bodily engagement and sensorimotor experiences in learning. These applications' two-way interactions, in which users interact with

digital avatars through speech and actions, immerse learners in a multisensory learning experience, creating a sense of presence in realistic virtual environments and increasing the embodied nature of the learning process, allowing learners to perceive language acquisition as a holistic and experiential experience (Tai et al., 2020).

Foreign Language in Secondary Education

Over the past three decades, there has been a substantial increase into the United States of an immigrant population who speak a language other than English at home. This population has nearly tripled in size, going from 23.1 million in 1980 to 67.8 million in 2019 (US Census Bureau, 2022), implying that one out of every five people now falls under this group, this is up from one in every ten in 1980. This linguistic diversity, however, is not effectively reflected in US classrooms in terms of emphasis on the importance of speaking a second language (Stein-Smith, 2021). Several factors contribute to this lack of diversity, including U.S. immigration policies (Von Esch et al., 2020), the shortcomings in teacher education, (Huhn & Davis-Wiley, 2023), and the premature language pedagogical approaches and practices (Stein-Smith, 2021).

The U.S. immigration policy and the shortcomings in teacher education appear to be interwoven in terms of impact. A more diversity-oriented policy could result in more funding and support for teacher education, as noted by Stein-Smith (2021). Moreover, Stein-Smith (2021) also pointed out that the absence of effective language educational resources, however, could be remedied through additional research and examination of language-diverse cultures, such as those found in Europe. Moreover, the author emphasized that foreign language educators are at the center of this surge in foreign languages impacting US communities and, as a result, the education system. This has led educators, on their own initiative, to advocate for professional groups and institutional and local communities to develop successful foreign language teaching

practices. When comparing language learning in the United States to other comparable countries, such as those in Europe, the United States falls behind where there is no official language or an emphasis on learning a language (Huhn & Davis-Wiley, 2023).

A substantial number of high school language programs in the United States exist. These programs reflect the importance of language education and the effort put into providing students with language learning opportunities. Most States have less than 25% participation, with only 9% of students studying a foreign language in New Mexico, Arizona, and Arkansas (American councils for international education, 2017). Furthermore, according to the same report, 10 States and the District of Columbia have foreign language graduation requirements for high school students, 24 have graduation requirements that can be met with foreign language classes or other non-language coursework, and 16 have no graduation requirements for foreign language education, resulting in many students graduating from high school at beginner and fewer at intermediate levels proficiency level. If the United States had a policy that encouraged or required students to learn additional languages, many K-12 students would enroll in foreign languages, leading to increased motivation and engagement in language learning, and resulting in a greater number of students arriving at college with higher proficiency levels (Stein-Smith, 2021).

The lack of effective policies for learning a foreign language, combined with ineffective teaching, and learning practices, has resulted in frequent language classrooms devoid of engagement. Current teaching and learning practices emphasize attentive listening, careful reading, and accurate vocabulary and grammar through tasks (Oga-Baldwin, 2019). These approaches, however, cause even motivated learners to fail to complete these tasks. Even if teachers recognize the nature and scope of engagement, they often lack the ability to recognize

when and how to motivate learners, Oga-Baldwin (2019) asserted. Learning that promotes learner activity rather than passivity is critical to achieving learning outcomes, and engaging learners in games, enjoyment, and communication has a far more significant impact on their outcomes. The primary reason is it creates a space for learners to act and interact with the foreign language to achieve the learning objectives (McEown &Oga-Baldwin, 2019 & Oga-Baldwin, 2019).

Foreign language education in the United States presents complex and multifaceted challenges and opportunities (Stein-Smith, 2021; Von Esch et al., 2020). While there are certainly dedicated foreign language educators advocating for change and improvement in their communities, an obvious disparity is present (Stein-Smith, 2021). In view of these challenges and opportunities, a compelling case for rethinking language education policies in the United States, comparing language education in the United States to countries such as those in Europe (Stein-Smith, 2021; Von Esch et al., 2020) prevails. Meanwhile, to have a significant influence on outcomes, current teaching and learning practices must seek effective ways to encourage active participation, enjoyment, and communication in the learning process (McEown and Oga-Baldwin, 2019 & Oga-Baldwin, 2019). The authors emphasized characteristics of effective language learning that can be found in Vygotsky's (1978) socio-constructivism and Johnson's (1989) embodied learning theories. Both theoretical perspectives emphasized the importance of social interaction and physical engagement in knowledge construction and acquisition processes. Technologies such as VR make these characteristics more affordable (Peixoto et al., 2020; Zheng et al., 2022).

Foreign Language Teachers' Attitudes Towards VR

The use of technology in educational settings has increased significantly in today's classroom, with its potential to improve teaching and learning experiences attracting considerable attention (Rahayu & Wirza, 2020). The success of VR in language classrooms, however, is dependent on the attitudes and perceptions of the educators in charge of its implementation (Al-Nuaimi & Al-Emran, 2021). The research on foreign language teachers' attitudes toward using technology in their teaching practices is divided into proponents who advocate for its use and opponents who express reservations or opposition to its use. Several influential factors contribute to the educational community's division on the use of technology (Al-Nuaimi & Al-Emran, 2021; Bower et al., 2020). Among these significant factors is the uncertainty surrounding whether technology truly provides tangible benefits to educators or merely introduces distractions in the form of gadgets for learners. Furthermore, an ongoing debate about the extent to which technology is necessary and the extent to which it may potentially supplant or diminish the roles traditionally held by educators is prevalent (Al-Nuaimi & Al-Emran, 2021).

The use of VR is a promising technological innovation that can provide learners with immersive and interactive experiences that have the potential to revolutionize foreign language education (Bower et al., 2020). Language educators who are tech-savvy discovered that VR-enabled learning opportunities allow them to take students to immersive environments that would otherwise be difficult to achieve with limited resources (Bower et al., 2020). The use of VR appealed to students more than teachers because of its novelty. However, this novelty promoted engagement, which educators found promising if it focused on the pedagogical potential of the technology (Cooper et al., 2019). On the other hand, a nearly equal number of

language educators had trouble understanding how to connect the use of technologies such as VR to pedagogical principles and frequently claimed that technology could distract students rather than attract them toward learning (Al-Nuaimi & Al-Emran, 2021; Bower et al., 2020; Cooper et al., 2019). For educators, the use of VR could represent a considerable shift. Given the promising literature on the use of VR to improve foreign language proficiency, stakeholders must provide professional development opportunities for language educators to experience the value of incorporating such technologies into their classrooms (Cooper at al., 2019).

The global spread of COVID and the shift to online learning provided an opportunity for educators to recognize the value of a variety of technologies, including VR (Asad et al., 2021). Although VR can provide learning opportunities remotely, many researchers on the topic have demonstrated that most VR-enabled learning opportunities are in-person and come at a cost that most public-school systems in the country cannot afford, especially with the growing number of students in these schools (Mystakidis & Christopoulos, 2022). This brings the discussion back to the fact that policymakers should prioritize foreign language learning, especially given the growing number of foreign languages spoken at home (US Census Bureau, 2022). The shift in emphasis toward foreign language learning will ultimately result in more funding for language teachers' education and professional development opportunities, as well as funding for the use of cutting-edge technologies that provide learners with student-centered learning opportunities (Stein-Smith, 2021).

The role of language teachers in implementing technologies such as VR in their classrooms is significant and could lead to positive actions by stakeholders in terms of funds and resources (Al-Nuaimi & Al-Emran, 2021). The discomfort that teachers experience when using technology in the classroom is gradually diminishing in an age of artificial intelligence,

smartphones, and mobile applications (Culp-Roche et al., 2020). It is important to acknowledge, however, that some of the discomfort teachers feel with the use of technology could be generational and is influenced by the teachers' experiences with these technologies. This generational shift led to changes in teaching models and approaches, necessitating teachers to continue experiencing these technologies through training or professional development opportunities (Al-Nuaimi & Al-Emran, 2021; Culp-Roche et al., 2020; Williams, 2019).

Foreign language learners, on the other hand, have consistently shown a positive attitude toward the use of VR in foreign language learning (Tai et al., 2020). This perception, when compared to traditional learning methods, foreign language learners found VR to be more enjoyable, motivating, and conducive to learning. This increased engagement can be attributed to the immersive nature of VR-enabled learning environments, which are supported by more realistic environments where learners can learn and practice the new language, receiving immediate feedback that can be critical in increasing learners' proficiency and accuracy (Li et al., 2022; Tai et al., 2022). This realistic learning experience allows learners to construct knowledge through interactions, allowing them to participate actively in the learning process, resulting in improved learning outcomes. This disparity in learners' and educators' perceptions of using VR in learning and teaching foreign languages necessitates additional research to add to the body of literature on the effectiveness of using VR as a pedagogical approach to increasing foreign language proficiency, offering innovative learning, and teaching methods that meet the needs of today's learners (Al-Nuaimi & Al-Emran, 2021; Culp-Roche et al., 2020; Williams, 2019).

