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A Dissertation Presented to
the Graduate School of Arts and Sciences,
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Acknowledgment

"There is a time for everything, and a season for every activity under heaven..."

- Ecclesiastes 3:1

I believe that every good thing that I have received thus far came from my Creator and that everything I have experienced in life led to this beautiful moment. I give thanks to Him for the completion of another milestone of my life. I would like to thank my wonderful parents, Ruben, and Marcela Figueroa, who lovingly raised me and supported me even in times when I should have been the one supporting them. I am grateful to my sister, Rachel Macabasco, who has been my confidant and supporter not just in my personal affairs, but also in my academic life. Her knowledge in research and her skills as an English teacher helped me a lot in my PhD journey. I thank Jonathan and Piper for supporting her and filling our lives with love.

I give thanks to my grandparents, Julita and Rufino Bacani, as well as my aunts Yay, Ellen, and Rosario for helping my parents raise me during my wonder years. Your love will always stay with me. I give thanks to Juan Pulhin, who has been my second father. We may not have been related by blood, but I never doubted his sincere care for my well-being. I am happy that Abigail has given joy to him and my equally loving aunt, Yay. I give thanks to Hiroshi Taniguchi who has been my family in Japan. I will forever be indebted to him.

I give thanks to Professor Mel Bandalaria and Dean Sandy Flor, as well as the rest of my colleagues at the University of the Philippines – Open University for patiently waiting for me while I pursued my PhD studies. Their support and encouragement in my research and PhD journey will never be forgotten.

I would like to thank my lab mates, Jenni, Janice, Eiman, Nhat, and Maia and research friends Gibran and Jimmy who made my stay at the university fruitful and enjoyable. I give thanks to my colleagues at J-Global, especially Suleyman and Hisako for being so helpful in assisting me with the translation of my abstract to Japanese together with Maia. I would like to thank Carmi, Etsuo, Eishi, Eric, Masato, Mizuho, Damien, Cedric, Eva, Edison, Vincent, Pat, Nas, Prof. Serlie, Stephane, Emira, Denielle, Emely, Joan, and many other friends for helping me with various details of my research.

I give thanks to my adviser, Professor Insung Jung for wisely and lovingly leading me and my lab mates during our stay at the university. She has been an inspiration and a great role model to all of us. I would also like to express my gratitude to Professor Sasao and Professor Fuji who also guided me in this journey. I am very grateful to the faculty members and staff of ICU for giving me one of the best educational experiences I've ever had in my life. Finally, I would like to thank the generosity of Japan and its people for the scholarship that made all these possible. 誠にありがとうございました。

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CHAPTER 1: Introduction

The chapter begins with an introduction to online learning (OL) and related concepts like open and distance education (ODE), emergency remote teaching (ERT), and adult learning. It continues with a discussion of the evolution of technologies used in online learning leading to virtual reality (VR). It then highlights the key environmental features of VR, which are immersive capability and spatial presence and some key benefits in motivation and learning. Finally, it presents a synopsis of gaps in literature that led to the purpose of the studies presented in this dissertation.

Online Learning

Online learning (OL), which used to be an alternative for learners who could not afford traditional modes of higher education because of spatial, temporal, or financial limitations, has been thrust center stage at the beginning of 2020 with the onslaught of the Covid 19 pandemic. The health pandemic imposed social constraints, globally forcing millions of people to stay in their homes for several months. For the educational sector, universities that have been offering in-person or residential education to their students were suddenly forced to either delay the start of their term or offer their courses fully online. Because of this drastic shift among the majority of learning institutions around the world, words like *online learning, open and distance education,* and *emergency remote teaching* have proliferated among academic circles. The concept of *adult learning* also gains prominence because of how online learning has fulfilled the developmental needs of adults from all walks of life.

Adult Learners

Adult learners have been important drivers of development in online learning. They are usually motivated by personal goals and aspirations, and thus often considered as more intrinsically motivated than university or K-12 learners. Their contexts range from retired workers, self-employed freelancers or entrepreneurs, post-graduate degree-pursuers, to professionals who want to continue learning. That is why they are often referred to as life-long learners. Their professional, social, or geographical circumstances often make face-to-face modes of learning challenging or impossible. OL opened multiple opportunities for them to continue learning.

Among adults interviewed in a UK study in 2009 by Hague and Logan, it was reported that 79% of them spent 8.6 hours a week learning informally through some form of media or material. The widespread use of the Internet enabled more adults to engage in such form of learning. With the fast advancement of synchronous communication tools and web conferencing platforms, the access to learning opportunities has expanded even more. Synchronous computer mediated communication (SCMC) platforms like Skype have fascinated teachers and researchers with how they have been used in language learning applications and how they were used as tools for second language acquisition (SLA).

One review of the literature reported that one of the themes of the ten research articles and dissertations reviewed between 1990 and 2012 was about how text-based-SCMC had a larger impact on SLA than analog alternatives (Lin et al., 2013). This was supported by the themes found in the literature review of Mahdi (2014). In his review, he reported that SCMC is beneficial because it serves as an avenue for learners to engage in

friendly conversations with one another in a safe and accessible environment. Another benefit that he found from the review was that using these platforms could also reduce anxiety and increase motivation. As a convenient platform to set up a learning environment for SLA and language learning, online learning, through the proliferation of SCMC, has become a common preference for adult learners.

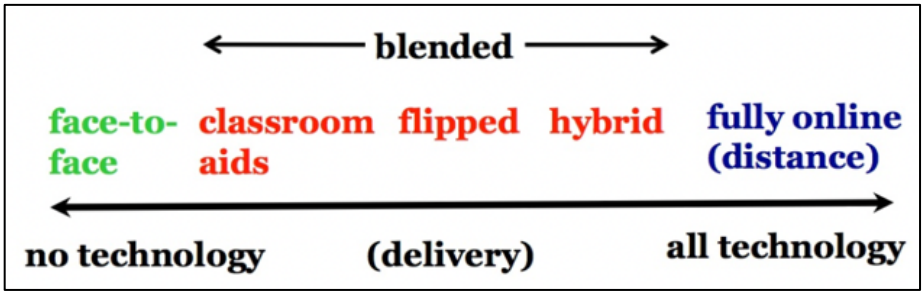
This has made researchers even more interested in how adult learners benefit in OL interventions not just in the context of language learning, but also in other fields of study. However, since online learning has been a widely used term in different contexts, it is only proper to define online learning and limit its scope in this discourse to avoid confusion and ambiguity.

Online Learning Defined

Tony Bates defined OL broadly as "any form of learning conducted partly or wholly over the Internet" (Bates, 2016). Bates explained that OL is an important component of a teaching continuum as seen in Figure 1.1 (Bates & Poole, 2003). He referred to the leftmost side of the continuum as pure face-to-face teaching. This could be imagined as a teacher doing a lecture in front of the class without any use of technology. Next to it is teaching with the use of teaching aids where technology, whether digital or non-digital, can be used. Digital teaching aids can include accessing materials or courses using the Internet. This is said to be part of the more fluid portion of the continuum, which is blended learning. Bates defined it as a combination of face-to-face teaching and a significant use of online learning with various forms. This includes classroom and hybrid learning. On the rightmost side is fully online learning wherein everything is delivered through and mediated by the Internet.

Figure 1.1.

Teaching Continuum



Bates emphasized that while online learning is present in most of the teaching methods in the continuum, online learning is a mode of delivery rather than a teaching method. The same stance is taken in the entirety of this discourse.

Online learning has been an important mode of delivery in most teaching and learning contexts. It has evolved with the emergence of new technologies and has become more ubiquitous with the growing demand and trust among learners and learning institutions. It can be argued that early implementers of OL were institutions involved in Open and Distance Education (ODE). As a result, much of the literature in OL used the terms *online learning*, *distance education (DE)*, and *distance learning (DL)* interchangeably.

Open and Distance Education

There is good reason for researchers to refer to online learning as distance learning and vice-versa. Despite ODE being broad as to include non-Internet based modes of delivery, online learning is said to be a pivotal part of its evolution and at one point became a synonymous term. In Jung's (2019) discourse on the generations of ODE, she pointed out that in the 1990s, OL contributed significantly to the advancement

of ODE. At this time, a vast majority of open universities chose OL as their main mode of delivery. Thus, research and reports on ODE or DE have most often been about OL.

Distance education (DE) has evolved through the years and has been associated with openness, which eventually led to the use of open distance education (ODE). ODE refers to a mode of education that is flexible (Moore & Kearsley, 1996), learner-centered (Maxwell, 1995), transcending traditional and geographical barriers (Gunawardena & Lekamge, 2010; Keegan, 1988; Maxwell, 1995), and widens access to higher education (Arinto, 2016; Chawinga & Zozie, 2016). The more specific term is often associated with open universities as formal academic institutions implementing and promoting ODE.

As technologies have evolved, the way ODE is being designed and delivered has evolved as well, leading to increasing flexibility and openness in education. Jung (2019) described this phenomenon by identifying ODE's four generations. She started with identifying correspondence education as the first generation. The second generation featured new modalities added to distance learning in the early 1900s such as the radio and broadcast communication. The third generation was dominated by the institutionalization of ODE through open universities.

The fourth generation was characterized by an exponentially rapid pace of technological development, with the Internet being the most significant enabler. This paved the way to innovations like open courseware (OCW), open educational resources (OER), and massive open online courses (MOOCs). Technology-integration has been the common characteristic of ODE in the present age. In the 4th generation, online learning

has become almost synonymous with ODE because most open universities have come to acknowledge OL as their primary mode of delivery.

Though OL has promised to be a viable alternative to traditional education, several challenges threaten its successful implementation. Low motivation among learners manifested in high attrition rates has been a consistent problem as observed by practitioners and researchers (Levy, 2007). Participation was also affected by the learners' reasons for engaging in OL. At times, finishing the course was not really the aim of many learners. Some just wanted to get an experience of studying online, while others wanted to obtain a particular piece of information from an open course. And in the past, when massive open online courses (MOOCs) were just supplementary options, extrinsic motivation levels were relatively low.

However, with the massive shift to online learning strategies which were collectively called emergency remote teaching (ERT) by formal education institutions due to government-initiated lockdowns, the stakes of finishing online courses have become much higher. Nevertheless, the experience of students who are taking online courses for the first time would determine the viability of this strategy for these learning institutions when society has returned to normal.

Keeping students motivated while taking online courses is as important, if not more, than having them take in-person classes. This is because online courses are conducted in less controlled environments, which makes it easy for students to disengage from the learning material when they get distracted by more interesting tasks. It is also more difficult to monitor learner behavior when they are not in the same geographical location as their instructor. Thus, genuinely keeping their motivation high throughout the

online course is essential to learner success. While studies by Bai (2003), Ke (2010), and Kang and Zang (2020) showed that social and teaching presence through information and communication technology (ICT) based interactions in forums, SCMCs, and other technologies, novel technologies are aggressively being tried and tested for greatly improving the benefits reaped from online learning. One novel technology that has been slowly changing the landscape of education is virtual reality (VR).

Virtual Reality

Virtual reality (VR) is part of a spectrum called immersive technology. Immersive technology is a phrase used to denote a combination of hardware and software that provides some level of immersion for users to experience a digitally created world or interact with digital objects in the physical world. Immersive technology is also a range of technologies that caters to individuals who want to experience a reality different from physical reality.

Milgram and Kishino's (1994) reality-virtuality continuum as shown in Figure 1.2 illustrates the different types of reality, which range from physical reality or the real environment to VR.

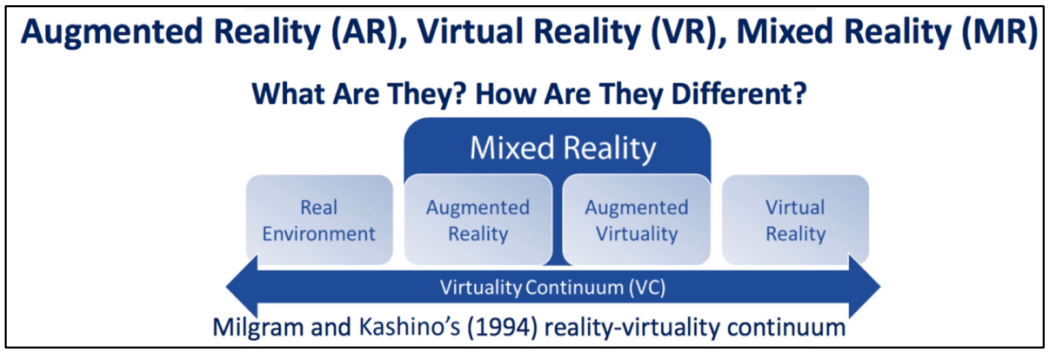
Though augmented reality (AR) has been used commonly in educational contexts and research, it is believed that VR has much more potential in online learning due to its environmental features.

While there are many competing views of VR, two main views have been summarized by Thompson (1993). The first view is that VR is strictly a theoretical concept, which pertains to any technology that can immerse the senses while optionally

providing interactivity. In this view, VR can be used to describe video games, synchronous Internet-based communication, and participating in a 2D virtual world. This is also the definition taken by many education researchers towards the end of the 20th century.

Figure 1.2

Reality-Virtuality Continuum by Milgram and Kishino (1994)



The other view has a stricter and technology-based standpoint. In this view, VR is characterized by specific hardware and software that bring about a real-time, computer-generated 3D environment that users, having a perceived self-location, can navigate and interact with (Hayward, 1993). It is this view that is mostly taken in this discourse. Furthermore, it suggests that experiencing VR can be classified as immersive or non-immersive.

A virtual environment where users interact using desktop computers or mobile devices but still allows them to move around the 3D virtual world is called non-immersive VR. In the strict sense, it should be offered as a mode that cannot exist without an immersive version. Thus, applications like Second Life are usually referred to as virtual worlds instead of VR because they were created solely for non-experiences. However, VR applications like Google Expedition have both an immersive and a non-

immersive mode. Therefore, non-immersive VR in this context can be seen as a mode and not as a stand-alone term.

Immersive VR, which is also often called VR-mode or immersive mode is commonly experienced using CAVE Automated Virtual Environment (CAVE) or a head mounted device (HMD). A CAVE, which is a recursive acronym, is an enclosed space of high-definition monitors, which are usually powered by Light Emitting Diodes (LED) that are synchronized with one another to simulate an environment. On the other hand, an HMD is a device that is usually worn by the user and placed on the user's head to provide stimulus to the user's vision. Usually, earphones, integrated or otherwise, are also connected to the HMD to provide auditory input that is synchronized with the visual input. A few decades ago, VR only found its way to military, space, and medical contexts. However, there were few educational applications because an immersive experience during that time would require a huge amount of investment in hardware and software.

Nowadays, the democratization of VR has reached the classroom because of commercial HMDs like the Oculus Rift and HTC Vive, as well as extremely cheap smartphone add-ons like Google cardboard. It is important to distinguish the two modes of experiencing VR in the design of this dissertation as they could contribute to the variation of two important aspects in a VR experience: *immersion* and *presence.*

Immersion and Immersive Capability

Immersion has an established definition in education, psychology, and gaming. One of the more famous theories that defines immersion is the theory of flow. Immersion is defined as the feeling of being absorbed in an activity (Otzen, 2015). Otzen said that

Csíkszentmihályi (1990) posited that flow is the deepest form of immersion. In games, Adams (2004) even categorized it into tactical, strategic, and narrative immersion and argued that there are certain factors in games that kill immersion by halting one's suspension of disbelief. In literature, it can be related to what is called hyper-fantasy. Studies in psychology show that immersion and suspension of disbelief are connected such as the uncanny valley by Mori et al. (2012).

Though the previous definition in psychology is being used in many research projects and articles involving virtual worlds and virtual reality, a different perspective was adopted by the technologists behind this spectrum of technologies. Immersion in their perspective, is an objective technological capability instead of a human condition. This view was popularized by Slater and Wilbur (1997) to differentiate the term from what is called *presence* among virtual experiences. Again, presence has different connotations depending on the field of research. These connotations and a proposed resolution will be discussed in the succeeding sections.

Among researchers of presence in VR, the term immersion refers to objective aspects of hardware and software systems such as display quality, stereoscopy, resolution, and field of view, which could facilitate presence. However, to clearly make it distinct from other forms of contextualization, the term *immersive capability* is used in this text.

Spatial Presence

Another term that has various definitions and theories from different researchers is the term *presence*. Lombard and Ditton (1997) grouped major interpretations into six from across literature. The first explication equates presence to social richness. Presence

is the extent to which a medium is viewed as sociable or personal when it comes to interacting with other people. The second explication treats presence as realism. In this view, presence is the extent to which a medium can be socially realistic. The third explication is presence as transportation, which pertains to the sensations of *being there.* The fourth explication interprets immersion as the extent to which the senses are engaged by the mediated environment. The fifth explication sees presence as the extent to which an individual responds socially to a representation of another person through a medium. The sixth explication refers to the extent to which the medium itself is perceived as a social actor by the user.