Summary

The use of VR in language education has emerged as a promising tool for the 21st century of learning (Berns & Sánchez, 2020). Several learning theories support the use of VR in

language learning. As discussed by Vygotsky (1978) and Johnson (1989), the shared characteristic of interaction in social environments and embodied learning leads to the construction of knowledge. Interaction, as described by Vygotsky and Johnson, is a critical component of VR-based learning and is frequently found in learners' engagement and presence with the learning experience. Researchers on this topic have consistently demonstrated that VR technology improves user engagement and presence, resulting in more effective learning experiences (Boffi et al., 2023; Katz et al., 2021; Lamb et al., 2022; Lei et al., 2022; Li et al., 2022; Tai et al., 2022).

According to American councils for international education (2017) a pressing issue in the United States is the lack of diversity in foreign language education Stein-Smith (2021). This challenge has been exacerbated by factors such as immigration policies, teacher education, and pedagogical practices (Huhn & Davis-Wiley, 2023; Stein-Smith, 2021; Von Esch et al., 2020). While many high school language programs exist throughout the country, most States have low participation rates, and graduates' language proficiency levels remain constrained (Stein-Smith, 2021). Rethinking language education policies, encouraging active learning practices, and considering the successes of language education in other countries, particularly in Europe, could help address these challenges and improve language education in the United States (McEown and Oga-Baldwin, 2019 & Oga-Baldwin, 2019). The integration of VR technologies, for example, can address a few of these issues by creating interactive, engaging environments that meet the needs of 21st-century language learners. The success of such technologies, however, is still dependent on the attitudes and perspectives of foreign language teachers, necessitating teachers to continue experiencing these technologies in order to match learners' enthusiasm for using these technologies (Al-Nuaimi & Al-Emran, 2021).

CHAPTER THREE: METHODS

Overview

The purpose of this quantitative, quasi-experimental nonequivalent control group study is to examine whether a statistically significant difference exists in the engagement and presence of high school students when exposed to foreign language content through VR, compared to those without such exposure. This chapter begins by introducing the study's design, including complete definitions of all variables. The research questions and null hypotheses follow. The participants, setting, instrumentation, procedures, and data analysis plans are presented.

Design

This study employs a quantitative, quasi-experimental nonequivalent control-group design to investigate whether the use of VR would significantly influence the presence and engagement of high school students when learning a foreign language compared to traditional methods of learning. Utilizing a quasi-experimental nonequivalent control-group design enabled the researcher to assess the intervention's effects while retaining the flexibility to manipulate variables, unencumbered by the necessity of employing random participant selection (Gall et al., 2007). In this study, the independent variable is the use of VR within foreign language learning. The dependent variables are the scores of the participants' engagement and presence with the learning materials.

The analysis of data generated from presence and engagement questionnaires, using a quantitative research approach, would provide empirical insight into the effect of VR on high

school students' engagement and presence. Determining if there is a statistically significant difference using these technologies might lead to comparable learning outcomes to those found by Boffi et al. (2023), Katz et al. (2021), Calvert & Hume, 2023, and Chiquet et al., 2023. Quasi-experimental nonequivalent control-group research design involves treatment and control groups, which according to Gall et al. (2007), greatly strengthens the internal validity of the experiment. Moreover, this research design allows researchers to work within the constraints of the educational system. The non-random assignment of participants in this specific design is particularly appropriate to the scope of this study. Given the context in which students are assigned to multiple classes, the feasibility of selecting classes and applying experimental intervention with one and traditional approaches with the other is evident. Therefore, the researcher selected two classes for each grade level. A treatment group was exposed to learning the foreign language through VR, while the other class utilized conventional methods of learning, and then observed the outcomes of the experiment.

The researcher selected a quantitative quasi-experimental nonequivalent control-group research design because the study calls for empirical evidence of whether the use of VR can increase high school students' presence and engagement with foreign language content. According to Gall et al. (2007), the use of experimental studies is commonly used in education. This type of study allows researchers to involve the participants in the manipulation of a single treatment followed by observing the effects of this treatment on one or more dependent variables. Furthermore, the use of experimental research designs in educational research is rapidly increasing, resulting in policy changes and the conversion of education techniques to more contemporary practices that meet the needs of today's learners (Gall et al., 2007). The nature of this study necessitated an experimental design that allowed the researcher to investigate

the application of VR in foreign language acquisition, a subject in which literature is limited (Chen, 2018; C. Chen et al., 2021; Huang et al., 2021; Parmaxi, 2020). In similar studies exploring the efficacy of VR in enhancing learning, Arents et al. (2021), Nicolaidou et al. (2021), and Weser et al. (2021) employed a quantitative quasi-experimental nonequivalent control-group research design wherein they manipulated a singular treatment, subsequently observing its effects on one or more dependent variables. This experimental approach, which is shared by these studies, allowed for a more focused examination of the impact of VR interventions on learning outcomes, providing valuable insights into their potential.

Research Question

The following research question guides this quantitative study:

RQ: Is there a difference in high school students' engagement and presence scores when using virtual reality to learn a foreign language?

Hypothesis

The null hypothesis for this study is:

$H_0$1: There is no difference in high school student's engagement and presence scores when using virtual reality to learn a foreign language as measured by User Engagement Scale and Presence Questionnaire.

Participants and Setting

The study examined the presence and engagement scores of high school students, who attended a high school in the southeast region of the United States. To protect the privacy of all involved parties, pseudonyms are used throughout the study. The population, participants, sample procedure, and setting will be described in this section. This section discusses the demographics of the study population, outlines the participants' characteristics, elaborates on the

sampling process, and delineates the study's context and environment.

Population

The research participants were sourced from a private school located in the southeastern region of the United States, studying during the second semester of the 2023-2024 school year. According to the data posted on the school's website for the school year 2022-2023, the school caters to a student population of 450. The curriculum at this school includes foreign language instruction in Spanish, French, and Latin

Participants

The researcher used convenience sampling to identify a sample of 160 participants, which exceeded the required minimum when assuming a medium effect size. According to Faul et al. (2009), 158 participants is the required minimum for MANOVA with two groups and two dependent variables when assuming a medium effect size with a statistical power of .7 at the .05 alpha level. The participants were selected based on their enrollment in Spanish, French, and Latin courses. The researcher collaborated with the school's principal, world language department chair, technology director, and foreign language teachers. This study was introduced to all parties involved, which required approval from the technology director to obtain access to the selected school's Wifi network. All parties participated voluntarily but every party involved in the study was enthusiastic about the potential benefits of using such technologies to improve foreign language learning.

The sample was drawn entirely from a single high school in the selected school district. Participants ranged in age from 14 to 18. The sample of this study was divided into two groups: the treatment group and the control group. The treatment group was exposed to foreign language content via a VR application, participating in interactive lessons supported by an AI within real-

life scenario-based instruction. The control group, on the other hand, went through an identical curriculum utilizing traditional instruction. Each group consisted of 79 participants.

Setting

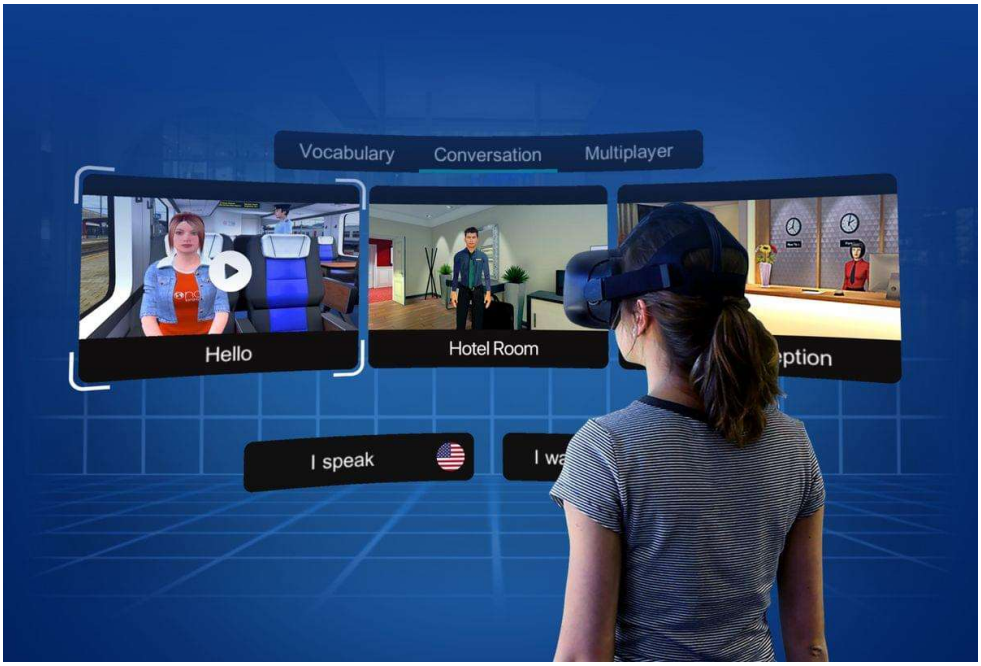
The sample was drawn from one school in the southeast region of the United States. Participants for this study were drawn from 9^{th}-12^{th} grades in the second semester of the school year 2023-2024 of the participating high school. Each student was placed either in a treatment group (learning Spanish or French using VR) or a control group (learning Spanish, French, or Latin using traditional methods). Participants in the treatment group received 4 sessions of foreign language lessons using VR wearing a VR headset and interacting with the learning environment with controllers (Figure 1). The control group received the same lessons but using the mobile-based version of the lessons (Figure 2). The format for these interactions is in-person at the school's language classroom, using VR Oculus Quest 2 to participate in scenarios based on the proficiency level described in a foreign language application called Mondly. Participants who are in the control group will receive the same scenarios using the mobile-based version of the lessons using an iPad.