Presence researchers like Heeter (1992) distinguished between definitions of presence by adding modifiers such as *personal presence* as the feeling of being in a virtual environment (VE), *social presence* as the feeling of being with others in the VE, and environmental presence as the extent to which the VE seemingly senses and reacts to actions of the participants in the environment. Meanwhile, Schloerb (1995) defined *subjective presence* as the likelihood of someone judging himself or herself to be in a VE and *objective presence* as the likelihood of the task being completed. Slater et al. (1994) used the term *exclusive presence* to pertain to a participants' feeling of being in a VE, which is brought about by a low sense of presence in the real environment.

Telepresence was used pertaining to presence as transportation or the feeling of being there (Schuemie et al., 2001). However, Sheridan (1992) made it more specific by defining it as the sense of being in a real remote location and not in the VE. In recent studies, the term *spatial presence* has emerged. A study by Weibel et al. (2015) subscribed to the definition of Heeter (1992) that spatial presence refers to the experience

of being there in a mediated environment, which gives the participant the impression of being in the mediated environment. The phenomenon is also called self-location.

VR studies have hinted at immersive capability and spatial presence's potential to explain how learners benefit from learning through VR-based applications. However, while reports regarding benefits abound as it will be detailed later in the review of literature section, a common aspect in learning was found to have been prevalent in literature but at the same time lacking in depth and evidence. These are the motivational effects of VR applications among learners.

There are several contemporary motivational theories that could be revisited to investigate how these features affect or influence learner motivation, leading to desirable learning behavior and outcomes. From these theories, two motivational constructs stood-out as appropriate lenses for observing motivation in a VR-based learning activity. These constructs are situational interest and the ideal future-self.

Situational Interest

Situational interest has been a recurring construct in many motivational models and theories. Keller's model on attention, relevance, confidence, and satisfaction (ARCS) in 1987 prescribes gaining attention or triggering one's interest to be the first step to motivating learners. This phenomenon where an activity gains someone's attention is called situational interest. Interest researchers defined situational interest as a psychological state that makes attention and learning effortless because in such a state, affective reactions, cognitive functioning, and perceived value intertwine (Ainley, 2006; Hidi & Renninger, 2006; Schiefele, 2009).

In their discourse on Self-Determination Theory (SDT), Ryan and Deci (2008) considered interest as an important dimension of intrinsic motivation - a type of motivation that causes someone to be energized by the activity itself. In Dornyei's (2009) L2 Motivational Self System and in his emerging concept of Directed Motivational Current (Dornyei et al., 2015), interest is a prominent feature of the instrumentation dimension, which is said to influence motivated learner behavior and induce cognitive gains (Harackiewicz et al., 2016).

Learning activities that establish relevance and context like field trips and exchange programs have been found to increase learners' interest in a certain field of study or a certain culture, aside from these providing entertaining experiences. VR is a technology specifically used to recreate environments for exploration activities like these. Thus, it would be logical to suggest that its ability to teleport beholders to various places while making them feel present in that virtual space could be the reason why VR-based learning activities are found to be interesting as initially reported in the author's previous study (Figueroa et al., 2020).

The Ideal Future-self

Another construct that recently dominated language learning research is the ideal future-self. It is one of the two future selves in the L2 Motivational Self System that represents one's desired possible self that also encapsulates his/her dreams and goals (Dörnyei, 2009) and is usually influenced by visioning techniques.

The concept of ideal future-self had benefited athletes and entrepreneurs. The imagery and the vividness of the ideal future-self are key factors in increasing a person's motivation in training or learning (You & Chan, 2014). As VR can create virtual settings

that could be related to an ideal future, there is reason to believe that there is potential in utilizing it to increase the vividness of the ideal future-self.

Gaps in Literature

The gaps found in literature, which are discussed in detail in the following chapter, could be summarized into three themes. Firstly, there was a lack of research on spatial presence and immersive capability and their relationship with situational interest, ideal future-self, and learning outcomes. Secondly, past studies were mostly developmental in nature and effects were measured using the usability framework. Lastly, past studies did not use motivation and learning theories as a framework. Instead, they often merely documented how an app was developed, used, and evaluated.

From these gaps, the purpose and aims of this dissertation have been established.

Research Purpose and Aims

Research Purpose

The main purpose of the interrelated studies presented in this dissertation is to primarily develop a model that describes the relationship of environmental features of VR (i.e., immersive capability and spatial presence) with motivation (i.e., situational interest and the ideal future-self) and learning outcomes in a VR-based learning activity especially when used as an intervention in online learning contexts. To achieve the main research purpose, four empirical studies were carried out in various online learning contexts in the Philippines, Japan, and France.

Studies and Aims

Study 1 aimed to explore the dimensions of *spatial presence, situational interest,* and *ideal future-self* among Filipino adult learners by undertaking survey research featuring a VR photo-based tour of an open university. Data were analyzed to confirm the validity and reliability of the dimensions of spatial presence through confirmatory factor analysis (CFA) and explore the dimensions of situational interest and ideal future-self through exploratory factor analysis (EFA). Findings from this study led to Study 2.

Study 2 aimed to further explore the dimensions of *situational interest and ideal future-self* in the same context through another survey research, this time featuring a VR photo-based tour about forest ecosystem services. Data were analyzed to confirm the validity and reliability of the motivational variables through EFA.

Study 3 aimed to investigate the relationship of *situational interest, ideal future-self, immersive capability, spatial presence, and learning outcomes* in the context of VR photo-based tours experienced by Filipino adult learners. Using the validated scales from Study 1 and 2, an experiment was conducted among three groups of participants. Relationships were investigated by performing ANOVA, t-test, correlation analysis, and path analysis.

Finally, Study 4 aimed to investigate the dynamics of *situational interest, ideal future-self, immersive capability, spatial presence, and learning outcomes* among online adult language learners in France and Japan who were given VR photo-based lessons in the span of two to three months. The study followed a design-based research approach, which involved an iterative reflective process in the design of the lessons as well as in developing and improving hypotheses.

Data were collected from post-lesson surveys, learner and teacher interviews, and observation notes from the recorded lessons. Descriptive statistics and repeated ANOVA were performed to discover patterns in variables across ten lessons. Inductive thematic analysis was performed after every lesson and across the ten lessons to develop and revise theories arising from this study.

Definitions of Key Terms and Abbreviations

Definitions of Key Terms

Online Learning. Any form of learning conducted partly or wholly over the Internet (Bates, 2016)

Adult Learner. Considered mature in status and experience, that is in a formal or informal learning process. In the Philippines, individuals as young as 18 years old are considered as adult learners.

Virtual Reality. Characterized by specific hardware and software that bring about a real-time, computer-generated 3D environment that users, having a perceived self-location, can navigate and interact with (Hayward, 1993).

Immersive Capability. Objective aspects of hardware and software systems such as display quality, stereoscopy, resolution, and field of view, which could facilitate spatial presence (Slater & Wilbur, 1997).

Spatial Presence. Sensation of being in a virtual environment device (Schuemie et al., 2001)

Sense of Physical Space. A factor in ITC-SOPI that encapsulates its definition of being there (Lessiter et al., 2001).

Engagement. A factor in ITC-SOPI that refers to the tendency to feel psychologically involved and to enjoy the content in the virtual environment (Lessiter et al., 2001).

Ecological Validity. A factor in ITC-SOPI that refers to the tendency of individuals to perceive the mediated environment as lifelike and real (Lessiter et al., 2001).

Negative Effects. A factor in the ITC-SOPI that describes adverse physiological reactions such as dizziness, nausea, headache, and eyestrain (Lessiter et al., 2001).

Ideal Future-self. A future-self guide that represents one's desired possible self that also encapsulates his/her dreams and goals (Dornyei, 2009).

Situational Interest. A psychological state that makes attention and learning effortless because in such a state, affective reactions, cognitive functioning, and perceived value intertwine (Ainley, 2006; Hidi & Renninger, 2006; Schiefele, 2009;).

VR Photo-based Tour. A tour involving a 360-degree image of as a background that is overlaid with information related to the lesson.

VR Tour Lesson. A lesson involving learning activities that include VR Photo-based tour as a primary task.

Commonly Used Abbreviations

CFA	confirmatory factor analysis
CFI	Comparative Fit Index
CMC	computer-mediated communication
DBR	design-based research
DE	

	distance education
EFA	exploratory factor analysis
EN	engagement
EV	ecological validity
IC	immersive capability
IF	ideal future-self
ITC-SOPI	Independent Television Commission- Sense of Presence Inventory
KMO	Kaiser-Meyer-Olkin
LO	learning outcomes
MI	modification index
NE	negative effects
ODE	open and distance education
OL	online learning
PL	perceived learning
PS	sense of physical space
RMSEA	root mean square error approximation
SI	situational interest
SP	spatial presence
SRMR	standardized root mean squared residual
TLI	Tucker-Lewis Index

CHAPTER 2: Review of Literature

This chapter establishes the gaps in literature addressed by the studies in this dissertation. First, it describes the trend in research on VR-based interventions in online learning and other learning contexts leading to gaps in defining clear environmental, motivational, and learning variables for measuring outcomes. Research on immersive capability and spatial presence are then discussed followed by the two constructs of motivation, situational interest and ideal future-self, and their relevance in VR-based related studies which further establishes the need for a unified model. Methodological gaps are also identified leading to the presentation of an initial model that is guided by three research questions.

Online Learning and Virtual Reality

The use of online learning in various contexts has resulted in the proliferation of research regarding key aspects of this mode of delivery. Though there have been many reviews of OL research undertaken since the 1990s, this past decade saw a growth spurt in their number.

Martin et al. (2020) released a systematic review of OL from 2009 to 2018 and mentioned other notable reviews covering different aspects of OL in the last ten years as shown in Table 2.1. Many of these literature reviews highlighted articles that featured innovative strategies, instructional design, and learning technologies (Davis et al., 2018; Martin et al., 2017; Tsai & Fan, 2013). Most of these studies reported that success brought about by these interventions could be attributed to increased learner engagement and motivation in the online courses.

Table 2.1.

Online Learning Research Review Trends in the Past Decade

Authors, Year	Topic
Lee and Choi, 2011	Online course dropout
Tsai and Fan, 2013	Game-based online learning environments
Lee, 2017	Accessibility in online education
Martin et al., 2017	Synchronous online learning
Davis et al., 2018	Online learning strategies

In many studies in online learning, attrition and retention were commonly attributed to motivational factors (Rovai, 2003), because learners were physically separated from the teachers and from the learning institution. Self-regulation, which is commonly linked to discipline and perseverance, is another characteristic that successful distance learners exhibit (Shea & Bidjerano, 2010). Self-regulation was also strongly linked to situational interest (Sun & Rueda, 2012). While the use of various technologies was found to facilitate learning by motivating learners, one technology that showed great potential in simulating environments thereby triggering interest was VR.

Research on VR in Online Learning

Numerous studies have claimed the potential of VR in training and educational applications. One application of VR was found to be useful for innovation training (Watts et al., 1998) through VR Learning Environments (VRLEs). VRLEs were found to

be a powerful tool for teaching and learning (Bricken & Bryne, 1993) as they have been found to support constructivist learning (Bricken, 1990). VRLEs allow educators to create context through a virtual environment where learners can safely experience consequences and learn from those experiences. Furthermore, VRLEs were also theorized to be effective tools for experiential learning grounded on Dewey and Piaget's ideas where learners can mirror their personal understanding with ascribing meaning to objects, relationships, and behaviors in the virtual world (Osberg, 1994). VR allows learners to experience and interact with a simulated environment as if they were physically there (Hoffman et al., 1995) without the limits of physical reality due to absence of geographical access or safety concerns.

Another phenomenon found to be experienced in VR is embodiment, which can bring about empathy among its users. Embodiment has been used by journalists to tell stories in a more engaging and compelling manner (Archer & Finger, 2018).

Various researchers have found that VR applications were able to contribute positively to learning motivation among adult learners such as health care professionals (Mantovani et al., 2003) as well as young learners. VR applications were found to provide enjoyment (Vogel et al., 2006) and help concretize abstract concepts (Harley et al., 2016).

Meanwhile, three studies agreed students who used VR-based educational activities showed greater learning achievement, gave higher satisfaction ratings, and showed greater interest than in other activities. The first example was a VR simulation application used as an educational tool for helping learners learn physics concepts (Kim et al., 2001). More recently, a virtual campus system that is based on VR was developed

for distance education in China (Chang et al., 2016). Another recent case involved teaching pharmacy online where it was reported that team-based learning done in VR could provide engaging elements without learners being present physically in the same room (Coyne et al., 2018).

Despite the numerous studies on VR and its benefits in learning and training contexts, the underlying factors contributing to these benefits have been found to be empirically lacking. Scholars have criticized research on VR-based educational interventions to be mostly developmental and lacking theoretical foundations. This was exemplified by the latest review paper conducted by Radianti et al. in 2020. In their paper, they revealed that the majority of 38 reviewed articles on VR-based educational innovations were development research. These were described further as studies that merely documented the overall development process. Other papers followed an experimental design with usability and user-testing research. While experimental design was mixed in with usability and user-testing research in one category, most of the articles reviewed did not apply any data analysis method. Only two used t-test and correlation analysis. Besides this, only four studies used qualitative methods such as observation and focus group discussions. Furthermore, most of these articles did not clearly mention a theoretical foundation from which the studies were based. Finally, only a few papers evaluated learning outcomes as most of them were usability oriented. In this regard, they echoed the dearth of empirical qualitative and quantitative research on VR-based interventions in learning contexts.

Research on Immersive Capability and Spatial Presence

The two environmental aspects of VR, immersive capability, and spatial presence have been the common aspects claimed by VR researchers to affect user-observed outcomes in VR-based projects. Immersive capability, being an objective quality of the VR environment, was often used as an independent variable in studies involving VR. Spatial presence, on the other hand, was often measured subjectively. Several studies have operationalized spatial presence in the context of VR and other related media. Wissmath et al. (2010), Schuemie et al. (2001), and van Baren and IJsselsteijn (2004) presented a survey of instruments that attempted to measure spatial presence objectively and subjectively. Objective measures, which include those that involved psychophysiological measures, neural correlates, task-performance, and behavioral-measures, could be used to strengthen the validity of one's findings from subjective measures. However, subjective measures, especially those that use subjective verbal ratings, are still the most common forms of measuring presence (Wissmath et al., 2010) because of their relative ease in terms of administration, analysis, and interpretation, as well as their low cost (van Baren & IJsselsteijn, 2004; Wissmath et al., 2010). After all, presence is a subjective experience (Sheridan, 1992). Schuemie et al. (2001) added that questionnaires are still the most recommended form for measuring presence because the presence theory is still in constant development and the rich feedback that questionnaires provide could add insights and understanding to this evolving concept.

Slater et al. (1995) designed a questionnaire that asked participants to rate each item from 1 to 7 for an experiment to find out the effect of dynamic shadows in an

immersive virtual environment vis-à-vis spatial perception and presence (see Appendix A).

In 1997, Kim and Biocca based their scale on the definition of telepresence and on the studies of Barfield and Weghost (1993) and Slater et al. (1994) and contextualized the questionnaire for television viewing. Eight items were included in their questionnaire to measure self-reported telepresence (see Appendix A).

Witmer and Singer developed the presence questionnaire (PQ) with immersive tendencies questionnaires (ITQ) in 1998 (see Appendix A). Items were rated using a semantic differential scale where participants were asked to put an "X" on the location of the scale near the label that matches how they felt. From an initial 32 items, 19 were retained with 17 loading into three subscales. From the analysis, 11 items loaded into the Involved/Control subscale, three items loaded into the Natural subscale, and three items loaded into the Interface Quality subscale. Items were also grouped into factors. The major factor categories were control factors (CF), sensory factors (SF), distraction factors (DF), and realism factors (RF).

Schubert et al. (2001) constructed the iGroup presence questionnaire (IPQ) where they theoretically distinguished presence from immersion by stating that the former was a variable of the user's experience, while the latter was a variable of the technology (see Appendix A). Aside from English, the scale was made available through their website (qgroup.org) in German, Dutch, French, and Japanese. Like the other scales, items did not have the same item scale anchors for representing the numerical ratings.

Lessiter et al.'s (2001) ITC Sense of presence included a comprehensive inventory that identified four dimensions of spatial presence. These are *Sense of Physical*

Space, Engagement, Naturalness, and *Negative Effects,* which are guided by Slater and Wilbur's (1997) three themes of presence, which included the sense of *being there,* the extent to which the virtual environment becomes more real, or present compared to physical reality, and the extent to which the virtual environment is thought of as a place that was visited rather than a set of images.

Bouchard et al. (2004) presented the reliability and validity of a single-item measure of spatial presence in VR. The single question item was: "To which extent do you feel present in the virtual environment; as if you were really there?". This questionnaire was said to be useful for measuring spatial presence at a particular moment as it can be verbally given, and feedback can be quickly received while the participant is immersed in the VR. These instruments laid the foundation to many empirical studies that tried to discover what caused spatial presence and what it resulted into in various contexts.

Despite the abundance of instruments, there were only a few studies that have tested the influence of spatial presence on motivation and learning outcomes. While there is a wide belief that spatial presence influences task performance (Ferrel & Sheridan, 1967; Witmer & Singer, 1998), others had contradicting results (Mania & Chalmers, 2001; Welch, 1999). Welch tested whether a stronger sense of spatial presence would lead to better task performance by comparing a group of participants who experienced a virtual environment with auditory stimulus with another group who experienced a silent version of the same virtual environment. While the first group reported a greater sense of presence in the environment, task performance between the two groups was not found to be statistically significant. However, they cautioned readers

that the difference in spatial presence between the two groups was small. Furthermore, they proposed that if future studies still find no evidence of task performance variation despite a large difference in spatial presence, their conclusion would be strengthened. Moreover, the blurred distinction between motivation and learning outcomes in their study, could be addressed by observing specific motivational constructs.

Motivation in VR and Online Learning

Motivation has been a recurring theme in OL research. From being a significant indicator of dropouts in online courses (Choi & Park, 2018; Laato et al., 2019; Yang et al., 2013) to what sustains learners and enables them to finish massive open online courses (Barak et al., 2016; Onah et al., 2014). Despite increasing studies, much is left to be discovered regarding what enables learners to complete online courses and the different factors affecting their motivation (Barak et al., 2016; Kizilcec & Schneider, 2015; Onah et al., 2014). As discussed in the previous section, motivation has often been identified as an outcome or effect of using VR-based interventions in online and face-to-face educational contexts. In understanding motivation among online learners, theories from psychology have been used as lenses in this increasingly relevant context. Table 2.2 shows these theories, relevant constructs, and their proponents.

Table 2.2.

Contemporary Motivation Theories

Theory	Concepts	Major Proponents
Goal Theories	Goals; Performance Orientation; Mastery Orientation	Bandura (1988); Locke and Latham (1990); Zimmerman (2008); Ames and Archer (1988)
Future-self Guides	Ideal future-self; Ought-to future-self	Dornyei (2009)
Self-Determination Theory	Intrinsic Motivation	Deci and Ryan (1985)
Interest Theory	Personal Interest; Situational Interest; Interestingness	Krapp (1999); Hidi and Renninger (2006)

Goal theories were potential lenses of observing motivation among online learners because goals and how they are set or oriented can motivate learners to begin or finish an online course. Schunk et al. (2014) defined a goal as a "behavior or outcome that an individual consciously is trying to accomplish." Two popular theories centered on goals are Goal Setting Theory and Goal Orientation Theory. Bandura (1988), Schunk (1990), Locke and Latham (1990), and Zimmerman (2008) identified goal setting as a key motivational process. In their view, learners who set their goals and believe that they could attain them through engaging in certain activities will be motivated to do so while seeing their progress leading them to acquire new skills. Once the goals have been

attained, new goals will most likely be set. Social cognitive theorists contributed three major findings in goal setting.

The second major theory involving goals is goal orientation. It focuses on why an individual wants to achieve a certain goal. This supposedly affects one's behavior especially in how one accomplishes tasks to achieve that goal (Schunk et al., 2014). In the context of OL, two types of learners can be identified.

Performance-oriented learners seek to be recognized for their ability. Hence, they focus on displaying competence, which often results in learners trying to be the best in class or attempting to surpass standards set by the teacher or the school. They also try to avoid being judged for poor performance, which makes them inclined to avoid tasks that may lead to getting low marks (Schunk et al., 2014).

On the other hand, mastery-oriented learners are more concerned about developing competence, gaining understanding of a topic, or mastering a skill. Hence, they focus on improving rather than just displaying competence, which results in students striving to be good at something sans recognition or despite disapproval even if some of the activities that they engage in would have led them to get low marks (Schunk et al., 2014). Goals and goal-orientation are indeed useful constructs for studying learner motivation in OL contexts.

Deci and Ryan's (1985) Self Determination Theory (SDT) is one of the broadest and well-referenced theories of motivation in education. It is in fact considered to be a meta-theory as it includes several theories that explain the relationship of different factors for learning. It includes smaller component theories such as Cognitive Evaluation Theory (CET), Organismic Integration Theory (OIT), Causality Orientations Theory (COT),

Basic Psychological Needs Theory (BPNT), Goal Contents Theory (GCT), and Relationships Motivation Theory (RMT).

SDT assumes that everyone is an active psychologically growing organism whose growth can either be supported or hindered by one's social context. Another assumption was inspired by Maslow's hierarchy of needs. Ryan and Deci (2000) identified three psychological needs that serve as the basis of people's behavior as framed by SDT. These are autonomy, competence, and relatedness. The satisfaction of these needs can predict an individual's growth, development, and psychological wellness resulting to the successful accomplishment of tasks.

Furthermore, one important contribution of SDT is categorizing motivation into intrinsic and extrinsic motivation. Intrinsic motivation drives an individual to do something without an external reward or punishment. It can include factors like interest, enjoyment, and curiosity and can be used to explain why motivation is sustained or why one persists in engaging in a learning activity. However, there are also factors, external to the individual like rewards and incentives that can drive an individual to do something. These are what extrinsic motivation represents (Deci & Ryan, 2008).

While major contemporary motivational theories like goal-related theories and self-determination theory offered viable lenses in observing learner motivation in online learning contexts, two theories were found to be best in observing motivation in VR-based activities.

Goals and goal orientations are usually associated with dispositional characteristics of motivated individuals. Despite being able to capture motivational aspects of the learning activity, SDT is too broad to focus on the dynamics of motivation

when one is subjected to a more specific environment, such as in VR. Furthermore, the theories, being originally developed for face-to-face educational contexts may not be able to highlight the unique environmental features of VR and their potential in affecting motivation in ODE contexts.

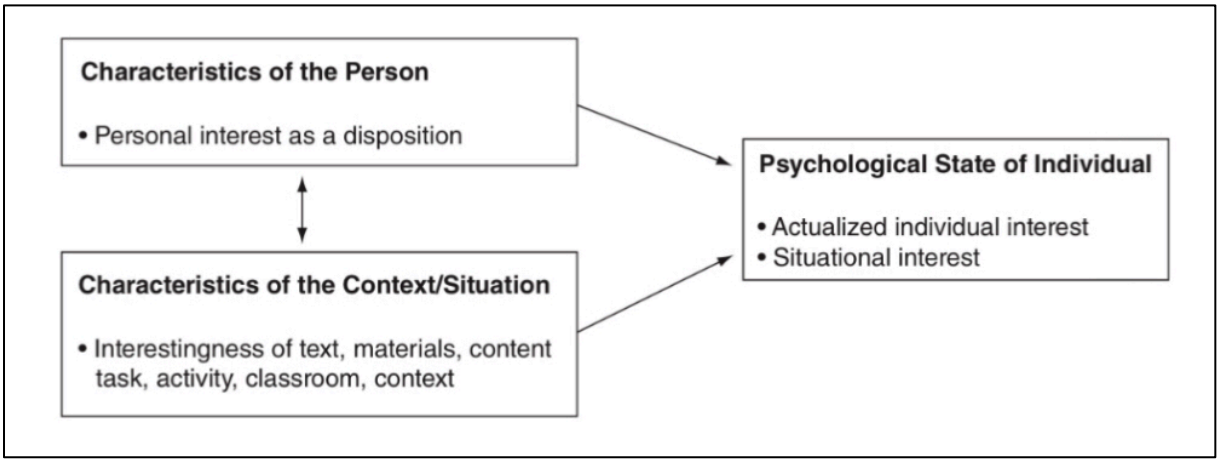
In a preliminary study involving a virtual campus tour (Figueroa et al., 2020), it was revealed that those who experienced the VR photo-based tour had heightened interest in the experience and the campus itself. Aside from this preliminary study, there is a dearth of research on the relationship between situational interest and spatial presence. Thus, this led to the selection of situational interest as one of the constructs for observing motivation in VR photo-based learning activities. In the same study, participants reporting feeling present in the environment and gaining interest in the activity also envisioned themselves to be future students at the university. This led to the selection of the second motivational construct, which is the ideal future-self. A detailed discussion of these two constructs and theories related to them follows.

Interest Theory

In the early years of research in motivation, little attention was given to interest. However, this trend has been changing recently. Schunk et al. (2014) defined interest as the "liking and willful engagement in an activity" (p. 246). Perspectives regarding interest research have been rather broad. Krapp (1999) was able to summarize them into three, which included two main types of interest: personal and situational. Figure 2.1 illustrates the three approaches to interest research as shown by Schunk et al. (2014).

Figure 2.1

Perspectives on Interest Research



*Note :*Adapted from Schunk, D. Pintrich, R. & Meece, J. (2014). *Motivation in Education: Theory, research, and applications* (4th ed., p. 243). Pearson.

Personal interest is seen as a relatively stable form of interest in an individual. However, personal interest varies from person to person. It is usually directed at specific activities or topics. Thus, the research focus on personal interest would usually be related to differences among individuals.

Interestingness is a construct attached to the learning environment rather than the learner or learner behavior. These are dimensions that trigger situational interest among learners. For example, dimensions such as novelty, surprise, complexity, and ambiguity can be seen as characteristics of a learning material or method that can trigger situational interest.

Situational interest is experienced in a context or an immediate environment. It is said to be increased by using media, engaging text materials, and watching presentations. Compared to personal interest, situational interest is relatively more consistent among individuals. In research taking the perspective of situational interest, interest is viewed as a psychological state (Schiefele, 2009). It is situational interest that is described as

something that makes attention and learning effortless because this is where affective reactions, cognitive functioning, and perceived value intertwine (Ainley, 2006; Hidi & Renninger, 2006).

A four-phase model of interest development was proposed by Hidi and Renninger (2006). The first phase is what they call triggered situational interest, which then evolves into maintained situational interest. The third phase is called emerging individual interest, which could develop into a self-sustaining, well-developed individual interest.

The first two phases of this model both pertain to situational interest. The first phase involves the actual triggering or activation of situational interest, and the second is the maintenance of the interest (Hidi, 1990, 2000; Hidi & Baird, 1986; Hidi & Harackiewicz, 2000).

A further distinction was made by Linnenbrink-Garcia et al. (2010) where they said that situational interest has a triggered, a maintained-feeling, and a maintained-value component. The maintained-feeling component refers to the extent that the material is enjoyable and engaging to the individual, while the maintained-value component refers to the extent that the material is deemed as important or valuable.

The model shows how compatible interest is with the contextual perspective of modern motivational thinkers. It also shows that interest has affective and cognitive components.

Individual interest is a state when an individual's personal interest can be heightened by a situational interest triggering activity or learning environment. However, others found that interest catching techniques that are supposed to induce situational interest affect motivation negatively among college students with high personal interest

on the subject, despite affecting motivation positively for those who had low personal interest (Durik & Harackiewicz, 2007).

Another string of studies involving interest as a psychological state revealed the relationship between interest and prior knowledge. Two models are illustrated in Figure 2.2. In the first model, situational interest is triggered when there is a high value regarded for that activity by the learner and when there is enough prior knowledge of the learner on that activity or the content of the activity.

Learners, on the contrary, are attracted to the activity or topic, if they see its value but have no or little prior knowledge of it. If both are low, then the learner may be ignorant of the activity and may be unmotivated. Another state that might not lead to motivation is when they have prior knowledge but see no value in the activity. This leads them to lose interest.

This model was disputed by researchers. They argued that it is possible to have interest without value or prior knowledge. They further noted that learners who do not have equally high prior knowledge may have equally high interest in a topic or activity as those with high prior knowledge (Alexander et al., 1994; Tobias 1994).

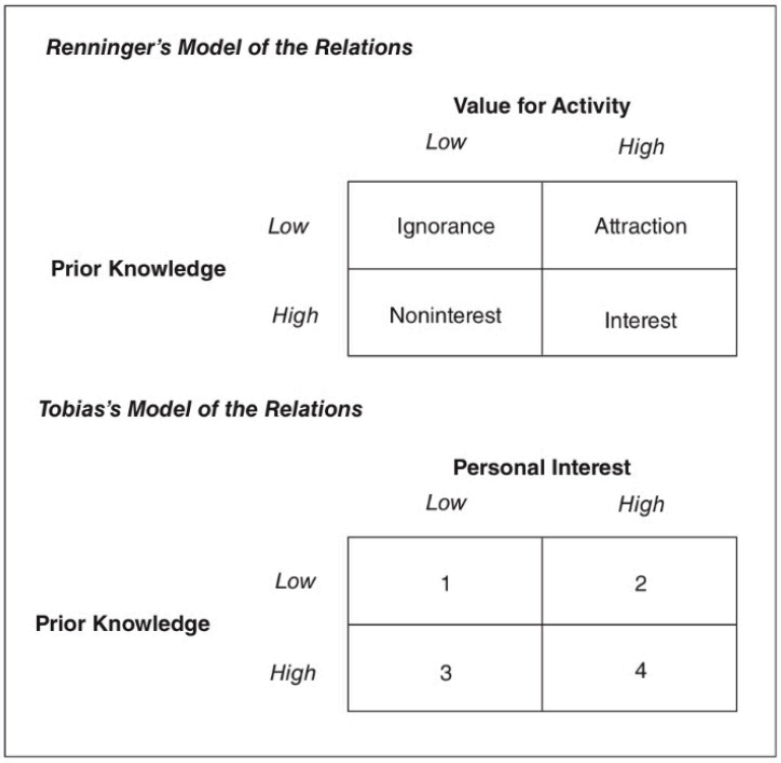
Thus, an alternative model was presented by Tobias (1994), which identified the level of situational interest generated based on a combination of prior knowledge and personal interest factors.

Despite conceptual and methodological issues in measuring interest, studies agree that personal interest and situational interest have a positive relationship with measures of memory, attention, comprehension, deeper cognitive engagement, thinking, and

achievement (Hidi, 2000; Hidi & Harackiewicz, 2000; Tobias, 1994; Trautwein et al., 2006).

Figure 2.2

Relational Models of Interest and Prior Knowledge



A study on preschoolers found that interest in different activities predicted their attention, recognition, and recall memory (Renninger & Wozniak, 1985). Among college students, it was found that personal interest had a positive correlation with their use of elaboration, seeking information, engagement in critical thinking, and self-reported time and effort engagement (Scheufele, 1999). Interest was also shown to be correlated positively with mastery goals (Harackiewicz et al., 2008).

More specifically, situational interest was found to be related to self-regulation, task engagement, and persistence (Sansone & Thoman, 2005; Smith, et al., 2009;

Thoman et al., 2011). Harackiewicz et al. (2016) argued that situational interest can directly promote learning by increasing attention and engagement. Furthermore, they argued that it predicts traditional measures of educational success, including which course will be taken in the future as well as learner performance.

The findings on the benefits of interest and the simplicity of situational interest as a construct have encouraged scholars to use it as a lens for observing motivation among learners who experienced technological and pedagogical innovations in face-to-face and online learning contexts.

There are many ways of observing situational interest, but a common method is through self-reported survey instruments. Following Hidi's (1990) Model of Situational Interest, survey instruments and scales that highlighted the two facets of triggered and maintained interest were reviewed for adoption and adaptation. Mitchell (1993), who explained the facets of situational interest with the concept of catching and holding developed a 38-item 6-point scale that was designed for students of an in-person Mathematics class. Items were grouped into sections that represented the components of his hypothesized model. Four items comprised personal interest that pertained to the students' dispositional interest in Mathematics (see Appendix A). One example item is: *Mathematics is enjoyable to me.* Four items measured meaningfulness. An example item is: *The stuff we learn in this class will never be used in real life.* Six items measured involvement. An example item is: *Our teacher has fun activities to learn the stuff that we need to know.* Class-specific sections, which pertain to Group work, Puzzles, and Computer, had six items each. A representative item is: *The mind-teasers or logic puzzles we do are fun.* The section that embodied situational interest had six items.

Schraw et al. (1995), who aimed to discover the sources of situational interest in reading materials, developed a 5-point Likert scale of ten items to measure situational interest (see Appendix A). They called the construct "perceived interest".

Chen et al. (2001) investigated sources of situational interest among students who participated in video viewing and participatory learning activities. In their path model, they showed that novelty, challenge, exploration intention, attention demand, and instant enjoyment affected students' interest either indirectly or directly. Among the 24 items of their Likert type survey, four items were designed to measure situational interest (see Appendix A), which they called "Total Interest".

Rotgans and Schmidt's (2009) findings supported claims that situational interest is predictive of observed achievement-related classroom behaviors and that these behaviors predict actual academic achievement. They based the development of their items on Hidi and Renninger's (2006) definition of situational interest, which pertained to an environmental stimuli-triggered focused attention and affective reaction. Both are triggered for a moment and may last for a certain time. This temporal dimension was captured by the researchers by doing repeated measures in their study.

A comprehensive scale developed by Linnenbrink-Garcia et al. (2010) presented items comprising triggered interest and maintained interest (see Appendix A). This instrument was identified to be a good basis for an instrument for measuring situational interest in VR-based learning intervention. However, modification of items was found to be necessary to make the instrument accommodate the context of VR-based activities in online learning settings in various fields of study.

Another motivational construct that could provide a good lens in observing motivation in VR-based online learning activities is the ideal future-self.