Oculus Quest 2 is "developed by Meta Platforms Inc., immerses the user in a completely simulated environment. Some VR environments can be shared over the Internet to allow users to communicate and interact with one another and share their experiences." (Raymer et al., 2023, p.2). Each participant in the treatment group will receive a headset and two controllers to immerse themselves in simulated scenarios that offer clear visual representation, refined haptic feedback, and increased precision (Meta, n.d.). This allows participants to interact with virtual

environments with ease. The headset also includes audio technology, which adds an auditory experience that replicates real-life scenarios.

Figure 1

Player wearing a VR headset interacting with AI in Mondly VR application. The visual as seen by the reader is identical to the user's view in the headset.



Note. Mondly, n.d., https://www.mondly.com/vr

Figure 2

Desktop version of the application Mondly. A user interacts through interactive exercises that leverage various multimedia elements such as audio, visuals, and interactive exercises.

Note. Mondly, n.d., https://www.mondly.com/vr

Instrumentation

The User Engagement Scale (UES) developed by O'Brien and Toms (2008) and Presence Questionnaire (PQ) developed by Witmer and Singer (1998) are the two instruments used in this study. The authors granted permission for their use through email. (Appendix A for the UES and PQ and Appendix B for a copy of the permission emails.)

User Engagement Scale

The User Engagement Scale (UES) developed by O'Brien and Toms (2008) to measure the engagement of participants when using a form of technology. User engagement (UE), as defined by the authors as "a quality of user experience characterized by the depth of an actor's cognitive, temporal, affective and behavioural investment when interacting with a digital system" (p.29). This characteristic is measured by the depth of the user's cognitive, temporal, affective, and behavioral engagement when using these technologies (O'Brien & Toms, 2008). The objective of creating a scale to measure a user's engagement was to first construct a definition of engagement and its components by evaluating and assessing previous studies on

engagement and its applications. Then, based on human-computer interaction theories, create a model of user engagement. O'Brien and Toms's (2008) research produced the first version of the UES, which was modified in subsequent studies for broad usage (O'Brien, 2016: O'Brien et al., 2018). This scale was designed to evaluate four factors that affected the engagement of a user when interacting with a digital system. These factors are: Cognitive, temporal, affective, and behavioral. These factors presented as subscales on the UES as follows: aesthetic appeal, focused attention, perceived usability, and reward.

The instrument was used in numerous studies (e.g., Bitrián et al., 2021; Flavián et al., 2021; García-Jurado et al., 2021) concluding that the range of using this scale is wide and includes several domains. On the UES, the four factors are: aesthetic appeal (AP), where the user feels engaged through the interface's visual and sensory aspects, focused attention (FA), where the user feels absorbed in the interaction and loses track of time, perceived usability (PU), where negative effects may affect the interaction and the degree of control, aesthetic appeal, where the user is drawn to the visual appeal of the environment, and reward factor (RW), where a user is motivated by the gains of reward upon completing tasks. Scores for each of the four factors can be calculated by adding the values of responses for the three items contained in each factor and dividing them by three (O'Brien & Toms, 2008). The instrument is robust and demonstrates a high internal reliability for the four factors. These factors appear as subscales on the UES: aesthetic appeal, focused attention, perceived usability, and reward. The Cronbach alphas values for these subscales are 0.82, 0.86, 0.84, and 0.81, respectively (O'Brien & Toms, 2008).

To measure each factor, the authors of the scale created three questions for each factor resulting in a 12-question five-point Likert scale that ranged from Strongly Agree to Strongly Disagree. Responses were as follows: Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2,

and Strongly Disagree = 1. The combined possible scores on the UES range from 12 to 60 points. A score of 12 indicates the lowest possible outcome, suggesting that participants didn't perceive VR as immersive, enjoyable, attractive, or rewarding. As a result, their engagement in learning while using VR was limited. A score of 60 points indicates the highest possible outcomes, suggesting that participants perceived VR as immersive, enjoyable, attractive, or rewarding. As a result, their engagement in learning while using VR was significant. The instrument will be provided to students upon completion of the intervention sessions. The survey will be administered by the researcher with the assistance of a teacher. The researcher will collect the documents and score the results once the survey is completed. Scale scores are calculated for each participant by summing scores for the items in each of the four subscales and dividing by the number of items. The estimated time for participants to complete the UES is determined by individual reading speed and thoughtful response consideration. It should take between 10 and 15 minutes on average.

Presence Questionnaire

This study used the Presence Questionnaire (PQ) developed by Witmer and Singer (1998) to measure the presence of participants when using a form of technology. The authors defined Presence "a psychological state of "being there" mediated by an environment that engages our senses, captures our attention, and fosters our active involvement" (p. 298). The authors concluded that four main factors play a role in developing the state of presence when experiencing a situation. These factors are involvement, adaptation/immersion, sensory fidelity, and interface quality. These factors appear on the PQ as: degree of control, environment richness, distraction, and scene realism (Witmer & Singer, 1998).

Numerous studies conducted by Schwind et al. (2019), Selzer et al. (2019), and Servotte

et al. (2020) have used the PQ instrument, confirming its reliability and validity. The set of 24 questions displayed high consistency with a Cronbach's alpha score of 0.91. In terms of the factors, the first factor (degree of control) accounted for the 31.9% of the variance, the second (environment richness) accounted for 8.8%, the third (distraction) for 6.5%, and the fourth (scene realism) for 5% (Witmer & Singer, 1998). The PQ covers many aspects of presence in virtual environments to provide an in-depth measure. Researchers use this instrument to measure the participant's perception of the treatment by reporting on the virtual environment sensory and control interfaces, how involved are they through the experiment, the quality of the involvement, how quickly they respond and adjust to the experiment, which are essential elements of measuring user's presence in a virtual environment.

The instrument includes 24 statements, where students report their answers on a seven-point Likert scale that ranges from Not at All to Completely. Responses depends on the statements, and described as follow: Not at all, Somewhat, and Completely, Extremely Artificial, Borderline, Completely Natural, Not Consistent, Moderately Consistent, Completely Consistent… etc. Scores for each of the four factors can be calculated by adding the values of responses for the three items contained in each factor and dividing them by number of questions. The combined possible scores on the PQ range from 00 to 168 points (Witmer & Singer, 1998). A score of 00 signifies the lowest possible outcomes, indicating that participants using VR faced challenges in controlling their virtual surroundings. The environment lacked depth, was distracting, and lacked realism. As a result, their presence in learning while using VR was lacking. A score of 168 points indicates the highest possible outcomes, suggesting that participants using VR exhibited a noteworthy level of control over their virtual environment. The environment was immersive, minimally distracting, and accurately simulated a real-life setting.

Consequently, their sense of presence during VR-based learning was substantial.

The instrument will be provided to students upon completion of the intervention sessions. The survey will be administered by the researcher with the assistance of a teacher. The researcher will collect the documents and score the results once the survey is completed. Scores for each of the four factors can be calculated by adding the values of responses for the three items contained in each factor and dividing them by six. The estimated time for participants to complete the PQ is determined by individual reading speed and thoughtful response consideration. It should take between 10 and 15 minutes on average.

Procedures

This study involves human participation; therefore, the researcher obtained permission from Liberty University's Institutional Review Board (IRB) (see Appendix C for approval). The IRB's approval allowed the researcher to move forward and request approval from the selected school district to conduct research at the selected school (see Appendix D for approval) The researcher provided each student with a parent's permission form to sign to be able to participate. In the parent's permission form, the researcher explained that participation is voluntary, confidential, and will not require either the parents or school to pay any obligatory fees for the use of VR (see Appendix E) for a copy of the parents' permission form. Once all parents' permission forms were collected, the researcher provided the students from both groups with the UES and PQ to complete. Both treatment and control groups completed the same forms at the end of the experiment.

The researchers also provided training on the use of VR to teachers. This included four sessions, addressing the safety required to use the VR, operating the headsets, accessing the program and lessons, and troubleshooting needed. Lessons are designed based on students'

foreign language proficiency level. Teachers select the proficiency level tailored to students using the setting option in Mondly VR application. Please see figure 1.