Theories Involving Future-self Guides

The ought self and the ideal self, known collectively as future-self guides were popularized in the context of language learning by Dornyei (2009) when he developed the L2 Motivational Self-System. These future-self guides can be likened to goals as both pertain to future end states. However, future-self guides are different because the ideal or ought selves are perceived and experienced with the same senses that the current motivated self is perceiving or experiencing through imagery. Dornyei (2009) emphasized that "the inclusion of imagery is a central element of possible-selves theory" (p. 17). One's image of a future ideal self can serve as a strong driving force to act towards fulfilling that dream.

Self-discrepancy Theory

Another theory that may support the possible selves is self-discrepancy (Higgins, 1987). In this theory, he presented the concept of a discrepancy between the actual or present self and the future self, which could either be the ideal self or the ought self. He stated that one is assumed to have the desire to reduce this discrepancy, which is the basis of one's motivation. This desire is fulfilled by self-regulatory strategies. Furthermore, Higgins (1998) added that future-self guides may either have a promotion focus or a prevention focus. Having a promotion focus means that future-self guides may aim for positive future concepts like hopes and dreams, while having a prevention focus refers to regulating negative outcomes that are brought about by failing to fulfill obligations.

Conditions for Motivation

Dornyei (2009) mentioned certain conditions that may either foster or hinder motivation triggered by future self-guides. The first condition pertains to the existence of a vivid future self-image. Furthermore, the image needs to be as vivid as possible to make the learner motivated to work towards that image. This also means that the more vivid the image of the future self-guide is, the stronger the motivation generated in the person. Dornyei referred to the work of Higgins (1987, 1998) and recognized that not everyone can have a vivid future-self image, which explains some learners' lack of motivation. Moreover, vividness of that image varies among learners (Richardson, 1994). Thus, this section of the theory has become an effective call for practical interventions in the language classroom.

The second condition pertains to one's belief that one can eventually reach the state of one's future-self. It means that the more likely the learner believes the future-self guide can be achieved, the stronger the motivation will be for the learner to reach that state. Conversely, if the learner feels that the possibility of reaching the state of the self-guide is low, then motivation will also be low. An important concept that embodies this phenomenon is called perceived behavioral control. The conceptualization of this condition was contributed by Norman and Aron (2003) who stated that perceived behavioral control represents the degree or strength of belief of a learner that his or her behavior can lead to or avoid a future-self guide.

The third condition pertains to the agreement of the ideal self and the ought self. One example is that of a learner of a second language such as English who is surrounded by peers who always speak in their first language. In some peer groups, speaking English

may be associated with social climbing, and thus can be the subject of ridicule. Because of social pressure from peers, the learner may have an ought self that only speaks the first language. However, the learner's ideal self may be someone who speaks English fluently. This disharmony can make the learner demotivated. If the ought self and ideal self agree with each other, the learner will have more motivation to learn the second language.

The fourth condition concerns cognition and working memory. It is said that despite having plausible future-self guides, they might still be stored in long-term memory and require activation before they can trigger motivation. That means that certain events related to these self-images are necessary to stimulate transference to working memory. A practical empirically tested intervention suggested by Ruvolo and Markus (1992) is what is called imagery manipulation, which involves asking learners to imagine themselves as someone successful in a task at hand before doing the task.

A vision is difficult to achieve without a plan or a strategy. Thus, it is important that future-self guides are accompanied by a strategy or a series of tasks or steps to reach that ideal or ought self. Furthermore, because future-self guides involve long-term images and thus associated with long-term goals, it would be useful to insert proximal goals as suggested by Locke and Latham (1990). Having a system or a plan for reaching the future-self guide is critical to generate and facilitate motivation.

The final condition mentioned is called offset by the feared self. This condition pertains to the notion that motivation is more effectively generated when there is a desired possible self and an additive feared possible self to complement it. Oyserman and Markus (1990) explained that negative consequences of not achieving a desired end-

state may help strengthen and sustain the motivation generated by the desire to reach that end-state.

These five conditions were often met by interventions that require visioning techniques. However, the researcher believes that spatial presence experienced in VR-based interventions can provide an alternative and potentially a more powerful way of meeting these conditions. Based on the results of the researcher's previous study (Figueroa et al., 2020), it was hypothesized that the spatial presence provided by VR to the learner may have had an impact on the formation and strengthening of the learner's ideal future-self. For example, a VR-tour of London may help a learner of English envision oneself as being there in the future, either as a tourist or as a resident. This includes being able to explore the area comfortably by using one's strong command of English, thereby energizing the learner to learn English. It was, therefore, identified to be a good lens together with situational interest in observing motivation among learners in VR-based online learning activities.

Like situational interest, the ideal future-self, which is a slightly newer construct, gained attention regarding instrument development among educational researchers, particularly those who are in the field of language learning. Most of the well-known instruments used in language learning were based on the instruments developed by Lamb (2012) and that of Mostafa et al. (2018).

The items developed by Papi et al. (2019) further divided the ideal future-self into the learner's vision for oneself and the one envisioned by those who are significant for the person like family and friends (see Appendix A). Due to the items' specificity

regarding the target language, modification would be necessary to adopt them in fields that are not related to language learning.

Problem Statement

The previous sections revealed what has been studies vis-à-vis VR-based interventions in educational contexts. They also revealed the lack of studies based on theoretical foundations that would have made their results more impactful.

In summary, there has not been any empirical study as of this writing that has explored the relationship of VR's environmental aspects of immersive capability and spatial presence; motivation as manifested by situational interest and ideal future-self; and learning outcomes in an online learning context that uses a VR-based intervention.

With the COVID-19 pandemic changing the educational landscape by compelling learning institutions to implement emergency remote teaching, the potential in finding the effects of VR's environmental attributes on situational interest and the ideal future-self among learners in a similar online learning context would contribute to knowledge needed for not only catalyzing, but also for maintaining motivation in learning situations that are likely to emerge in what is dubbed as *the new normal*. The researcher attempted to address these gaps by first conceptualizing a model based on the theories highlighted in this chapter and conducting studies based on this initial model as the theoretical framework.

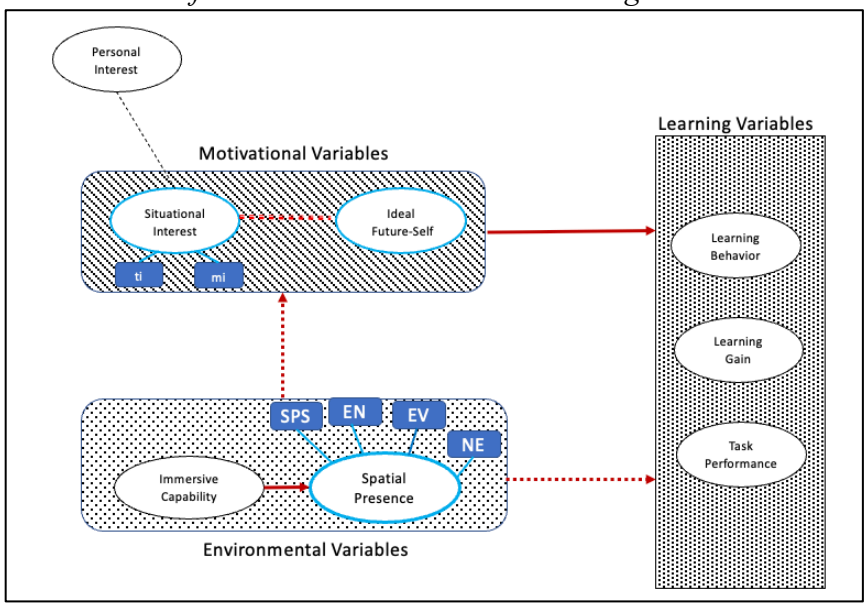
Theoretical Framework

The studies presented in this dissertation were guided by assumptions gathered from theories and empirical studies reviewed. Figure 2.3 is an initial model that

illustrates the constructs and their theoretical relationship with each other as well as learning-related variables. The model served as a theoretical framework of the studies. Situational interest and its relationship with personal interest was based on the theories of Krapp (1999) and Hidi and Renninger (2006). The two phases of situational interest, which are triggered interest and maintained interest, were established by Hidi's (1990, 2000) early studies and supported by associates (Hidi & Harackiewicz, 2000; Hidi & Renninger, 2006; and Linnenbrink-Garcia et al., 2010).

Figure 2.3

Initial Model of Motivation in VR-based Learning



Legend. ti: Triggered Interest; mi: Maintained Interest; SPS: Sense of Physical Space; EN: Engagement; EV: Environmental Validity; NE: Negative Effects.

Solid lines represent relationships that were empirically proven by studies while broken lines represent theoretical relationships that were implied by previous research but lacked empirical evidence. Thus, the studies aimed to validate the previously proven relationships in various VR-based learning contexts and provide empirical evidence supporting assumed relationships based. The definition of spatial presence was based on

what has been established by Slater et al. (1995) and supported by other researchers (Bouchard et al., 2004; Lessiter et al., 2001; Schmutz et al., 2015;). The effects of different aspects of VR's immersive capability on spatial presence were supported by Slater and Usoh (1994), Witmer and Singer (1998), Sheridan (1992), and Steuer (1992). The studies were also built upon the assumptions that situational interest, ideal future-self, and spatial presence have an influence on certain aspects of learning such as academic and task performance (Kim & Biocca, 1997; Rotgans & Schmidt, 2009; Welch, 1999), behavior (Dornyei & Chan, 2013), and actual outcomes like memory retention and grades (Kim & Biocca, 1997). Using the theoretical framework as a guide, the following research questions were formulated:

Research Questions

The proposed studies in this dissertation aimed to answer the following research questions in the context of a VR photo-based tour:

1. Studies 1 and 2: How are situational interest, ideal future-self, and spatial presence measured and understood in the context VR photo-based tours experienced by a particular group of adult learners?
2. Study 3: What is the relationship between the motivational variables (situational interest and ideal future-self), environmental variables (spatial presence and immersive capability), and learning outcomes in the context VR photo-based tours experienced by a particular group of adult learners?
3. Study 4: How do the levels and relationships among the motivational variables (situational interest and ideal future-self), environmental variables (spatial

presence and immersive capability), learning behavior, and learning outcomes change through time among adult learners from different backgrounds?

The Studies and their Scope

The ideal future-self, which was extracted from the L2 Motivational Self-System had been used and operationalized mainly for language learning. Moreover, the original scale of situational interest was designed for in-person traditional classes and contained items that were not relevant to the context of using a VR-based learning activity. Furthermore, spatial presence as operationalized by the ITC-SOPI has been validated in various contexts but not for VR photo-based tours taken by Filipino adult learners. **Studies 1 and 2** addressed these gaps by employing iterative development of VR photo-based tours in ODE and Sustainability Science coupled with survey research. This was followed by a Confirmatory Factor Analysis of Spatial Presence and Exploratory Factor Analysis (EFA) of situational interest and the ideal future-self construct among Filipino adult learners. In the framework shown in Figure 2.3, the dimensions of variables (*highlighted in blue*) were explored to answer the first research question. Details are found in Chapter 3.

Previous studies investigated situational interest as an individual construct or as a component of other motivational constructs in educational settings, but no single study has investigated its relationship with the dimensions of spatial presence as well as its interaction with the ideal future-self. Thus, **Study 3** tested the relationships and interactions of the variables in the same framework (*highlighted in red*) through an experiment of two groups of participants. Variable relationships in the data were tested

using ANOVA, correlation analysis, and path analysis. Details of the experimental study are found in Chapter 4.

As VR is still considered as a novelty, it is worth considering how situational interest and the ideal future-self linger and fluctuate among learners through time. As of this writing, a study that investigated dynamics in the context of VR photo-based tours is not yet in existence. **Study 4** investigated these dynamics qualitatively in ten lessons taken individually by seven online learners of English in Japan and France. This qualitative exploration is outlined in Chapter 5.

CHAPTER 3:

Study 1: Dimensions of Spatial Presence, Situational Interest, and Ideal Future-self

Study 1 mainly clarifies the dimensions of spatial presence, situational interest, and ideal future-self among adult Filipino learners exposed to a VR photo-based tour of an open university in the Philippines. It starts with a detailed description of the three phases and the findings derived from the analyses performed. A discussion of the findings leads to the justification of Study 2, which involves a VR photo-based tour of a tropical forest in the Philippines. It follows the same activities as Study 1 but further clarifies the one-dimensional constructs of situational interest and ideal future-self in the same demographic context.

Objectives

This chapter describes the design and implementation of studies and the analyses of data necessary to quantitatively understand and measure spatial presence, situational interest, and the ideal future-self by establishing validity and reliability of instruments and performing factor analyses.

More specifically, the objectives of the studies were:

1. To clarify the dimensions of spatial presence,
2. To clarify the dimensions of situational interest, and
3. To clarify the dimensions of ideal future-self in the context of VR photo-based tours among Filipino adult learners.

Methodology

The first study featured a VR photo-based tour on Open and Distance Education (ODE). The following sections describe the context and design of the study as well as the instruments developed, the analyses performed, and findings from these analyses that led to the decision of conducting *Study.*

A VR photo-based tour that features important spots of the university as the learning activity for teaching ODE concepts was developed. It was developed using *Kuula,* an online platform for designing and developing VR photo-based tours. Participants experienced the learning activity using a VR headset or smartphone.

Participants

There were 228 participants recruited in the study, but only 206 were able to complete the survey questionnaire. They were either university students or working adults who were prospective online learners aged 18 to 50. There were 68 males and 137 females in the group. One was identified to be of another gender. Among those who completed the survey, 74% have experienced VR before.

Instruments

Three instruments were used in this study. The first one was a scale developed based on the existing situational interest scale. The second instrument was a scale developed with modified items from the ideal L2-self scale. The third instrument was ITC-SOPI, which could measure the four dimensions of spatial presence.

Situational interest

From the review of scales that could be used to measure situational interest, the questionnaire published by Linnenbrink-Garcia et al. (2010) was chosen and later modified to fit the context of the study because it clearly operationalized Hidi and Renninger's (2006) concepts of triggered and maintained interest in the academic setting.

This questionnaire composed of 5-point Likert items was originally designed to measure situational interest in an in-person class on Introductory Psychology. However, the scale that was used in Study 1 was for a single learning activity that teaches Open and Distance Education. Thus, many of the items had to be modified. Table 3.1 lists the items that were adjusted for the study's context. Important modifications included changing the subject matter, replacing "class" with "activity", and removing one item which was about the instructor.

Table 3.1

Situational Interest Items for a Learning Activity in ODE

Item Code	Item Description
mi1	I think that the topic of the activity (Open and Distance Education) is very interesting.
mi2	Open and Distance Education fascinate me.
mi3	I am excited about Open and Distance Education.
mi4	I think that what we are learning in the activity is important.
mi5	I think that what we are studying in the activity is useful for me to know.
mi6	I think that Open and Distance Education is important to learn

Item Code	Item Description
mi7N	To be honest, I just don't find Open and Distance Education interesting.
mi8	I find Open and Distance Education personally meaningful.
mi9	I see how I can apply what we are learning in the activity in real life.
ti1N	This activity has been a waste of my time.
ti2N	I don't like the activity very much.
ti3N	The activity is not very interesting.
ti4	I enjoy doing tasks in the activity.
ti5N	The activity seems to drag on forever.
ti6	I am enjoying the activity very much.

Ideal Future-self

From the review of questionnaires that could be used to measure ideal future-self, the one published by Lamb 2012 was chosen and later modified to fit the context of the study.

This questionnaire consisting of 5-point Likert items was originally designed to measure the ideal L2-self in English. However, because the topic in Study 1 was ODE, the items had to be modified. Table 3.2 lists the items that were adapted for the study's context.

Table 3.2

Ideal Future-self Items Contextualized for ODE

Item Number	Item Description
idf1	The things I want to do in the future involve Open and Distance Education.
idf2	I imagine myself as someone who will be able to practice skills in Open and Distance Education.
idf3	I aspire to be someone who can accomplish tasks requiring knowledge of Open and Distance Education.
idf4	I see myself as one day effectively applying Open and Distance Education-related knowledge and skills.
idf5	If my dreams come true, I'll one day practice the skills and apply knowledge related to Open and Distance Education effectively.
vv1	I clearly see myself in the future practicing the skills and applying knowledge related to Open and Distance Education.
vv2	The vision of myself practicing the skills and applying knowledge related to Open and Distance Education is vivid.
vv3	The vision of myself accomplishing tasks requiring knowledge of Open and Distance Education is very clear.
vv4	I strongly envision myself as someone who can use Open and Distance Education-related skills and knowledge effectively.
idf6	It is easy to think of myself as a future user of Open and Distance Education-related skills and knowledge.

Important modifications included changing the subject matter and removing adverbs that expressed frequency or degree as each item was scored depending on degree of agreement. Furthermore, as suggested by literature, the concept of vividness was included in the scale. Thus, items related to vividness, which also pertained to the clarity or strength of the vision, were added to the scale.

Spatial Presence

After reviewing the various instruments developed for measuring spatial presence, the 44-item 5-point scale inventory developed by Lessiter et al. (2001) was chosen due to its comprehensiveness as it included dimensions like negative effects, engagement, and naturalness. Due to its copyright conditions, the full scale was shared only to the committee members of this dissertation. A full copy of it needs to be personally requested from the main author through her email (J.Lessiter@gold.ac.uk).