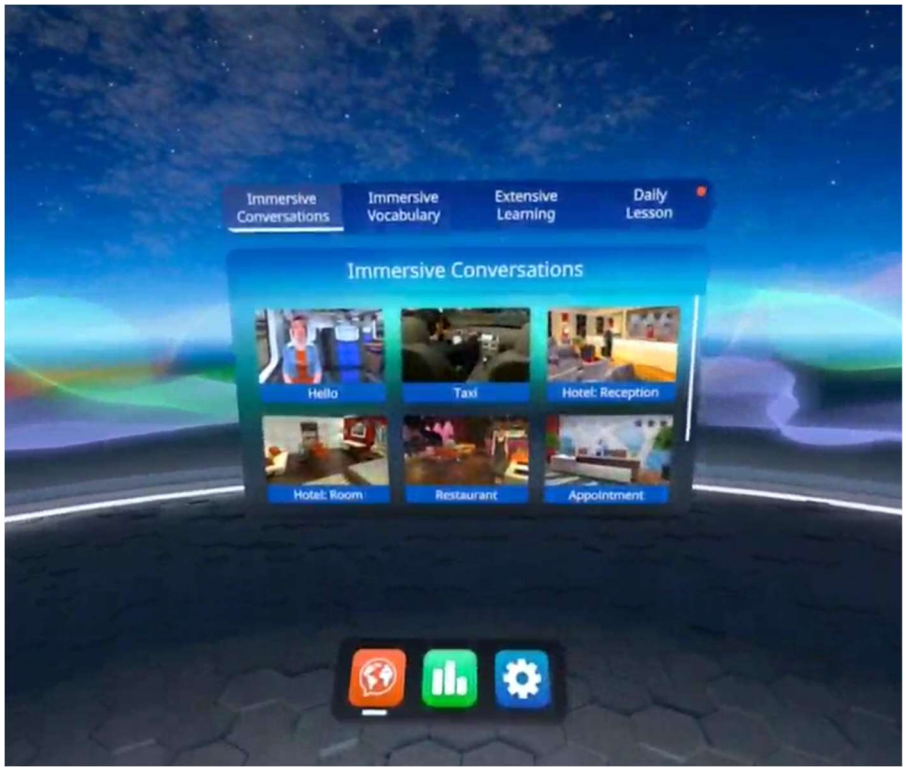
Figure 1

Selection of language proficiency level and other settings tailored to participants.

Note. Oculus, n.d., https://www.oculus.com/casting

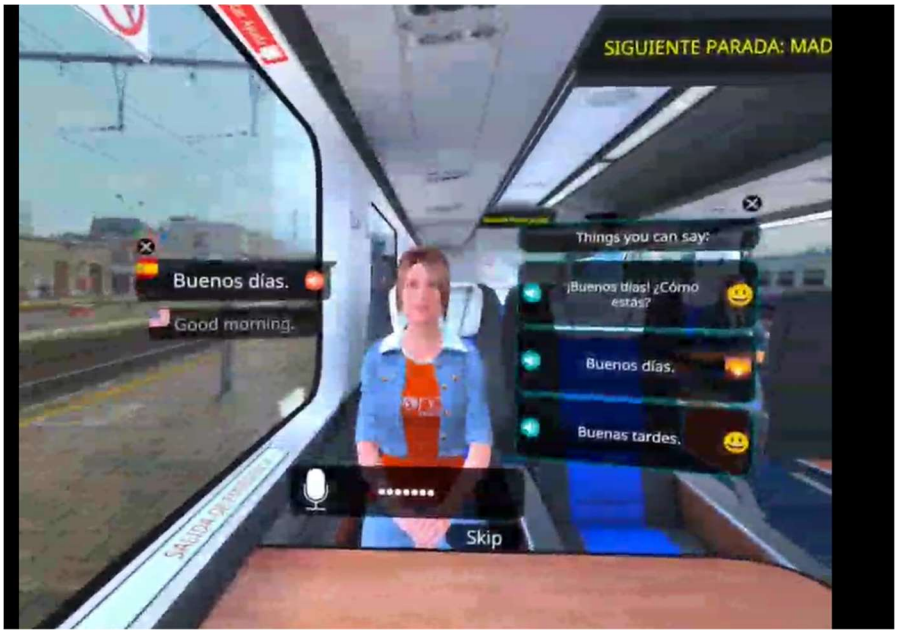
Lessons offered four options for teachers and students to select from. These options included immersive learning, immersive vocabulary, extensive learning, and daily lessons. See figure 2. Based on the students' needs and the course objectives, teachers selected immersive learning and extensive learning. Immersive learning provides students with scenario-based learning. See figure 3. Students interacted with two scenarios and were selected by the teachers. Extensive learning guided by an avatar operated using artificial intelligence. See figures 4 and 5. Students interacted with two lessons and were selected by the teachers.

Figure 2



Note. Oculus, n.d., https://www.oculus.com/casting

Figure 3



Note. Oculus, n.d., https://www.oculus.com/casting

Figure 4

Note. Oculus, n.d., https://www.oculus.com/casting

Figure 5

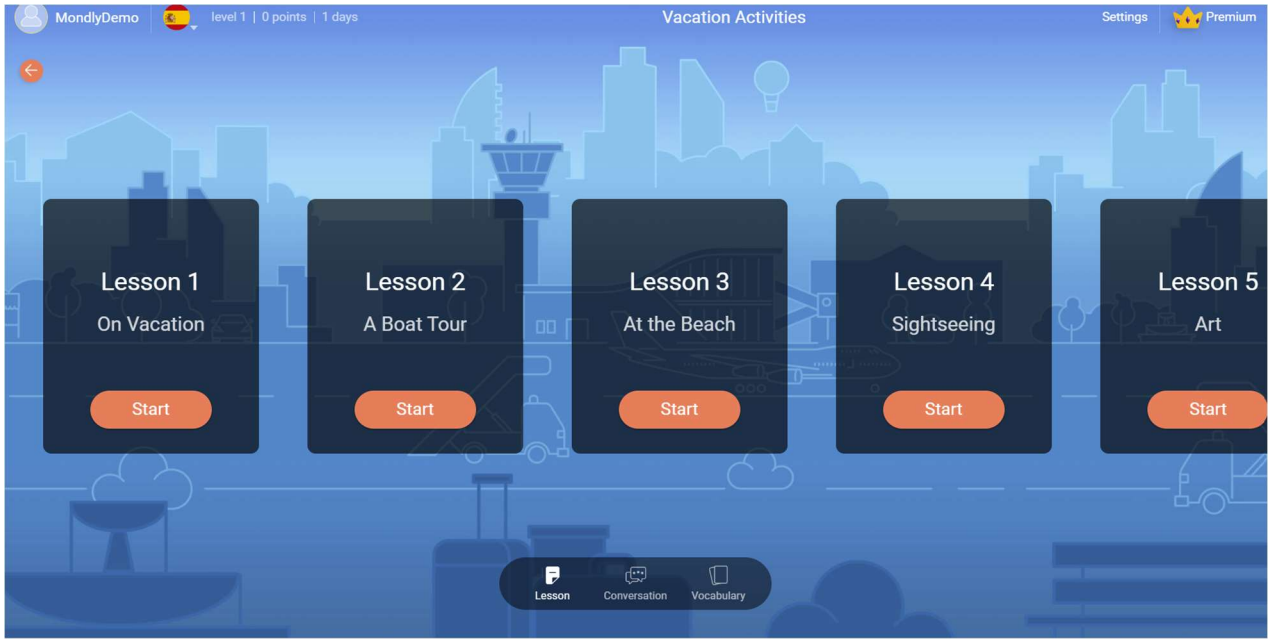
Note. Oculus, n.d., https://www.oculus.com/casting

The treatment group received four sessions of content in Spanish tailored to the student's proficiency level, where the participants were interacting with the content using Mondly VR lessons. The control group received the same lessons but using computer-based instruction as opposed to VR. See figure 6. The computer-based lesson includes several interactive lessons. See figures 7 and 8.

Figure 6

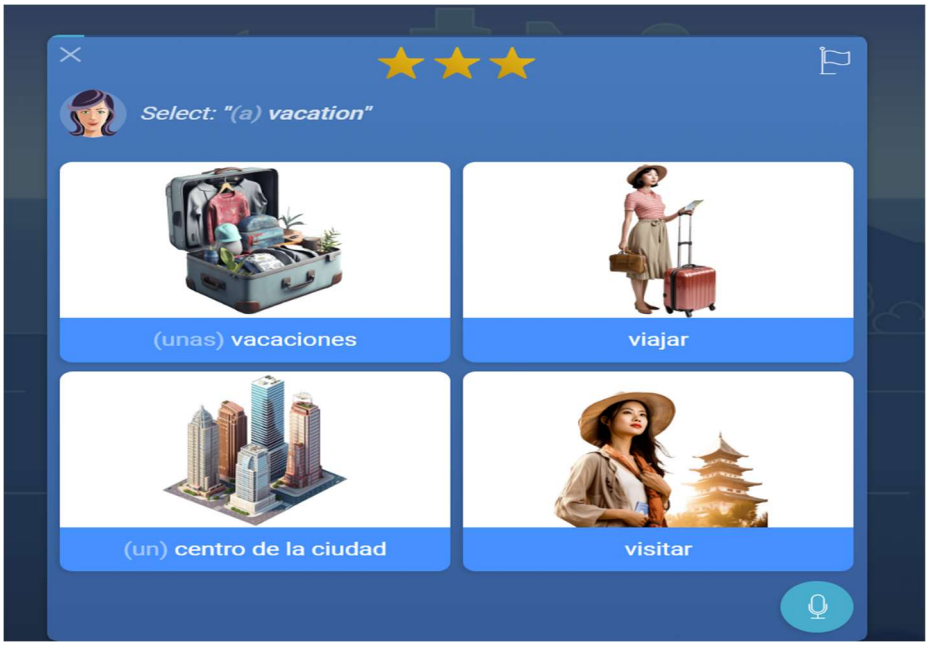
Note. Mondly, nd. https://app.mondly.com/home

Figure 7



Note. Mondly, nd. https://app.mondly.com/home

Figure 8



Note. Mondly, nd. https://app.mondly.com/home

On conclusion of the sessions, the participants from both groups completed the UES and

PQ. Each participant received a hard copy of both instruments, the UES and PQ. Once the students completed the forms, the researcher collected the forms, scanned them at the end of the day, and uploaded them in a secure data file storing system. The researcher employed measures to maintain participant confidentiality and anonymity throughout all phases of data collection. The researcher also used safeguarding methods to secure any personally identifiable information. The researcher's security precautions were preserved by allowing the researcher exclusive access to the stored material. These files were saved on a computer with password protection, within a secure file that was likewise password protected. When the data was not actively being accessed, the password-protected file was safely closed and the computer was locked, providing an additional degree of protection. Following the completion of the research project, the data will be kept for five years in accordance with known best practices.