Development and Implementation

VR Photo-based Tour Preparation

The components of the VR photo-based tour included photos of an open university. Thus, permission was secured from the university's Information Office Director. Then, all the necessary technological equipment were purchased. Fourteen key areas of the campus were identified to be included in the tour. VR-photos of these key areas were taken using a *Rico Theta VR Camera*. Finally, VR-photos for the tour were prepared for uploading through a method called stitching.

Scriptwriting and Tour Creation

The script for audio explanations of various hot spots of every key area was written. There then followed the recording of audio narration for each hot spot of the tour

using *Audacity*, a free and open-source audio editor. Once the components were complete, the media elements were uploaded and organized in the platform. The platform also had the capability to apply stereophonic ambient sounds and implement artificial rays of the sun. Those features were utilized to increase the environmental validity of the tour.

The first scene of the VR photo-based tour is shown in Figure 3.1. The tour has an ambient sound of a park with occasional chirping of birds to provide a more realistic experience for the viewers. The sound file was downloaded from a repository of royalty free and CC0 licensed audio files. Hotspot audio was played every time an information icon is clicked when using a computer or gazed at when using a VR headset or HMD. Text labels were made to float as markers of each hotspot.

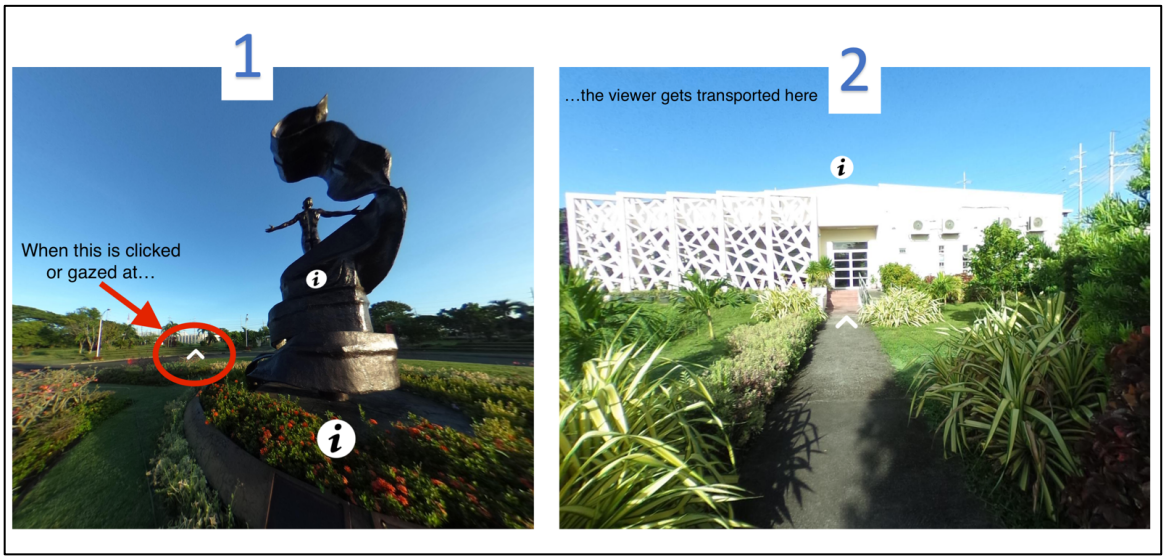
Figure 3.1

Opening Scene of the VR Photo-based Tour in Study 1

Clicking on or gazing at path icons transported viewers to the next area, which was geographically adjacent to the current area in real life. Gazing in VR refers to directing one's focus on a particular area that is usually represented by a small white dot. It is usually counted as a gaze when the dot stays on a specific area for at least 2 seconds. Figure 3.2 shows how an area transition happens after a gaze or click.

Figure 3.2

Area Transition in a VR Photo-based Tour



Designing the Online Survey

An online survey that included an introduction of the study and the primary investigator as well as ethics related statements was developed using a free online software system (FOSS) called *Limesurvey* (Baker, 2013). All the items were approved by the Ethics Committee of the International Christian University before they were incorporated into the online and printable versions of the survey. This study had a target of at least 200 participants. The printed version of the survey is included in Appendix B.

Data Collection and Analysis

People who were recruited and agreed to participate received a short introduction on how to operate the VR headset. The process took around two to five minutes per participant. Then, they were asked to experience the tour for about five minutes. After the experience, they filled out the online or printed survey form depending on their situation. Accomplished printed forms were encoded into the survey platform.

The dataset had to be cleaned first as there were entries that were deemed to be invalid because of a considerable number of missing values or because they were detected to be duplicate answers of some of the participants who experienced technical issues while they were answering the online survey.

Confirmatory Factor Analysis

Data were analyzed for the variables constituting spatial presence (P), using *R*, a programming language and software environment that has a plethora of libraries for statistical computing and data science. More specifically, a confirmatory factor analysis (CFA) was performed in *R* using the lavaan (Rosseel, 2012) and semPlot (Epskamp, 2019) libraries. Due to administrative constraints, two items from ITC-SOPI were dropped. These were B9 and B10.

Exploratory Factor Analysis

Data were analyzed for the variables constituting situational interest (SI) and the ideal future-self (IF) using *R*. More specifically, exploratory factor analysis (EFA) was performed using the psych (Revelle, 2012) and MVN (Korkmaz et al., 2014) libraries, which contain methods for psychometric analysis and testing for multivariate normality.

Tests of adequacy. Tests of adequacy were performed to prepare the data for factor analysis. Both SI and IF data also passed Kaiser-Meyer-Olkin's (KMO) sampling adequacy criteria with values of 0.89 and 0.94 respectively. The MSI values of the items ranged from 0.78 to 0.94 for SI and from 0.92 to 0.96 for IF, which were all considered to be good. Thus, none of the items were dropped at this stage. Items for both SI and IF passed the Bartlett's test of sphericity with both p-values being less than 0.01.

Tests of normality. After the data were found to be adequate for factor analysis, tests of normality were conducted to determine the method to use for exploring dimensions. The data were inspected visually by producing histograms of each item from the situational interest and ideal future-self scales. A Shapiro-Wilk Test of normality was also performed on each item. None of the items had a p-value greater than or equal to 0.05. Therefore, none of the items followed a normal distribution according to this test. Mardia's multivariate skewness and kurtosis tests of normality were also performed using the mvn function. Mardia's skewness and kurtosis values were 2,483.66 and 35.31, respectively with p-values that were less than 0.05. Since Mardia's kurtosis value was not less than 5 (Bentler, 1995), it was concluded that the items of SI failed the multivariate normality test. A visual inspection using a Q-Q plot confirmed this conclusion as data that conformed to multivariate normality should follow a straight line (Arifin, 2015). From these tests, it had been determined that SI data did not follow a normal distribution.

The data of IF had a similar trend. All items failed the Shapiro-Wilk tests of normality. As for Mardia's multivariate, skewness and kurtosis values were 347.21 and 11.16, respectively with p-values that are less than 0.05. The IF scale likewise failed

Mardia's kurtosis cut-off value, which was supported by the Q-Q plot shown in Figure 3.6.

Determining the number of factors. Before proceeding to factor analysis, it was important to determine the number of factors to extract. Among several methods available, parallel analysis was chosen as this compares scree plots with randomly generated data plots (Brown, 2015). The method assumes that observed eigenvalues that are higher than random ones are more likely from meaningful factors than those lower than the latter. The scree plot from the parallel analysis suggested two factors of situational interest and one factor of ideal future-self for initial extraction.

Factor Analysis. The results of the previous tests for SI and IF helped in deciding on the extraction and rotation methods employed in the factor analysis. For extraction, Principal axis factoring (PAF) was chosen as it did not assume normality of data (Brown, 2015). Furthermore, the *oblimin* rotation method was chosen due to the widely taken assumption in the social sciences that correlated factors depict reality more and are less restricting than orthogonal rotations.

To perform EFA, the *fa* function from the *psych* package (Revelle, 2012) was used with maximum iterations modified from a default of 50 to 100.

Findings

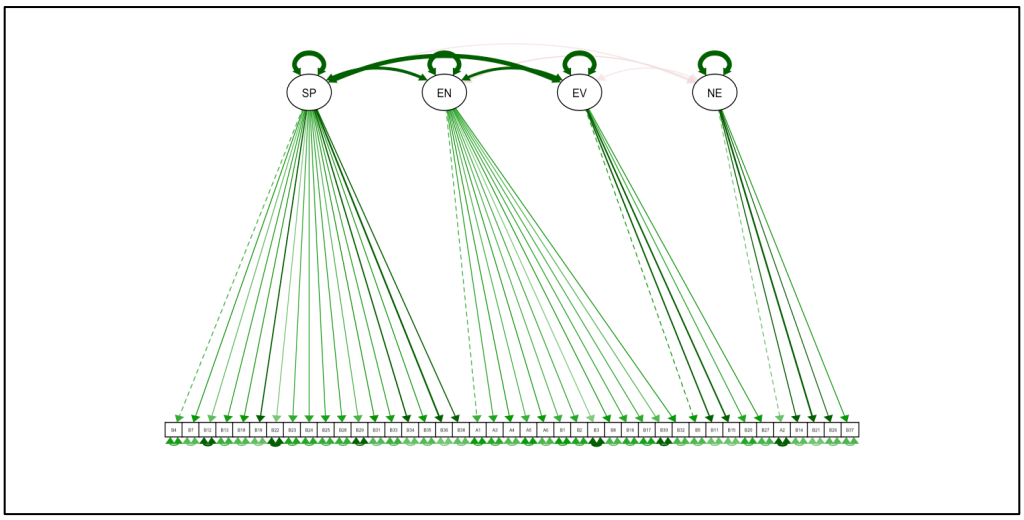
Objective 1: Dimensions of Spatial Presence

The first objective of the study was to clarify the dimensions of spatial presence by investigating the validity and reliability of ITC-SOPI in the context of a VR Photo-

based tour through CFA. The plot of the model generated in the CFA is shown in Figure 3.3.

Figure 3.3

Four-factor Diagram of ITC-SOPI Dimensions



Darker shades of item edges represented strong factor loadings, while paler shades represented weak factor loadings. The thickness of edges between factors represented correlation between them. Highly correlated factors had thick bidirectional edges between them, while factors that were barely correlated with each other had thin or almost indistinguishable edges between them

Fit indices and their chi-square significance were inspected to find out whether the model fit the data well and establish the reliability of the ITC-SOPI four factor model. Table 3.3 shows the relevant values based on Hu and Bentler's (1999) recommendation. The significant p-value of Chi-square was expected because of the sample size. A sample size that is greater than 200 tends to have a significant p-value. The relative or incremental fit indices CFI (Comparative Fit Index) and TLI (Tucker-Lewis Index) were below the ideal values, while the absolute fit indices RMSEA and SRMR were within the

acceptable range. Therefore, the model was found to have a mediocre fit vis-à-vis the data collected from Filipino adult learners.

Table 3.3

CFA Fit Indices for ITC-SOPI Dimensions

Index	Value	Ideal
Chi-square p-value	0	>0.05
Comparative Fit Index	.80	>0.90
Tucker-Lewis Index	.79	>0.90
RMSEA	.07	<0.08
SRMR	.08	<0.08

Modification indices were inspected to determine whether a model that would better fit the data existed. After iteratively removing 18 items from the model, fit indices showed ideal values as shown in Table 3.4. The modified model is illustrated in Figure 3.4.

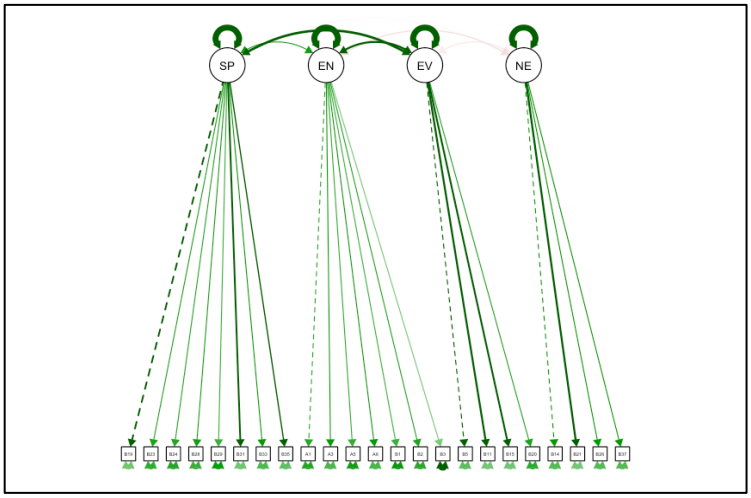
Table 3.4.

CFA Fit Indices for Modified Items in ITC-SOPI Dimensions

Index	Value	Ideal
Chi-square p-value	0	>0.05
Comparative Fit Index	.92	>0.90
Tucker-Lewis Index	.91	>0.90
RMSEA	.06	<0.08
SRMR	.06	<0.08

Figure 3.4

Four-factor Diagram of Modified ITC-SOPI Items

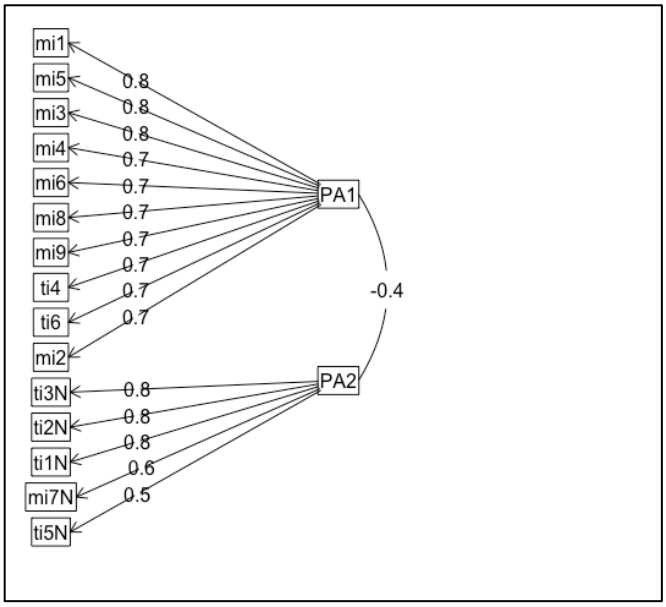


Objective 2: Dimensions of Situational Interest

Figure 3.5 illustrates the factor loadings of items in each of the two dimensions produced for situational interest.

Figure 3.5

Two-Factor Diagram of Situational Interest in Study 1

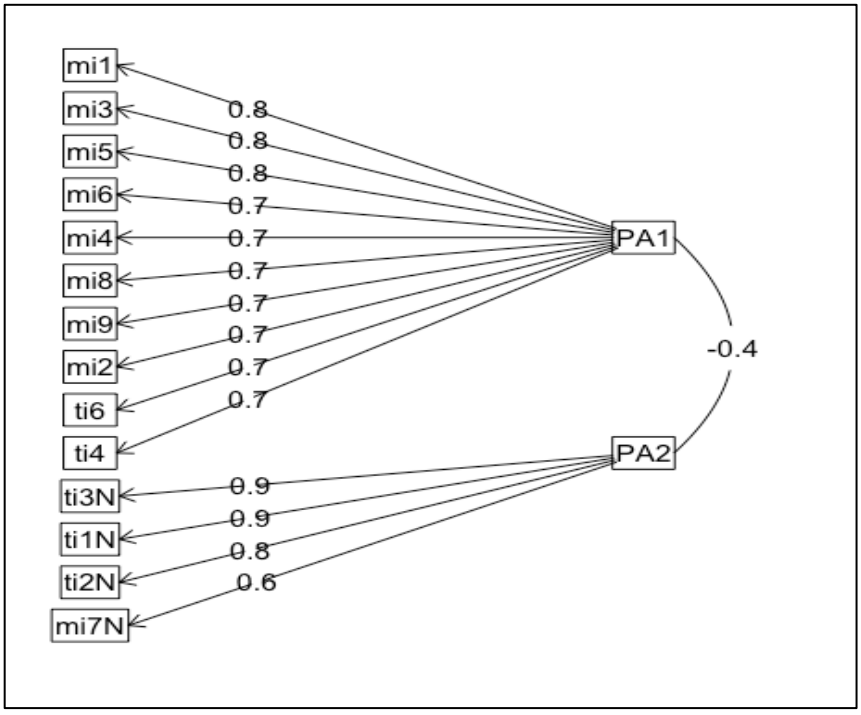


The factor loadings of observed variables in factor 1 (PA1) ranged from 0.7 to 0.8, while those in factor 2 (PA2) ranged from 0.5 to 0.8. Values between 0.3 to 0.4 were minimally acceptable, somewhere between 0.5 and 0.7 were practically significant, and those greater than or equal to 0.7 were a well-defined structure. Therefore, 0.5 was established to be the cut-off value. This meant that items with factor loadings that were less than 0.5 would have to be removed. From the results, ti5N had a factor loading of 0.465 that was a little below the cut-off value on Factor 1 (PA1). Thus, it had to be removed.

Factor analysis was again performed on the data without ti5N. Figure 3.6 shows the factor analysis diagram of situational interest after the removal of item ti5N.

Figure 3.6

Diagram of Situational Interest after Removing Ti5N



Factor loadings, cross-loadings, and communalities were again inspected. This time, the factor loadings of items in either factor were all greater than the cut-off value. Furthermore, there were no cross-loadings of items observed across factors where the assigned cut-off was 0.3. Another value that was inspected to indicate cross-loading was item complexity (com). Items specific to one factor should have an item complexity close to the value 1. Communalities (h2) were also inspected. An item communality expresses how much the variance in an item is explained by the extracted factors. Arifin (2015) suggested the value 0.25 if the cut-off for factor loadings is 0.5. Based on this cut-off, it could be said that all items satisfied the communalities criterion.

Finally, factor correlations were also inspected. According to Brown (2015), factors that have a correlation greater than 0.85 were considered indistinct from each other and could be combined. The factor correlation between factor 1 and factor 2 was -0.386, which led to the conclusion that the two factors were distinct from each other.

Upon verifying the existence of two factors and upon inspection of the items comprising each factor, the first factor was arbitrarily named positive situational interest (PSI), while the second factor was named negative situational interest (NSI) or situational disinterest.

The result of the Chronbach's alpha analysis for positive situational interest was 0.913, while that of negative situational interest or situational disinterest was 0.854.

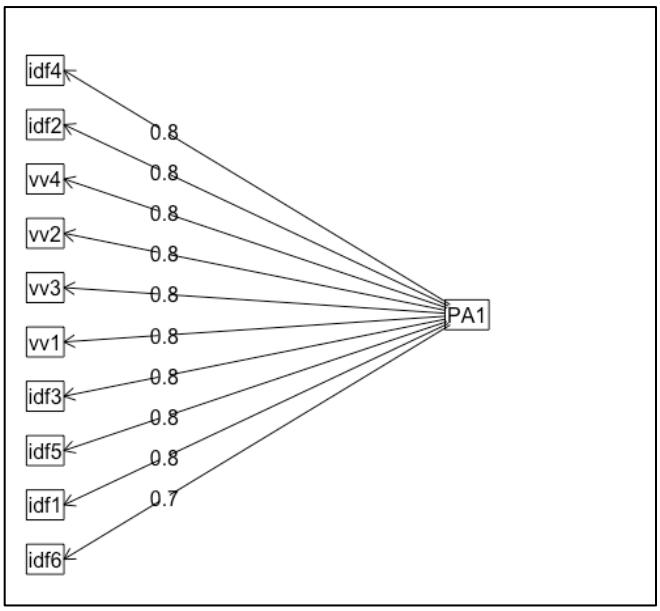
Objective 3: Dimensions of Ideal Future-self

Figure 3.7 illustrates the factor diagram of the ideal future-self with factor loadings of all items close to 0.8 after running EFA. Communalities of each item were also greater than the cut-off. Inspecting for cross-loading and factor correlations was not

relevant because there was only one factor extracted in the analysis**.** The result of the Chronbach's alpha analysis for ideal future self (IF) was 0.942.

Figure 3.7

One-Factor Diagram of Ideal Future-self in Study 1



Method Effect and Reliability Issues

The findings revealed two dimensions that could be considered as polar opposites: interest and disinterest. Situational interest as a multi-dimensional construct is common in literature (see Chen et al., 1999; Deci, 1992; Hidi & Renninger, 2006; Linnenbrink-Garcia et al., 2010). Although initially, the instrument was based on triggered and maintained interest as dimensions of situational interest as prescribed by previous studies, the outcome of the EFA produced positive situational interest and negative situational interest or situational disinterest as dimensions.

Although negative constructs exist in literature, such as amotivation (Deci & Ryan, 1985) and negative effects (Lessiter et al., 2001), the two polar opposite dimensions obtained from the EFA of this study gave rise to a suspicion that the results

were caused by the *method effect* (Ibrahim, 2001; Salazar, 2015). Other researchers pertain to this phenomenon as *wording effect* (Carmines & Zeller, 1979; Dobson et al., 1979; Wu, 2008). According to literature, this phenomenon is usually brought about by participants carelessly evaluating negatively worded statements that are mixed in the instrument with positively worded statements to reduce acquiescence bias. They argued that method effect was a threat to construct validity. At first, it was assumed that removing negatively worded statements could easily fix it, but literature supports maintaining negatively worded items to lessen acquiescence bias. Therefore, after reflecting on the steps performed in creating the survey instrument, it was revealed that being reviewed by experts in the field for face validity can be complimented by a review by experts that are part of the target context. Doing this would have minimized the occurrence of method effect by identifying words or phrases that might be deemed confusing by participants of that culture. Furthermore, it was realized that reminding each participant to read the items carefully and asking questions anytime while answering the survey should have been an important part of participant orientation.

Though the alpha value of negative situational interest was found to be very good at 0.854, the alpha value of positive situational interest at 0.913 was found to be too high (DeVellis, 2016) and led to the consideration of shortening the scale. The same could be said about the alpha value of ideal future self, which was 0.942.

These issues led to the revision of the instruments and conducting another study to further clarify dimensions as presented in Chapter 4.

CHAPTER 4:

Study 2: Clarifying Situational Interest and Ideal Future-self

Study 2 addresses the issues found in Study 1 by conducting another study that uses revised improved instruments for situational interest and ideal future-self among adult Filipino learners exposed to a VR photo-based tour of a tropical forest in the Philippines. The study was aimed at achieving two objectives carried over from the first study. More specifically it aimed to clarify the dimensions of situational interest and ideal future-self in the context of VR photo-based tours among Filipino adult learners.

Methodology

The VR photo-based tour designed and developed in this study was one of the materials of a massive open online course (MOOC) entitled Forest Ecosystem Services and Community Livelihoods, which will be jointly offered by The University of British Columbia (UBC) and the University of the Philippines (UP) in 2022. The learning activity was designed to teach the different types of forest ecosystem services while being virtually situated in a protected forest in the Philippines.

Participants

There were 254 participants in the survey, but only responses from 232 participants were deemed to be valid in the study. There were 140 male and 102 female participants in the group. Their ages ranged from 20 to 70 years old. Most of the participants were in their 30s. The variety of their occupations were like the first study's participants, which were dominated by graduate students, researchers, and working professionals.

Among the participants, 60% have experienced using VR before joining the study. Around 52% of the participants experienced the tour using a computer or a mobile phone without a VR device, while the other 48% experienced the tour using either an Oculus Go or a mobile device with VR goggles.

Instruments

A modified version of the two scales were incorporated in the survey questionnaire used in this study. Table 4.1 shows the revised 7-point situational interest scale. The items from the previous interest scale were re-inspected. Two experts and three Filipino adult learners were consulted for face and content validity. The scales were also modified into 7-point scales from the original 5-point scales to moderate skewness.

Table 4.1

Situational Interest Items for Study 2

Item Number	Item Description
si1p	The virtual tour was entertaining.
si1n	I did not enjoy doing the virtual tour.
si2p	I liked the virtual tour.
si2n	I felt bored when doing the virtual tour.
si3p	I can see how I can apply what we are learning in the virtual tour in real life.
si3n	What we are learning in the virtual tour is not important.
si4p	The topic of the virtual tour was interesting.
si4n	The topic of the virtual tour is not useful.

The activity was also replaced by a more specific phrase: *Virtual tour* to avoid the confusion among the participants as they might think about other activities of the class if they would answer in a class setting. Items that had the adverb "very" were removed or modified as the Likert scale was said to already express degree of agreement. Items that had similar meanings were also merged into one. Upon interviewing Filipino consultants, the term *fascinating* was replaced by *entertaining.* They also mentioned that mentioning the actual topic could make each statement difficult to read. Therefore, it was decided to replace *Forest Ecosystem Services* with *topic.* With these changes, it was also hoped that the scale would be easier to adopt in other fields of study.

Finally, the number of positively worded and negatively worded items were balanced and interspersed to reduce the likelihood of acquiescence bias as supported by researchers in the past (DeVellis, 2016; Schriescheim & Hill, 1981). Despite recent studies reporting method effects coming from negatively worded items (e.g., Salazar, 2015; Sonderen et al., 2013), it was decided to mix negatively worded items based on the counter examples provided by recent studies (e.g., Lin et al., 2017; Locker et al., 2007; Riedel, 2012) with strategies that involved minimizing polar opposites and negated polar opposites as suggested by Schriesheim and Hill (1981).

As the ideal future-self scale developed in the previous study had a Cronbach's alpha value that suggested a reduction of items, the scale items were re-examined the same way as the ones in situational interest. The same strategies were applied which resulted into the list found in Table 4.2.

Table 4.2

Ideal Future-self Items for Study 2

Item Number	Item Description
IFS1P	The things I want to do in the future involve the topic of the virtual tour.
IFS1N	I do not imagine myself as someone who can practice skills related to the topic of the virtual tour.
IFS2P	I aspire to be someone who can accomplish tasks requiring knowledge of the topic of the virtual tour.
IFS2N	I do not see myself applying the topic of the virtual tour in any aspect of my life.
IFS3P	I have a clear vision of myself doing something related to the topic of the virtual tour.
IFS3N	When I imagine the future, I am uncertain as to how the topic of the virtual tour can be relevant in my life.

Design and Development

Developing the VR Photo-tour

VR photos of key areas in a tropical forest were taken using a *Rico Theta VR Camera.* One VR photo that exemplified the subject matter was chosen among several candidates. The photo was then stitched so that it could be loaded onto the VR tour platform. The title of the tour was “Forest Ecosystem Services”.

The script was crafted from the main study material and was matched with the chosen area. The voice over based on the script was also recorded using *Audacity*

(Audacity Team, 2014). Hotspots were then carefully overlaid onto various areas of the VR photo where the voice over would be played upon being triggered by a click or a gaze. Figure 4.1 shows the VR photo-based tour.

Figure 4.1

Forest Ecosystem Services VR Photo-based Tour

Designing the Online Survey

Another survey using the same system, *Limesurvey*, was developed. The items were approved by the committee members through an update that was given to them by the researcher. This iteration also had a target of at least 200 participants. The printed version of the survey is shown in Appendix C.

Data Collection

The procedure for data collection of the second iteration was quite similar with the first iteration. A key difference was that it took less time experiencing the tour for

each participant because it featured only one area or scene. Therefore, there were no transition markers or arrows in this tour.

The procedure followed the same sequence. Participants received instructions on how to operate the VR headset, which took around two to five minutes per participant. Then, they were asked to experience the tour for around two minutes. After the experience, they were asked to fill out the online or printed survey form depending on their situation. Filled out printed forms were encoded into the survey platform.

Exploratory Factor Analysis

After cleaning the dataset and removing invalid records, the data for the variables constituting situational analysis (SI) and ideal future-self (IF) were imported and analyzed using *R*. An exploration of the underlying dimensions of situational interest and the ideal future-self was repeated. The same functions for conducting multivariate normality testing and EFA were used.

Tests of Adequacy

According to the sample size criterion, the dataset of 232 valid samples was found to be adequate. The KMO of SI and IF were 0.87 and 0.77, respectively. Thus, they were both considered adequate for factor analysis. MSI values of SI items ranged from 0.84 to 0.90, while that IF items ranged from 0.67 to 0.83. Thus, none of the items were dropped at this stage. The third test was Bartlett's test of sphericity. Items for both SI and IF passed the test with both values less than 0.01.

Tests of Normality

After the data was found to be adequate for factor analysis, tests of normality were conducted to determine what method to use for exploring dimensions. The data

were inspected visually by producing histograms of each item from the situational interest and ideal future-self scales. From the visual inspection, most of the items seemed to not follow a normal distribution. A Shapiro-Wilk Test of normality was also performed on each item. None of the items had a p-value greater than or equal to 0.05. Therefore, none of the items followed a normal distribution according to this test. Mardia's multivariate skewness and kurtosis tests of normality were also performed using the mvn function. Mardia's skewness and kurtosis values were 1,418.61 and 39.63, respectively with p-values that were less than 0.05. Since Mardia's kurtosis value was not less than 5 (Bentler, 2006), it was concluded that the items of SI failed the multivariate normality test. A visual inspection using a Q-Q plot confirmed this conclusion as data that conforms to multivariate normality should follow a straight line (Arifin, 2015).

From these tests, it was found that the SI data did not follow a normal distribution. The data of IF had a similar trend. They all failed the Shapiro-Wilk test of normality. As for Mardia's test, skewness and kurtosis values were 235.38 and 9.58, respectively with p-values that were less than 0.05. Since Mardia's kurtosis value was not less than 5, it was concluded that the items of IF failed the multivariate normality test.

Determining the Number of Factors

Parallel analyses were conducted to determine the number of initial factors to be extracted for situational interest and ideal future-self. The scree plots suggested three for situational interest and two for ideal future-self.

Factor Analysis

The results of the previous tests for SI and IF helped in the selection of the extraction and rotation methods in the factor analysis. For extraction, Principal axis

factoring (PAF) was chosen as it does not assume normality of data (Brown, 2015). Furthermore, the *oblimin* rotation method was applied because they were less restrictive and assumed correlated factors as suggested by Fabrigar and Wegener (2012).

To perform EFA, the *fa* function from the *psych* package (Revelle, 2012) was used with maximum iterations modified from a default of 50 to 100. After determining the construct validity of both situational interest and ideal future-self using EFA, reliability through internal consistency was determined using Cronbach's alpha.

Findings

Objective 1: Dimensions of Situational Interest

Like Study 1, findings in this study could not be separated from some activities. Therefore, intermediary methods were included in this section. Figure 4.2 illustrates the factor loadings of items in each of the three factors produced for situational interest. No Item loaded onto factor 3 (PA3) so another iteration was done, this time for two factors. Figure 4.3 shows the new diagram.

The item si3p cross-loaded onto factor 1 and 2 with FL values of 0.312 and -0.456, respectively and a complexity value of 1.77. Thus, it was removed. Upon removing it and running EFA again, si1n showed to have exhibited cross-loading with FL at -0.363 and 0.373 and was removed. After the next iteration, only si4n and si3n loaded onto factor 2. This led to the merger of the two factors. Upon doing this, si3n was shown to have 0.229 communality value, which prompted the researcher to remove it. Another run showed that si4n had a low communality of 0.238 and was also deleted.

Figure 4.2

Three-Factor Diagram of Situational Interest in Study 2

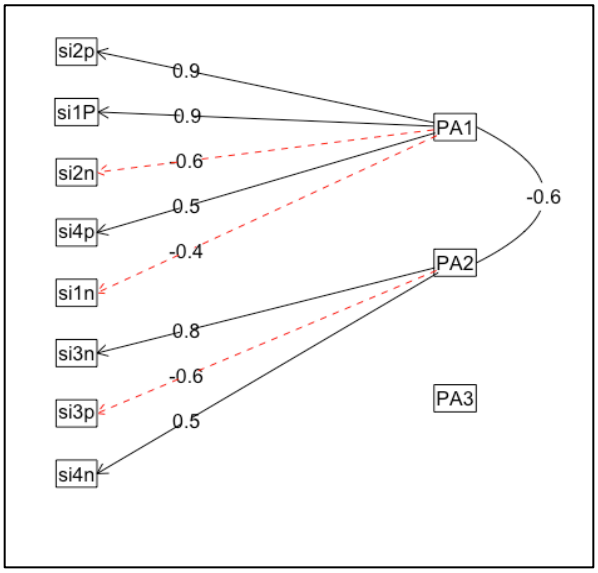
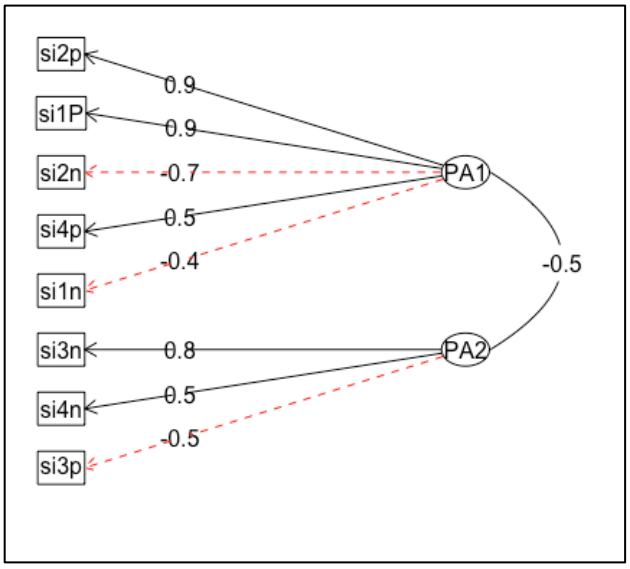


Figure 4.3

Two-Factor Diagram of Situational Interest in Study 2



The resulting one-factor diagram is shown in Figure 4.4. After the last iteration, communalities and factor loadings were found to be satisfactory. Table 4.3 shows a list of these values of the final situational interest items.