Data Analysis

The hypothesis of this study was tested through a one-way multivariate analysis (MANOVA). The use of a MANOVA allowed the researcher to examine whether there is a statistical difference in the scores of presence and engagement of high school students who use VR when learning Spanish to those who do not. According to Gall et al. (2007), a MANOVA allows researchers to determine whether groups differ on more than one dependent variable and provide empirical insight from multivariate perspectives. The researcher opted to use the MANOVA as this statistical analysis is the most suitable statistical analysis for differentiating the means of two groups (treatment and control) (Gall et al., 2007). Each participant received a score for each dependent variable (engagement and presence). These scores allowed the researcher to calculate the mean of each group and compare them to identify any significant

difference in means. According to Gall et al. (2007), the purpose of using a MANOVA is to determine whether these two groups differ significantly from each other.

The researcher tested the linear relationship between the dependent variables for each group of the independent variable by plotting and visually inspecting. The researcher also created scatterplot matrices for each group of the independent variable to detect if there is a linear relationship. To confirm the assumption of no multicollinearity, the researcher tested this assumption by running Pearson correlations between the dependent variables for each group of the independent variable. The researcher tested to identify univariate outliers first by examining boxplots of each dependent variable per each of the independent variable groups. Then tested to identify multivariate outliers using Mahalanobis distance. These tests met the assumption of no univariate or multivariate outliers. The Shapiro-Wilk test for normality was used to confirm meeting the assumption of multivariate normality. Finally, the Box's M and Levene's tests were conducted to meet the assumptions of homogeneity of variance-covariance and homogeneity of variances, respectively. Moreover, a MANOVA was used to assess the null hypothesis regarding the effects of VR on learning a foreign language among high school students. The alpha level for hypothesis testing in this study was set at $p < .05$. The researcher reported eta squared as the effect size. A post hoc analysis was conducted to examine the specific, individual differences among groups.

CHAPTER FOUR: FINDINGS

Overview

This chapter begins with the research question and null hypothesis, followed by the descriptive statistics of the dataset. Subsequently, data screening procedures for the one-way multivariate analysis of variance are detailed after the descriptive statistics. The concluding section reports the results of the analysis.

Research Question

RQ: Is there a difference in high students' engagement and presence scores when using virtual reality to learn a foreign language?

Null Hypothesis

$H_0$1: There is no difference in high school students' engagement and presence scores when using virtual reality to learn a foreign language as measured by the User Engagement Scale and Presence Questionnaire.

Descriptive Statistics

A one-way multivariate analysis of variance was run to determine the effect of using VR on the engagement and presence of students when learning a foreign language. Engagement and presence were assessed using students' scores on the presence questionnaire and user engagement scale. Students were divided into two groups of 79 each: VR and mobile instruction. The mean scores for the VR group are 5.44 for presence and 4.26 for engagement, while for the mobile group, they are 4.09 for presence and 3.14 for engagement.

Table 1

Dependent Variable: UES and PQ Scores

	Group Type	*M*	*SD*	*n*
Presence Score	Mobile	4.09	.163	79
	VR	5.44	.613	79
	Total	4.76	.881	158
Engagement Score	Mobile	3.14	.254	79
	VR	4.26	.475	79
	Total	3.70	.681	158

Results

Hypothesis: There is a difference in user engagement scores (UES) and presence questionnaire scores (PQ) between high school students who use virtual reality to learn a foreign language and those who use traditional instruction.

Data Screening

Data screening was conducted on each group's dependent variable, and data were scanned for entry errors and inconsistencies. No data errors or inconsistencies were identified. All data points were retained.

Assumptions

One-way MANOVA requires that the following assumptions be tenable:

- linearity
- no multicollinearity

- no univariate or multivariate outliers
- multivariate normality
- homogeneity of variance-covariance matrices
- homogeneity of variances

Assumption of Linearity

The assumption of linearity was tested using scatterplots for each group. The scatterplots show a linear relationship between the dependent variables in each group; therefore, the assumption of linearity was tenable. Refer to Figure 1 and Figure 2 below.

Figure 1

Scatterplot Matrix: Mobile Instruction

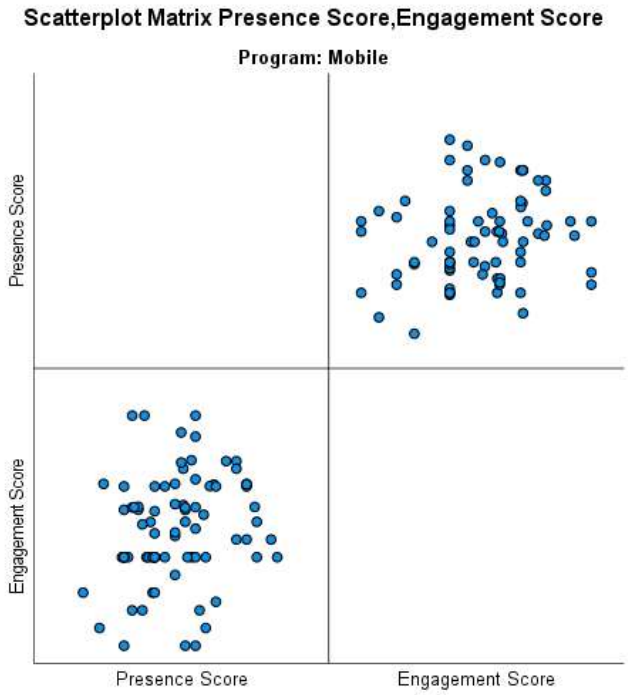
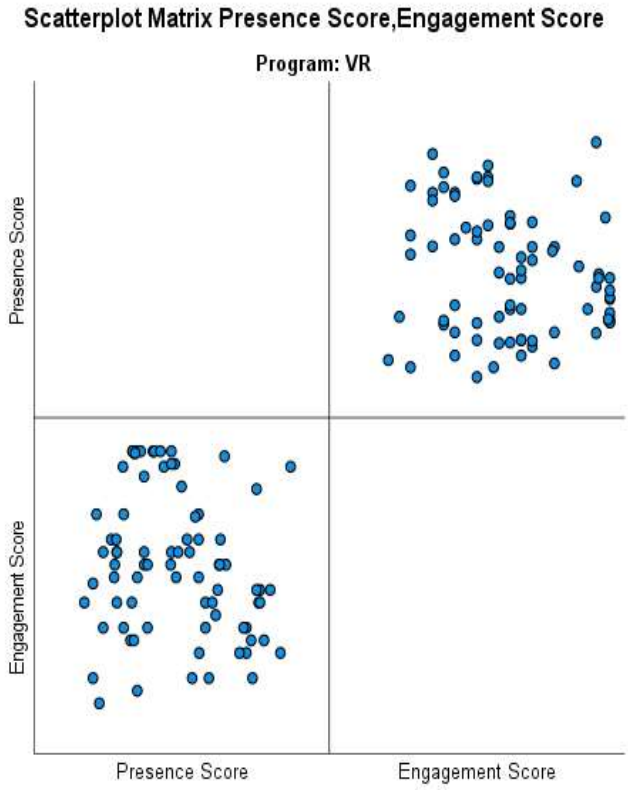


Figure 2

Scatterplot Matrix: VR Group



Assumption of No Multicollinearity

Pearson correlations between the dependent variables were used to test this assumption. The dependent variables should show a slight correlation. The assumption is tenable if the correlation is moderate and less than .9. As seen in Table 2, the correlations are both less than .9; therefore, the assumption of no multicollinearity is tenable.