Figure 4.4

One-Factor Diagram of Situational Interest in Study 2

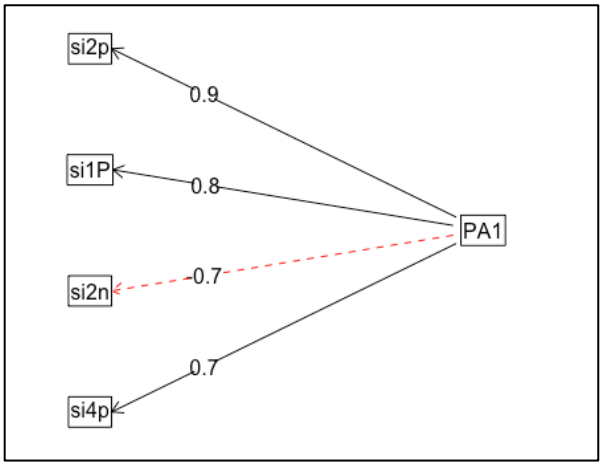


Table 4.3

Factor Loadings of Situational Interest in Study 2

Items	PA1	h2
si1p	0.83	0.30
si2p	0.89	0.21
si2n	-0.73	0.47
si4p	0.71	0.50

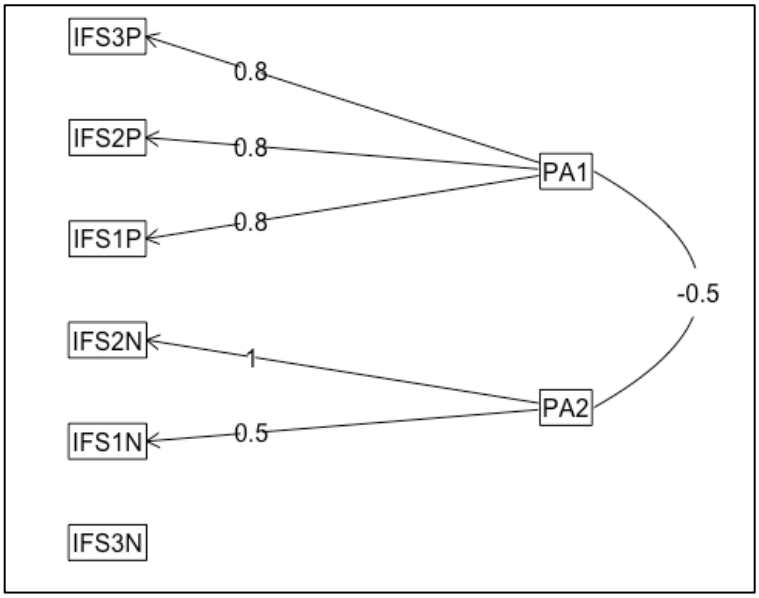
The Cronbach's alpha value for situational interest was 0.865. Based on the interpretation by DeVellis (2016), the model was found to have a very good internal consistency.

Objective 2: Dimensions of Ideal Future-self

The EFA for IF resulted in a model that had initially two factors based on the parallel analysis results. Figure 4.5 shows the two-factor diagram produced after running the analysis in *R*.

Figure 4.5

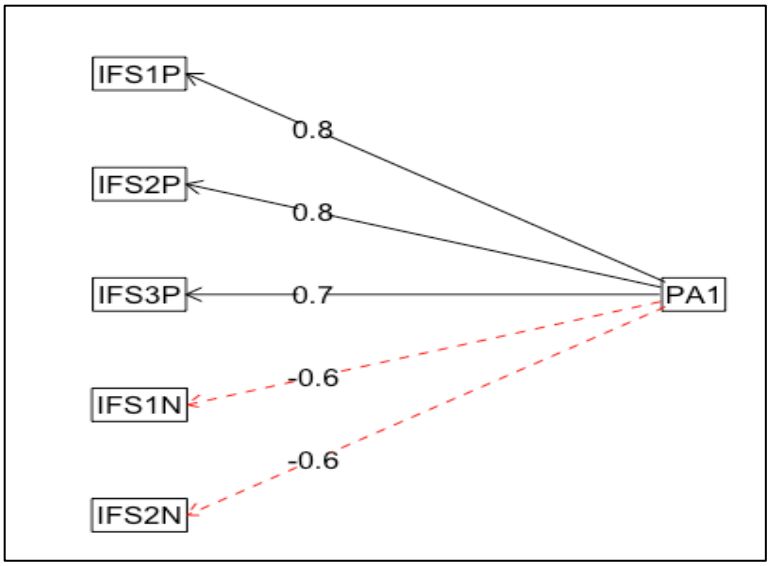
Two-Factor Diagram of Ideal Future-self in Study 2



None of the two factors loaded sufficiently onto IFS3N. Thus, the item had to be deleted. After this, Factor 2 (PA2) ended up with only two items, leading to its merger with Factor 1 (PA1). This final step led to a one-factor diagram for IF as shown in Figure 4.6.

Figure 4.6

One-Factor Diagram of Ideal Future-self in Study 2



After this, all the factor loadings and communalities were inspected and found to be acceptable. Table 4.4 shows the factor loading and communality of each item of the ideal future-self.

Table 4.4

Factor Loadings of Ideal Future-self in Study 2

Items	PA1	h2
IFS1P	0.77	0.60
IFS1N	-0.64	0.41
IFS2P	0.77	0.59
IFS2N	-0.62	0.39
IFS3P	0.74	0.55

The Cronbach's alpha value for ideal future-self was 0.834. Based on the interpretation by DeVellis (2016), the model was found to have a very good internal consistency.

Chapters 2, 3, and 4 clarified dimensions of spatial presence, situational interest, and ideal future-self. The instruments that were found to be valid and reliable became the main instruments for Study 3 which is discussed in detail in Chapter 5.

CHAPTER 5: Study 3 - Relationship of Immersive Capability, Spatial Presence, Situational Interest, Ideal Future-self, and Learning Outcomes

This chapter discusses the results of a study that investigated the relationships of environmental, motivational, and learning-related variables in an educational VR photo-based tour experienced by Filipino adult learners. It starts with a brief introduction and objectives of an experimental study that was aimed at investigating the relationship of immersive capability, spatial presence, situational interest, and ideal future-self.

The study is outlined in three main phases: 1) the selection of the VR photo-based tour; 2) the experiment involving two groups of participants who experienced the VR photo-based tour with devices providing different levels of immersive capability; and 3) the statistical analyses performed for investigating variable relationships.

Objectives

The chapter describes the design and implementation of *Study 3* and the analyses of data necessary to investigate the relationship of immersive capability, spatial presence, situational interest, and the ideal future-self by performing the necessary statistical tests.

More specifically, the objectives of the studies were:

1. To investigate the effect of immersive capability on the dimensions of spatial presence;
2. To investigate the effect of immersive capability on situational interest and ideal future-self;
3. To investigate the effect of immersive capability on learning outcomes;

4. To determine the correlations between the dimensions of spatial presence, situational interest, ideal future-self, and learning outcomes; and
5. To create a model that describes causal relationships between situational interest, the ideal future-self, and the dimensions correlated with them.

Methodology

The subject matter and VR photo-based tour chosen for the current study was the same as in *Study 2*. It was designed to teach the different types of forest ecosystem services while featuring a prominent protected forest in the Philippines, which could be accessed through URL: http://bobfigueroajr.com/esvr2.

Participants

A total of 60 participants who had experience in or were taking online courses were recruited using purposive sampling as Filipino adult learners. However, only 59 responses were deemed to be valid as one participant was not able to complete the questionnaire after the experiment. The study had 15 male and 44 female participants. Most of the participants were in their twenties (44) and thirties (11). Three were in their forties and fifties, and one participant was in her sixties.

Materials and Instruments Selection

The instruments used in this study included the following: 1) situational interest scale; 2) the ideal future-self scale validated in the previous study; 3) the original ITC-SOPI scale; and 4) the learning outcomes operationalized by getting the difference between the post-test and pre-test of an eight-item quiz.

The quiz was developed to test participant knowledge of concepts that were taught in the VR photo-based tour. The difference was called learning gain or simply *gain*.

Experiment Setup

The participants were randomly assigned to one of the two groups. In *Group 1, 29* participants experienced the VR photo-based tour on a laptop computer or smart phone without a head mounted device (HMD) or VR-glasses. This was referred to as the *low immersive capability group.* Meanwhile, 30 participants in *Group 2* experienced the VR photo-based tour with an HMD. Specifically, they used an *Oculus Go* to experience the tour immersively. This was also referred to as the *high immersive capability group*. The step-by-step procedure of the experiment is outlined in Table 5.1 with the time allotment for each step.

Table 5.1

Procedure of the Experiment in Study 3

Time	**Group 1**	**Group 2**
5 min.	Orientation	Orientation
10 min.	Pre-test	Pre-test
10 min.	VR Photo-based tour without HMD	VR photo-based tour with HMD
10 min.	Post-test	Post-test
15 min.	Survey	Survey

Each participant was asked to answer a short quiz containing items regarding the topic before experiencing the activity. The items of the quiz are listed in Appendix D. Then, participants were asked to experience the VR photo-based tour within ten minutes. Those who were in Group 1 used a laptop with a headset that the researcher provided during the experiment to experience the tour. Those who were in Group 2 used Oculus Go with the tour already loaded. They were then asked to answer the same short quiz that was given before the experience followed by a survey containing items pertaining to situational interest, ideal future-self, and spatial presence.

Data Analysis

Data were subjected to statistical analysis to achieve the objectives of the study. The effect of immersive capability on the dimensions of spatial presence, situational interest, ideal future-self, and learning outcomes, were tested using t-test. The test was performed using the *R stat* package, while comparison of means was visualized using the *ggplot2* package (Wickham, 2016).

Relationships between variables were determined using correlation analysis. A visual correlation matrix was generated using the *Performance Analytics* package (Peterson et al., 2018). Finally, hypothesized relationships were tested using path analysis via structural equation modelling functions in the *R lavaan* package (Rosseel, 2012), while path diagrams were generated using the *semPaths* package (Epskamp, 2019). The hypotheses set for t-test and correlation analysis of each variable can be found in Appendix E.

The sequence of measures taken as well as their corresponding statistical procedures are outlined in Table 5.2.

Table 5.2

Statistical Methods and Objectives in Study 3

Measure	Statistical Procedure
1. Effect of Immersive Capability on dimensions of Spatial Presence	t-test
2. Effect of Immersive Capability on Situational Interest and Ideal Future-self	t-test
3. Effect of Immersive Capability on Learning Outcomes	t-test
4. Relationship of Spatial Presence, Situational Interest, Ideal Future-self, and Learning Outcomes	Correlation Analysis
5. Hypothesized Effects between Situational Interest, Ideal Future-self, and correlated variables	Path Analysis

The initial model (see Chapter 2) and modifications were tested using path analysis. It is composed of a set of expressions containing endogenous variables on the left and exogenous variables that were assumed to have influence on the former based on theory.

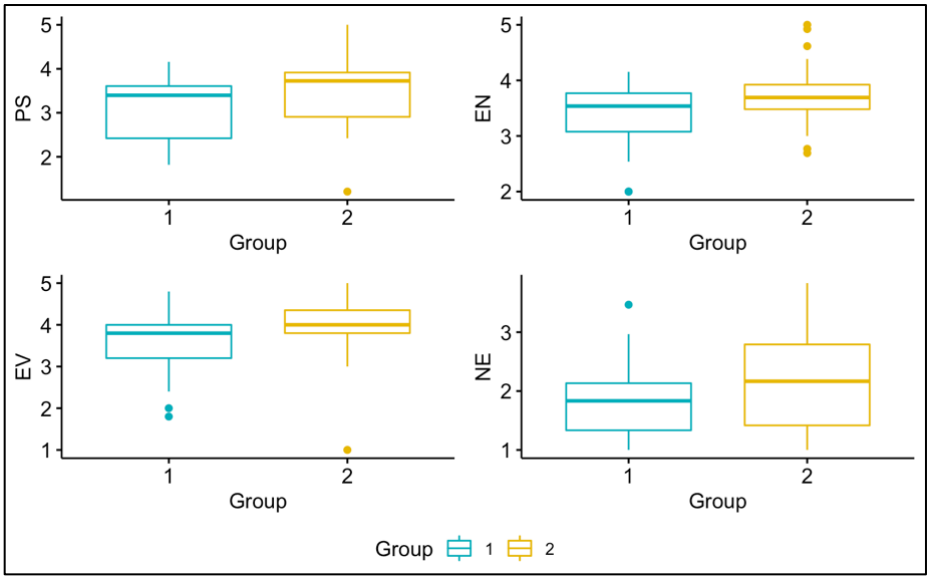
Findings

Objective 1: Dimensions of Spatial Presence and Immersive Capability

Figure 5.1 shows a comparison of boxplots of the four dimensions of spatial presence among three groups. Participants in Group 2 (high immersive capability group) had higher means of sense of physical space (PS), engagement (EN), environmental validity (EV), and negative effects (NE) than those in Group 1 (low immersive capability group).

Figure 5.1.

Boxplots of Spatial Presence Dimensions in Study 3



Legend. PS: Sense of Physical Space; EN: Engagement; EV: Environmental Validity; NE: Negative Effects

These differences were statistically tested and a summary of results from the t-test performed for the four dimensions are shown in Table 5.3.

Table 5.3.

Mean Difference in Spatial Presence Dimensions

Variable	t	p-value
PS	2.24	0.03*
EN	2.65	0.01*
EV	1.59	0.12
NE	2.33	0.02*

Legend. PS: Sense of Physical Space; EN: Engagement; EV: Environmental Validity; NE:
Asterisks: * ($p < 0.05$), ** ($p < 0.01$), *** ($p < 0.001$)

Effect of Immersive Capability on Sense of Physical Space

The 29 participants in the low immersive capability group had an average score of 3.07 (SD = 0.74), while the 30 participants in the high immersive capability group had an average sense of physical space score of 3.52 (SD = 0.81).

Results from the t-test revealed that the effect of immersive capability on the sense of physical space dimension was statistically significant t (57) = 2.24, p = 0.03.

Effect of Immersive Capability on Engagement

Participants in the low immersive capability group had an average score of 3.36 (SD = 0.58), and those in the high immersive capability group had an average score of 3.75 (SD = 0.53).

Results from the t-test revealed that the effect of immersive capability on the engagement dimension was significant, t (57) = 2.65, p = 0.01.

Effect of Immersive Capability on Environmental Validity

Participants in the low immersive capability group had an average score of 3.61 (SD = 0.78), and those in the high immersive capability group had an average score of 3.93 (SD = 0.76).

Results from the t-test revealed that the effect of immersive capability on the environmental validity dimension was not significant, t (57) = 1.59, p = 0.12.

Effect of Immersive Capability on Negative Effects

Participants in the low immersive capability group had an average score of 1.79 (SD = 0.57), and those in the high immersive capability group had an average score of 2.24 (SD = 0.87).

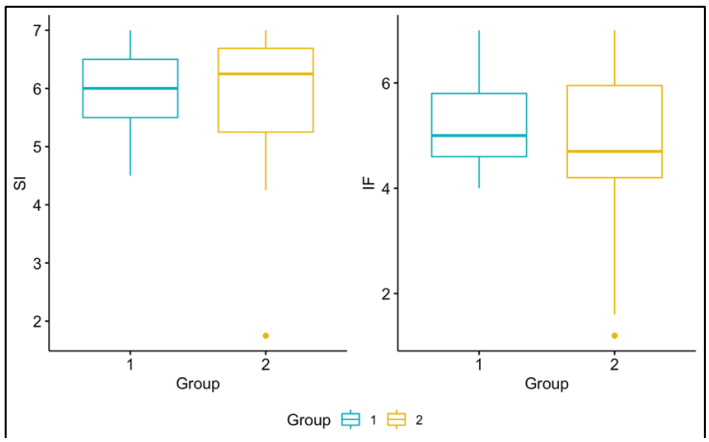
Results from the t-test revealed that the effect of immersive capability on the negative effects dimension was significant, t (50) = 2.35, p = 0.02.

Objective 2: Immersive Capability, Situational Interest, and Ideal Future-self

Figure 5.2 shows a comparison of situational interest (SI) and ideal future-self (IF) among two groups

Figure 5.2

Boxplots of Situational Interest and Ideal Future-self in Study 3



Legend. SI: Situational Interest; IF: Ideal Future-self

The mean of the high immersive capability group was found to be slightly higher than the low immersive capability group. However, a reversed trend was found in ideal future-self.

A summary of results from the t-test performed for situational interest and ideal future-self are shown in Table 5.4.

Table 5.4.

Mean Difference in Situational Interest and Ideal Future-self

Variable	t	p-value
SI	0.06	0.95
IF	1.24	0.22

Legend. SI: Situational Interest; IF: Ideal Future-self

Effect of Immersive Capability on Situational Interest

Participants in the low immersive capability group had an average score of 5.94 (SD = 0.77), and those in the high immersive capability group had an average score of 5.92 (SD = 1.11).

Results from the t-test revealed that the effect of immersive capability on situational interest was not significant, t (57) = 0.06, p = 0.95.

Effect of Immersive Capability on Ideal Future-self

Participants in the low immersive capability group had an average score of 5.18 (SD = 0.84), and those in the high immersive capability group had an average score of 4.79 (SD = 1.51).