Table 2

Pearson Correlation

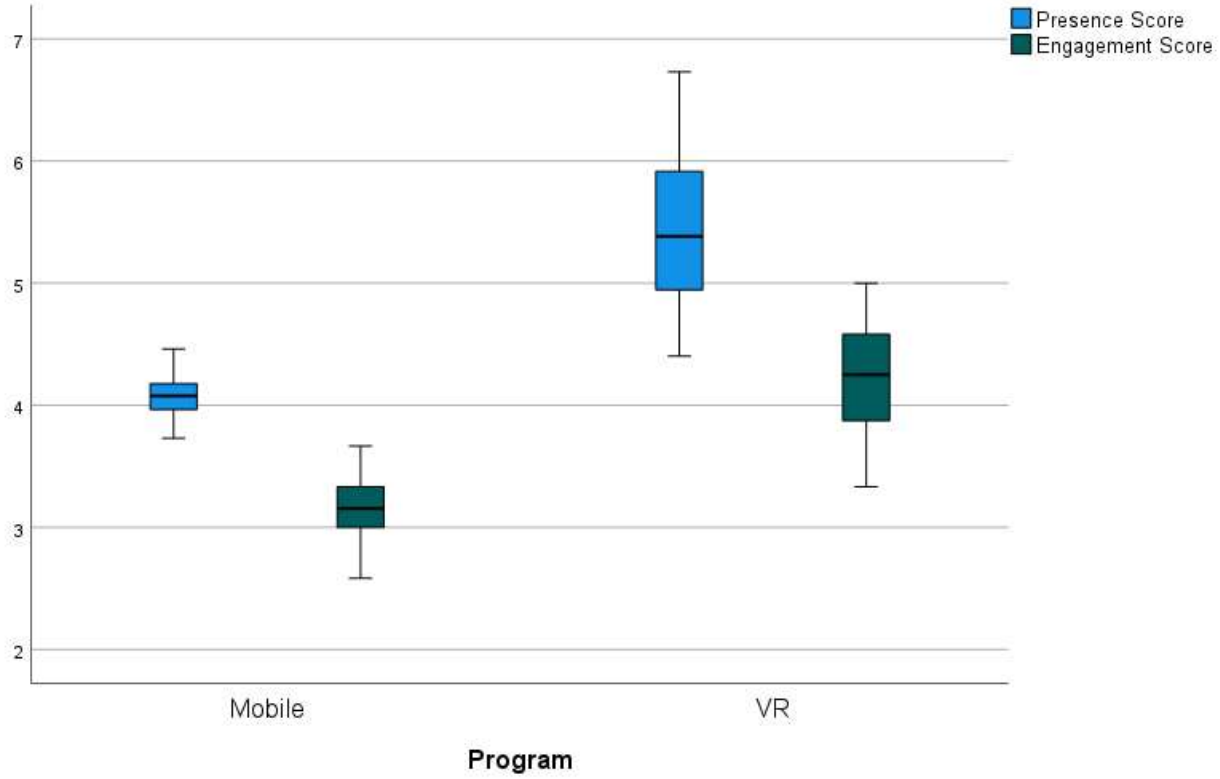
Group			*Dependent variables*	
			Presence Score	Engagement Score
Mobile	Presence Score	Pearson Correlation	1	.651
		Sig. (2-tailed)		<.001
		n	79	79
	Engagement Score	Pearson Correlation	.651**	1
		Sig. (2-tailed)	.002	
		n	79	79
VR	Presence Score	Pearson Correlation	1	.676
		Sig. (2-tailed)		<.001
		n	79	79
	Engagement Score	Pearson Correlation	.676	1
		Sig. (2-tailed)	<.001	
		n	79	79

Assumption of No Univariate or Multivariate Outliers

Box plots were used to detect extreme univariate outliers in each dependent variable. There were no univariate outliers in the data, as assessed by inspection of a boxplot for values greater than 1.5 box lengths from the edge of the box.

Figure 3

Box Plots: VR and Mobile Groups



Mahalanobis distance was used to test the assumption of no multivariate outliers. To determine if a calculated Mahalanobis distance was a concern, the computed value was compared to a chi-square (χ^2) distribution with degrees of freedom equal to 2, the number of dependent variables, and an alpha level of .001 (Tabachnick & Fidell, 2014). The chi-square critical value is 13.82. The largest Mahalanobis distance was 7.59 which is less than 13.82. Therefore, the assumption of no multivariate outliers was tenable.

Assumption of Multivariate Normality

Shapiro-Wilk test was used to test for multivariate normality. Table 3 provides the results of all Shapiro-Wilk tests. Since the results of the Shapiro-Wilk test for the VR did not show $p >$ .05, the assumption of normal distribution was not tenable. Data was transformed using square

root transformation. However, the results continued to violate the assumption of normality as shown in table 4.

Table 3

Tests of Normality

Shapiro-Wilk				
Groups		Statistic	*df*	Sig.
VR	Presence	.956	79	.008
	Engagement	.945	79	.002
Mobile	Presence	.976	79	.133
	Engagement	.972	79	.080

Table 4

Tests of Normality-Transformed Data

Shapiro-Wilk				
Groups		Statistic	*df*	Sig.
VR	Presence	.938	79	<.001
	Engagement	.874	79	<.001
Mobile	Presence	.973	79	.089
	Engagement	.973	79	.098

Assumption of Homogeneity of Variance Covariance Matrices.

Box's M, also called the Box's Test of Equality of Covariance Matrices, was used to test the assumption of equality of variance-covariance using the transformed data. There was no homogeneity of variance-covariance matrices as assessed by Box's test of equality of covariance

matrices ($p < .001$): the assumption of equality of variance-covariance was not tenable.

Table 5

Box's Test of Equality of Covariance Matrices

Box's M	284.096
F	93.383
df 1	3
df 2	4380480.000
Sig.	<.001

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.
a. Design: Intercept + Group

Assumption of Homogeneity of Variance

The assumption of homogeneity of variance was examined using the Levene's test. The results of the tests show no homogeneity of variance since both presence and engagement scores are less than p <.05. The assumption of homogeneity of variance was not met as seen in Table 5. Consequently, the researcher opted to use Pillai's criterion instead of Wilks' Lambda, as Pillai's criterion is more robust to violations of the assumption of equal covariance matrices (Olson, 1976).

Table 6

Levene's Test of Equality of Error Variances

		Levene Statistic	*df* 1	*df* 2	Sig.
Presence Scores	Based on Mean	127.555	1	156	< .001
	Based on Median	102.114	1	156	< .001
	Based on Median and with adjusted df	102.114	1	82.976	< .001
	Based on trimmed mean	121.257	1	156	< .001
Engagement Scores	Based on Mean	74.158	1	156	< .001
	Based on Median	45.718	1	156	< .001
	Based on Median and with adjusted df	45.718	1	121.519	< .001
	Based on trimmed mean	67.160	1	156	< .001

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Group

Results for Null Hypothesis

Hotalling's T^2 was used to test the null hypothesis that there is no difference in the presence and engagement scores of high school students who used VR to learn a foreign language to those who used traditional instruction. The null hypothesis was not rejected at a 95% confidence level where $F(2,155) = 266.588$, $p < .001$; Pillai's Trace = .775; partial $\eta 2 = .775$. Students who used VR in learning a foreign language had higher presence scores (M = 5.436, SD = 0.05) than students who used traditional instruction (M = 4.086, SD = 0.05). Students who used VR in learning a foreign language had higher engagement scores (M = 4.263, SD = 0.043) than students who used traditional instruction (M = 3.137, SD = 0.043). The

differences between the groups on the combined dependent variables were not statistically significant, $F(2,155) = 266.588$, $p < .001$; Pillai's Trace = .775; partial $\eta 2 = .775$ as seen in Table 6. Therefore, the researcher failed to reject the null hypothesis.

Table 6

Multivariate Tests[a]

Effect		Value	*F*	*df*	Error *df*	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.989	6928.327b	2.000	155.000	< .001	.989
	Wilks' Lambda	.011	6928.327b	2.000	155.000	< .001	.989
	Hotelling's Trace	89.398	6928.372b	2.000	155.000	< .001	.989
	Roy's Largest Root	89.398	6928.372b	2.000	155.000	< .001	.989
Group	Pillai's Trace	.775	266.588b	2.000	155.000	< .001	.775
	Wilks' Lambda	.225	266.588b	2.000	155.000	< .001	.775
	Hotelling's Trace	3.440	266.588b	2.000	155.000	< .001	.775
	Roy's Largest Root	3.440	266.588b	2.000	155.000	< .001	.775

a. Design: Intercept + Group

b. Exact statistic

CHAPTER FIVE: CONCLUSIONS

Overview

This chapter begins with a discussion of the results of the study and presents a comparison of the results with the literature presented in previous chapters. The discussion is followed by sections dealing with the implications and limitations of this research study. The final section of the chapter presents recommendations for future research.

Discussion

The purpose of this quasi-experimental, nonequivalent control group study was to determine if a statistically significant difference existed in the engagement and presence of high school foreign language learners who used VR in their language learning and those who used traditional methods. The researcher aimed to assess the impact of VR on students learning a foreign language. This study investigated the effects of VR on the acquisition of learning a foreign language. According to the findings of the studies conducted by Hatzilygeroudis et al. (2021), Mystakidis (2022), and Rojas-Sánchez et al. (2023), VR-enhanced environments have emerged as effective tools for increasing learner engagement and addressing critical aspects of learning. The socio-constructivism theory proposed by Vygotsky in 1978 places a significant emphasis on the significance of social interactions and internal motivation. These environments highlight the importance of both of these aspects. Furthermore, embodied learning theory is directly utilized in the process of establishing the theoretical foundation for the incorporation of VR in the process of learning a foreign language. This is because it enables the production of realistic interactions that replicate an immersive and authentic setting in which a foreign language is spoken (Al-Jundi & Tanbour, 2022; Bahari, 2022; Bian et al., 2023).

Several key assumptions of this study were unmet, leading to inconclusive results. The

researcher failed to reject the null hypothesis, which posited that there is no significant difference in engagement and presence scores among high school students who use VR for foreign language acquisition. First, the assumption of normal distribution was violated since the presence and engagement scores did not follow a normal curve, thereby skewing the data analysis. Second, the assumption of variance homogeneity, which needs similar variances within each group, was not evident. This inconsistency may have an impact on the analysis' reliability. Third, the equality of variance-covariance assumption, which demands equal covariance matrices for dependent variables across groups, was also violated. These assumption violations imply that the statistical tests may not have accurately reflected the true differences between the control and treatment groups, resulting in a failure to reject the null hypothesis. This outcome emphasizes the need for further exploration of the influence of VR technology in improving students' immersion and perceptual integration in simulated environments. This study adds to the literature conducted by Cowie and Alizadeh (2022), Klimova (2021), and Peixoto et al. (2021), which suggested that using virtual reality VR can effectively enhance the engagement of foreign language learners, leading to improved learning outcomes.

Recently, an increasing number of researchers have examined the educational and behavioral effects of VR in the context of foreign language learning (Alfadil, 2020). The researchers examined the efficacy of VR applications through the development and assessment of different instructional models. Researchers and educators have explored the use of VR to enhance learners' language skills and accuracy in foreign language learning. This is particularly evident in applications such as Mondly, as demonstrated by studies conducted by Di Natale et al. (2020), Hamilton et al. (2021), Radianti et al. (2020), Repetto et al. (2021), and Tai and Chen (2021). This study that used Mondly’s VR and mobile application adds to the body of literature

that supports the importance of interactive foreign language learning rather than static learning.

Moreover, the use of VR-enabled foreign language learning is part of a growing and promising body of literature, demonstrating the potential benefits of immersive environments. Several prominently featured studies in foreign language education collectively bring clarity to the significant increase in engagement and presence that learners experienced when exposed to immersive VR settings for foreign language instruction (Deng & Yu, 2022; Dhimolea et al., 2022; Hua & Wang, 2023; Peixoto et al., 2021; Symonenko et al., 2020; Zheng et al., 2022).

Implications

This study has identified important implications for the use of VR in learning a foreign language. Although the predicted significant difference in student engagement and presence between VR and the traditional methods of learning was not evident, the potential benefits of VR should not be overlooked. The use of VR emphasized the significance of active involvement and a sense of being fully present with the learning materials. The students were able to engage with their environment to build new knowledge, which is a fundamental principle of Vygotsky's socio-constructivist theory (1978). Furthermore, the use of VR enabled students to fully engage in the learning environment by interacting with objects and completing tasks, which are essential elements of Johnson's theory of embodied learning (1989).

Z. Zhang (2020) argued that VR technology immerses students in a foreign language learning environment. The author stressed the importance of authentic settings that mirror the foreign language and culture to promote emotional and cognitive engagement and language acquisition. Learners actively use their cognitive and behavioral skills to communicate in authentic settings where the foreign language is the only medium. In such authentic settings where the foreign language is the sole means of communication, learners actively engage with

the language, employing their cognitive and behavioral skills to effectively interact (Z. Zhang, 2020). Furthermore, the use of virtual reality (VR) provided students with an affordable opportunity to fully engage in the language, thereby creating novel possibilities for investigation and development (Deng & Yu, 2022; Dhimolea et al., 2022; Hua & Wang, 2023; Peixoto et al., 2021).

This study emphasized the need for more interactive and engaging foreign language instruction using available technologies. It underscored how VR can simulate authentic language learning environments that are conducive to active and immersive learning. Increased foreign language learning proficiencies at the high school level could result in rethinking language education policies to address challenges such as teacher education, lack of diversity in foreign language teaching methodologies, and improve language education in the United States (McEown & Oga-Baldwin, 2019 & Oga-Baldwin, 2019). The integration of VR technologies, for example, can address a few of these issues by creating interactive, engaging environments that meet the needs of 21st-century language learners (Al-Nuaimi & Al-Emran, 2021).

Limitations

First and foremost, the study's hypothesis that the use of virtual reality (VR) would lead to increased engagement and presence among high school students compared to traditional learning methods was not supported by the findings. The data collected from the presence questionnaire and user engagement survey violated several analysis assumptions. These assumptions included the lack of a normal distribution, variance homogeneity, and variance-covariance equality. The researcher failed to reject the null hypothesis since these violations jeopardized the findings' validity. The non-normal distribution of scores may have resulted in an error in parameter estimation, and uneven variances within groups may have influenced the

robustness of the statistical tests. Consequently, these limitations hindered data interpretation, necessitating future research to address these assumption violations to produce more reliable and valid results.

Second, the inability to randomly select samples for use. The lack of randomization in this experiment can pose a threat to internal validity (Gall et al., 2007). Randomization was not an option for this research study because of the challenge of finding a participating school that already uses virtual reality in its teaching and learning. Moreover, due to the school setting and predetermined class enrollment, randomization could not be used in the research study.

Third, the size of the study's sample and the demographics of the participants. The data was collected from a single high school. That only one school situated in a particular region of the United States was used, may have affected generalizability of the results. Therefore, it to generalize and apply the findings of this study beyond this population is beyond the scope of this study.

Fourth, the complexity of the survey questions for the age group of participants could have led to inaccuracies in reflecting their actual interaction using VR. A few teachers indicated that they had to explain a selection of the questions because students found some of the survey questions difficult to understand or interpret correctly, which could have affected the reliability of their responses.

Finally, the study spanned four weeks, with a two-week break included. Although the study yielded results, it remains uncertain whether a more prolonged investigation would generate more precise data that truly reflects the impact of VR. Additionally, the research was conducted toward the end of the academic year and encompassed a two-week interruption,

factors that might have influenced the students' scores as they reflected on their experiences with an intervening gap.

Recommendations for Future Research

Recommendations for further research include:

- Conducting an extensive study to determine how VR affects students' presence and engagement over a prolonged period. Tracking participants' progress and proficiency levels over a school year or two would help researchers determine variation in observations over time.
- Expanding the study to explore other VR language learning applications or platforms and include a gamification element into learning to see the impact of using VR on students' learning. This could involve testing VR simulations or environments to see which ones improve high school students' presence, engagement, and language proficiency.
- Complementing quantitative findings with qualitative data to better understand students' and teachers' VR experiences. Conducting interviews or focus groups to learn about students' and teachers' VR language learning preferences, challenges, and perceptions.
- Using different surveys that are appropriate for the age group or adopting pre-and post-test methods to ensure the clarity and accuracy of the data. Using language proficiency tests that the students are familiar with could result in more accurate data.

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APPENDIX A

User Engagement Scale

No.	Statement	Strongly Agree (5)	Agree (4)	Neither Agree nor Disagree (3)	Disagree (2)	Strongly Disagree (1)
1.	I lost myself in this experience.					
2.	The time I spent using Mondly just slipped away.					
3.	I was absorbed in this experience.					
4.	I felt frustrated while using Mondly.					
5.	I found this Mondly confusing to use.					
6.	Using Mondly was taxing.					
7.	Mondly was attractive.					
8.	Mondly was aesthetically appealing.					
9.	Mondly appealed to my senses.					
10	Using Mondly was worthwhile.					
11	My experience was rewarding.					
12	I felt interested in this experience.					

PRESENCE QUESTIONNAIRE

(Witmer & Singer, Vs. 3.0, Nov. 1994)*
Revised by the UQO Cyberpsychology Lab (2004)

Characterize your experience in the environment, by marking an "X" in the appropriate box of the 7-point scale, in accordance with the question content and descriptive labels. Please consider the entire scale when making your responses, as the intermediate levels may apply. Answer the questions independently in the order that they appear. Do not skip questions or return to a previous question to change your answer.

WITH REGARD TO THE EXPERIENCED ENVIRONMENT

1. How much were you able to control events?

|_____|_____|_____|_____|_____|_____|_____|
NOT AT ALL SOMEWHAT COMPLETELY

2. How responsive was the environment to actions that you initiated (or performed)?

|_____|_____|_____|_____|_____|_____|_____|
NOT MODERATELY COMPLETELY
RESPONSIVE RESPONSIVE RESPONSIVE

3. How natural did your interactions with the environment seem?

|_____|_____|_____|_____|_____|_____|_____|
EXTREMELY BORDERLINE COMPLETELY
ARTIFICIAL NATURAL

4. How much did the visual aspects of the environment involve you?

|_____|_____|_____|_____|_____|_____|_____|
NOT AT ALL SOMEWHAT COMPLETELY

5. How natural was the mechanism which controlled movement through the environment?

|_____|_____|_____|_____|_____|_____|_____|
EXTREMELY BORDERLINE COMPLETELY
ARTIFICIAL NATURAL

6. How compelling was your sense of objects moving through space?

|_____|_____|_____|_____|_____|_____|_____|
NOT AT ALL MODERATELY VERY
COMPELLING COMPELLING

7. How much did your experiences in the virtual environment seem consistent with your real world experiences?

|_____|_____|_____|_____|_____|_____|_____|
NOT MODERATELY VERY
CONSISTENT CONSISTENT CONSISTENT

8. Were you able to anticipate what would happen next in response to the actions that you performed?

|_____|_____|_____|_____|_____|_____|_____|
NOT AT ALL SOMEWHAT COMPLETELY

9. How completely were you able to actively survey or search the environment using vision?

|_____|_____|_____|_____|_____|_____|_____|
NOT AT ALL SOMEWHAT COMPLETELY

10. How compelling was your sense of moving around inside the virtual environment?

|_____|_____|_____|_____|_____|_____|_____|
NOT MODERATELY VERY
COMPELLING COMPELLING COMPELLING

11. How closely were you able to examine objects?

|_____|_____|_____|_____|_____|_____|_____|
NOT AT ALL PRETTY VERY
CLOSELY CLOSELY

12. How well could you examine objects from multiple viewpoints?

|_____|_____|_____|_____|_____|_____|_____|
NOT AT ALL SOMEWHAT EXTENSIVELY

13. How involved were you in the virtual environment experience?

|_____|_____|_____|_____|_____|_____|_____|

NOT INVOLVED — MILDLY INVOLVED — COMPLETELY ENGROSSED

14. How much delay did you experience between your actions and expected outcomes?

|_____|_____|_____|_____|_____|_____|_____|

NO DELAYS — MODERATE DELAYS — LONG DELAYS

15. How quickly did you adjust to the virtual environment experience?

|_____|_____|_____|_____|_____|_____|_____|

NOT AT ALL — SLOWLY — LESS THAN ONE MINUTE

16. How proficient in moving and interacting with the virtual environment did you feel at the end of the experience?

|_____|_____|_____|_____|_____|_____|_____|

NOT PROFICIENT — REASONABLY PROFICIENT — VERY PROFICIENT

17. How much did the visual display quality interfere or distract you from performing assigned tasks or required activities?

|_____|_____|_____|_____|_____|_____|_____|

NOT AT ALL — INTERFERED SOMEWHAT — PREVENTED TASK PERFORMANCE

18. How much did the control devices interfere with the performance of assigned tasks or with other activities?

|_____|_____|_____|_____|_____|_____|_____|

NOT AT ALL — INTERFERED SOMEWHAT — INTERFERED GREATLY

19. How well could you concentrate on the assigned tasks or required activities rather than on the mechanisms used to perform those tasks or activities?

|_____|_____|_____|_____|_____|_____|_____|

NOT AT ALL — SOMEWHAT — COMPLETELY

IF THE VIRTUAL ENVIRONMENT INCLUDED SOUNDS:

20. How much did the auditory aspects of the environment involve you?

|_____|_____|_____|_____|_____|_____|_____|
NOT AT ALL SOMEWHAT COMPLETELY

21. How well could you identify sounds?

|_____|_____|_____|_____|_____|_____|_____|
NOT AT ALL SOMEWHAT COMPLETELY

22. How well could you localize sounds?

|_____|_____|_____|_____|_____|_____|_____|
NOT AT ALL SOMEWHAT COMPLETELY

IF THE VIRTUAL ENVIRONMENT INCLUDED HAPTIC (SENSE OF TOUCH):

23. How well could you actively survey or search the virtual environment using touch?

|_____|_____|_____|_____|_____|_____|_____|
NOT AT ALL SOMEWHAT COMPLETELY

24. How well could you move or manipulate objects in the virtual environment?

|_____|_____|_____|_____|_____|_____|_____|
NOT AT ALL SOMEWHAT EXTENSIVELY

Last version : March 2013

*Original version : Witmer, B.G. & Singer. M.J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence : Teleoperators and Virtual Environments, 7*(3), 225-240. Revised factor structure: Witmer, B.J., Jerome, C.J., & Singer, M.J. (2005). The factor structure of the Presence Questionnaire. *Presence, 14*(3) 298-312.

APPENDIX B

Dear Nibras,

I am happy to provide students with permission to use the User Engagement Scale (UES) for academic (non-commercial) purposes to support their work. In using the UES, I request that you acknowledge the original work in your own theses and publications. I recommend including the questions for the UES as you have modified them for your VR tool in your appendix so other scholars can refer to them.

UES publications for citing:

[1] O'Brien, H.L. (2008). Defining and measuring engagement in user experiences with technology. Doctoral Dissertation. Dalhousie University, Halifax, NS.

[2] O'Brien, H. L., & Toms, E. G. (2010). The development and evaluation of a survey to measure user engagement. Journal of the American Society for Information Science and Technology, 61(1), 50-69

[3] O'Brien, H. L., Cairns, P., & Hall, M. (2018). A practical approach to measuring user engagement with the refined user engagement scale (UES) and new UES short form. International Journal of Human-Computer Studies, 112, 28-39. https://nam04.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.sciencedirect.com%2Fscience%2Farticle%2Fpii%2FS1071581918300041&data=05%7C01%7Cnclapp3%40liberty.edu%7C1059ee2d896644638d2d08db664735df%7Cbaf8218eb3024465a9934a39c97251b2%7C0%7C0%7C638216228276716307%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=l4sTtzSP8%2Fp8uNScfQ1xo3JaRQH1vUCh9tHYYCgL8Jc%3D&reserved=0

The most recent version of the UES is in publication #3, which is open access. The appendix in the article contains the long and short form questionnaire and there is instructions on scoring.

All the best,

Heather

Heather L. O'Brien MLIS PhD (she/her)

Associate Professor

School of Information

The University of British Columbia | Vancouver | Musqueam Traditional Territory

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13. ABSTRACT (Maximum 200 words)

A primary argument for the efficacy of Virtual Environments (VE) applications is that the user is "present" in the simulated environment. Presence is defined as the subjective experience of being in one environment (there) when physically in another environment (here). Presence may be based on external factors and internal tendencies that support both awareness of the current situation and the transition from the immediate physical location (here) to a remote or artificial environment (there). These factors are labeled as immersive because they may lead to the experience of presence. Some major immersive factors identified in current literature or hypothesized as contributing to presence are briefly revieved in this report. These concepts and ideas have been used as the basis for two questionnaires. An Immersive Tendencies Questionnaire (ITQ) was developed to investigate possible correlates that may indicate an individual's tendency to experience more or less presence in artificial environments. The Presence Questionnaire (PQ) addresses different factors or features peculiar to the artificial environment that may affect the experience of presence, or the capability to immerse oneself, in that environment. The results of

(Continued)

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Immersion	Simulator Sickness	16 PRICE CODE
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APPENDIX C

Combined Parental Consent and Student Assent

Title of the Project: The Use of Virtual Reality for Foreign Language Learning
Principal Investigator: Nibras Clapp (PhD candidate for Instructional Design and Technology, School of Education, Liberty University.

Invitation to be Part of a Research Study

Your child is invited to participate in a research study. To participate, he/she must bring a signed copy of this form. Taking part in this research project is voluntary.

Please take time to read this entire form and ask questions before deciding whether to allow your child to take part in this research project.

What is the study about and why are we doing it?

The purpose of the study is to explore the impact of virtual reality on high school students' engagement and presence in learning foreign languages.

What will participants be asked to do in this study?

If you agree to your child's participation, he/she will be asked to:

- Attend in-person sessions utilizing a VR headset to interact with foreign language content. These sessions will occur twice a week for two weeks, lasting 15 minutes each during regular class hours.
- Complete a survey/questionnaire reflecting on the experience of using VR for language learning.

How could participants or others benefit from this study?

Participants may directly benefit from the donation of VR headsets to the World Languages department, enhancing students' interactive learning experiences. Furthermore, societal benefits include contributions to language education and the broader fields of education and technology, fostering 21st-century skills.

Benefits to society, include research in the field of language education can contribute to the broader field of education and technology. Moreover, the study empowers students with 21st-century skills like digital literacy and critical thinking, positioning them for success.

What risks might participants experience from being in this study?

The expected risks from participating in this study are minimal, which means they are equal to the risks your child would encounter in everyday life.

How will personal information be protected?

- The records of this study will be kept private. Research records will be stored securely, and only the researcher will have access to the records.
- Participant responses will be anonymous and will be kept confidential by replacing names with pseudonyms.
- Data will be stored on a password-locked computer/in a locked file cabinet. After three years, all electronic records will be deleted, and all hardcopy records will be shredded.

Is study participation voluntary?

Participation in this study is voluntary. Your decision whether to allow your child to participate will not affect your or her/his current or future relations with Liberty University or [redacted]. If you decide to allow your child to participate, he/she is free to not answer any question or withdraw at any time before submitting the survey without affecting those relationships.

What should be done if a participant wishes to withdraw from the study?

If you choose to withdraw your child from the study or your child chooses to withdraw, inform the researcher that your child wishes to discontinue his/her participation and that he/she should not submit the study materials. Your child's responses will not be recorded or included in the study.

Whom do you contact if you have questions or concerns about the study?

The researcher conducting this study is Nibras Clapp. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her at [redacted] or [redacted]. You may also contact the researcher's faculty sponsor, Dr. [redacted] at [redacted]

Whom do you contact if you have questions about rights as a research participant?

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the IRB. Our physical address is Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA, 24515; our phone number is 434-592-5530, and our email address is irb@liberty.edu.

Disclaimer: The Institutional Review Board (IRB) is tasked with ensuring that human subjects research will be conducted in an ethical manner as defined and required by federal regulations. The topics covered and viewpoints expressed or alluded to by student and faculty researchers are those of the researchers and do not necessarily reflect the official policies or positions of Liberty University.

Your [Consent/Opt-Out]

By signing this document, you are agreeing to allow your child to be in this study. Make sure you understand what the study is about before you sign. You will be given a copy of this document for your records. The researcher will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I have read and understood the above information. I have asked questions and have received answers. I consent to allow my child to participate in the study.

_____
Printed Child's/Student's Name

_____
Parent/Guardian's Signature Date

_____
Minor's Signature Date