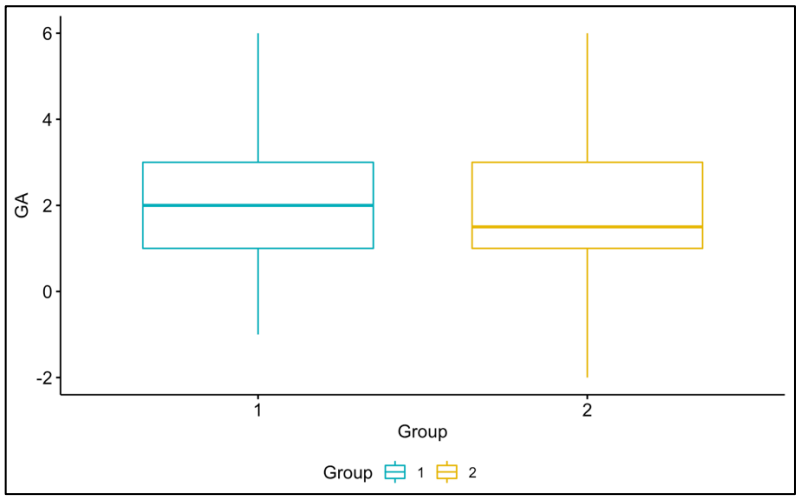
Results from the t-test revealed that the effect of immersive capability on ideal future-self was also not significant, t (46) = 1.24, p = 0.22.

Objective 3: Immersive Capability and Learning Outcomes

Figure 5.3 shows a comparison of boxplots of score gain among two groups. Participants in the low immersive capability group had the higher score gains than those in the high immersive capability group.

Figure 5.3

Boxplots of Score Gain in Study 3



Legend. GA: Score Gain

Effect of Immersive Capability on Score Gains

Participants in the low immersive capability group had an average score gain of 2.07 (SD = 1.91), while those in the high immersive capability group had an average score gain of 1.7 (SD = 1.78).

Results from the one-way t-test revealed that the effect of immersive capability on score gain was not significant, t (57) = 0.77, $p = 0.45$.

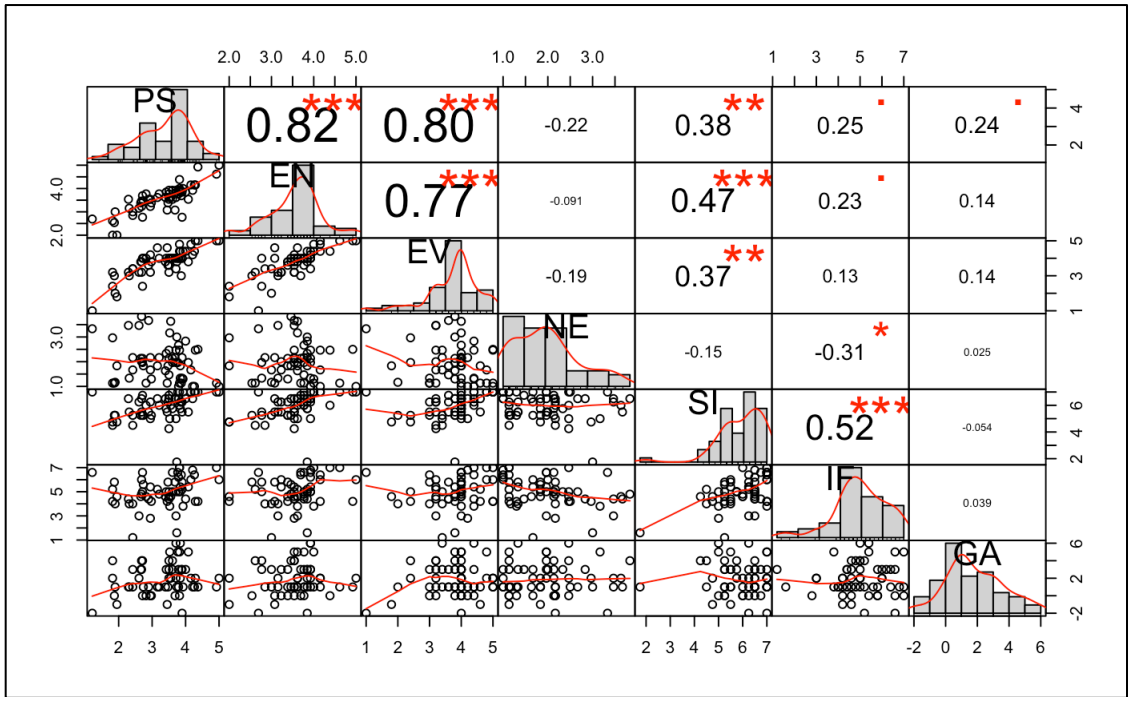
Objective 4: Correlation Among Variables

Results from the correlation analysis performed among variables are shown in Figure 5.4. The matrix contains various information regarding correlational results. The

principal diagonal elements containing variable labels (i.e., PS, EN, EV, NE, SI, IF, and GA) also show the respective distribution of their data.

Figure 5.4.

Correlation Plot of Variables in Study 3



Legend. PS: Sense of Physical Space; EN: Engagement; EV: Environmental Validity; NE: Negative Effects; SI: Situational Interest; IF: Ideal Future-self; GA: Score Gain; Asterisks: * ($p < 0.05$), ** ($p < 0.01$), *** ($p < 0.001$)

Effect size of each correlation is displayed as upper diagonal elements and are intersections of the variables. For example, intersection of PS and EN is a cell containing the effect size of their correlation (i.e., 0.82), which is also marked by asterisks. One asterisk represents p-values that are less than 0.05. Two asterisks represent those that are less than 0.01, while three asterisks represent those that are less than 0.001. The font-size of the text in the cell is displayed proportional to the effect-size.

Lower diagonal elements show scatter plots with trend lines that approximate linear relationships between variables orthogonal to them.

Dimensions of Spatial Presence

Sense of physical space (PS) and engagement (EN) were found to be strongly correlated, r (57) =0.82, $p < .001$. PS and EV were also found to be strongly correlated, r (57) = 0.80, $p < .001$. Lastly, EN and EV were found to be strongly correlated, r (57) = 0.77 $p < .001$. None among the other dimensions of spatial presence was significantly correlated with negative effects (NE).

Situational Interest, Ideal Future-self, and Learning Gain

Among participants, situational interest (SI) was found to be moderately correlated with PS, r (57) =0 .38, $p < 0.01$, EN, $r(57) = 0.47$, $p < 0.001$, and EV, $r(57) = 0.37$, $p < 0.01$. Meanwhile, ideal future-self (IF) was found to be weakly correlated with PS, r (57) = 0.25, $p < 0.05$, EN, r(57) = 0.23, $p <$0. 05, and inversely correlated with NE, r (57) = -0.31, $p < 0.05$. SI and IF were found to be strongly correlated, r (57) =0.52, $p <$ 0.001. Score gain was found to be weakly correlated with SP, r(57) = 0.24, $p < 0.05$.

Objective 5: Path Analysis of Environmental, Motivational, and Learning-related

The path analysis for the initial model yielded bad fit indices, thus it had to be modified. These modifications were based on the results of the correlational analysis and previous studies. The list containing the representation of the initial model in *R* and its modified versions together with their respective fit indices are presented in Table 5.5.

The initial model had bad fit indices. Therefore, two subsets of the model (i.e., Model 2 and Model 3) that was still supported by theory was tested. In Model 2, only the indication of direct effects of motivational variables on score gain was kept. However, it still yielded bad fit indices.

Table 5.5.

Fit Indices of the Initial Model and Modifications in Study 3

Model Number	R-code	Fit indices
1: Initial Model	SI ~ PS + EV + EN + NE IF ~ PS + EV + EN + NE GA ~ SI + IF + PS + EV + EN + NE	χ2 p-value = 0.000 CFI= 0.560 TLI = -5.594 RMSEA = 0.50 SRMR = 0.07
2:	SI ~ PS + EV + EN + NE IF ~ PS + EV + EN + NE GA ~ SI + IF	χ2 p-value = 0.000 CFI= 0.519 TLI = -0.443 RMSEA = 0.23 SRMR = 0.10
3:	SI ~ PS + IF IF ~ NE GA ~ PS + NE	χ2 p-value = 0.434 CFI= 1.000 TLI = 1.026 RMSEA = 0.000 SRMR = 0.060

Legend. PS: Sense of Physical Space; EN: Engagement; EV: Environmental Validity; NE: Negative Effects; SI: Situational Interest; IF: Ideal Future-self; GA: Score Gain; R-Code: Dependent variables are on the left of the tilde (~) and predictor variables are on the right.

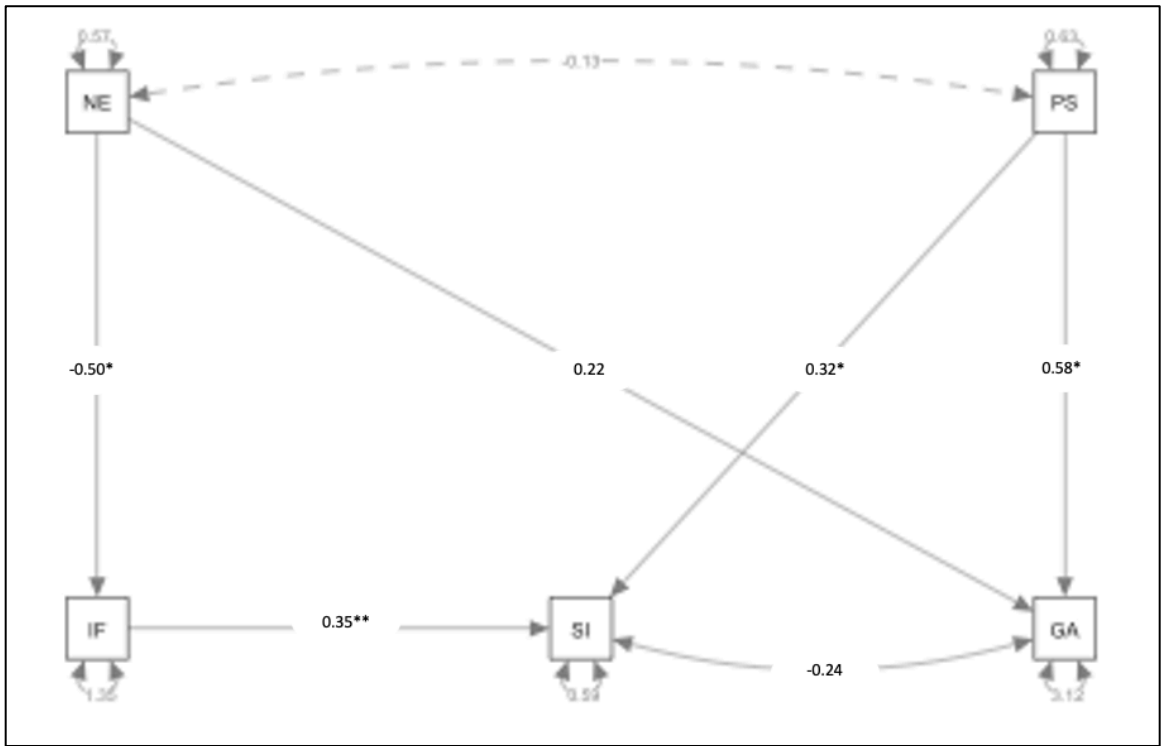
In Model 3, only the indication of direct effects of selected dimensions of spatial presence on score gain was kept. Furthermore, IF was added as a predictor of SI. These changes were guided by literature and the results of correlational analysis. This time, the indices indicated a very good model fit. These results will be further explained in the discussion section. A path diagram illustrating this model is shown in Figure 5.5

Figure 5.5 shows that the negative effects (NE) dimension of spatial presence had a strong direct inverse effect on ideal future-self (β= -0.50, $p < 0.05$) and a weak indirect inverse effect on situational interest (β= -0.173, $p < 0.05$). It also shows that the sense of physical space dimension had a strong direct effect on score gain (β= 0.58, $p < 0.05$) and a moderate direct effect on situational interest (β= 0.32, $p < 0.05$). Finally, it shows that

ideal future-self had a moderate direct effect on situational interest (β= 0.35, p < 0.01). It also shows an inverse covariance between situational interest and learning gain, but it was not statistically significant (r = -0.24, p = 0.18). Furthermore, the weak direct effect of NE on score gain was also not statistically significant (β= 0.22, p = 0.48).

Figure 5.5.

Path Diagram of SP, SI, IF, and GA



Legend. PS: Sense of Physical Space; NE: Negative Effects; SI: Situational Interest; IF: Ideal Future-self. GA: Score Gain. Asterisks: * (p < 0.05), ** (p < 0.01), *** (p <0.001)

The findings, as discussed in the final chapter, eventually contributed to the modification of the model. While this fulfilled the need for empirical evidence of relationships through a one-off experimental study, a long-term qualitative study provided extensive insight on variable dynamics in an in-situation setting. This fourth study is presented in the succeeding chapter.

CHAPTER 6: Study 4 - Dynamics of Spatial Presence, Situational Interest, and Ideal Future

This chapter starts with the context, which includes the participants, the teacher, and the subject matter, and followed by the objectives of the study. The next section discusses the methods, including the materials, data collection instruments, and methodology outlining the design, development, and implementation of a design-based research (DBR) for online English lessons utilizing VR photo-based tours. For brevity, these lessons will be pertained to as *VR tour lessons* throughout this chapter.

The methodology section was structured according to the first two phases of DBR projects: Design and Teaching Experiment. The third phase is a retrospective analysis described in the data collection and data analysis sections. Finally, the findings are discussed according to how they met each of the study's objectives.

Objectives

Study 4 investigated the dynamics of situational interest, ideal future-self, spatial presence, and learning-related outcomes among different learners from Japan and France who took ten VR tour lessons in four months. Following a design-based research approach, it also identified characteristics of effective online English VR tour lessons through iterative and reflective improvement.

Specifically, the objectives of the study were the following:

1. To document iterative pedagogical and theoretical improvements applied in English VR tour lessons through retrospective analysis;
2. To investigate the dynamics of spatial presence, situational interest, ideal future-self, and learning outcomes across multiple VR tour lessons; and

3. To identify learner differences in these dynamics.

Methodology

Computer-mediated Communication (CMC) has been found to be one of the popular methods of teaching English in both formal and non-formal online learning contexts. Synchronous communication using a CMC tool like *Skype* or *Zoom* has been found to be beneficial in countries that have limited geographical access to speakers of the target language. It gives learners practice opportunities by communicating with fluent speakers of the target language in a relaxed and private environment while allowing them to develop intercultural understanding (Belz, 2002; Kern, 2000; Kinginger et al., 1999; Meskill & Ranglova, 2000; Thorne, 2003)

With the English language becoming increasingly important as a professional and academic competence in a globalizing world, adult learners in non-English speaking nations have started to engage with online teachers through CMC-based online classes. Thus, learning another language has become a promising educational context for observing motivational and learning- related variables among online adult learners who are exposed to novel methods and technologies.

Study 4 took place in online one-on-one English classes taken by adult learners using Computer-mediated Communication (CMC).

Participants

The participants were selected based on their amount of interest, perceived need in learning, and willingness to participate in the study. They were interviewed and chosen based on a series of questions (see Appendix F). The participants were recruited from May to July of 2019 from Japan and France, two countries from different continents

where the demand for English has been increasing due to its use in foreign trade and globalization of companies (Fidrmuc & Fidrmuc, 2016; Morita, 2017; Uysal et al., 2007).

Five French learners and four Japanese learners agreed to participate in the study. Each learner came from different professional, generational, and cultural backgrounds. They had different reasons for learning English. As part of the researcher's confidentiality agreement with the participants, they were given pseudonyms in describing their characteristics and background in this section. The teacher assigned to the students was given the pseudonym, Cher.

Table 6.1 lists the participants' pseudonyms and their background information. Their English level was a Common European Framework of Reference for Languages (CEFR) estimate based on two short online tests that they took and an initial interview with the researcher. The online tests are listed in Appendix F.

Table 6.1.

Participants and their Background in Study 4

Participant	Level	Location	Occupation	Age	Nationality
Eiji	B2	Kyoto, Japan	Graduate Student	24	Japanese
Eito	B1	Kanagawa, Japan	Retired Banker	70	Japanese
Mizuki	B1	Chiba, Japan	Cram School Manager	26	Japanese
Masaki	B1	Tochigi, Japan	Professor	45	Japanese
Denis	B1	Grenoble, France	Sales Officer	37	French
Eiman	B1	Bordeaux, France	Engineer	32	French
Emma	A2	Bordeaux, France	Engineer	34	French
Este	C1	Paris, France	Architect	29	Italian
Charles	A2	Grenoble, France	Engineer	34	French

Note. Names in the Participant column are pseudonyms

Eiji

Eiji is a graduate student in Kyoto. He experienced living in the Philippines as a university exchange student for six months, so he was exposed to speaking English and a third language. He also experienced living in the USA. He is in his mid-twenties and is very active in following current events in the Philippines as well as in translating Philippine news, mostly written in English, to Japanese. He is interested in trying out a new way of learning a language, so he decided to join the study.

Eito

Eito is a retired banker in his early seventies who lives in Yokohama with his wife. He is very active in learning English through free radio shows and conversation classes via an online *Eikaiwa* company. He has been Cher's student in Eikawa for more than six years when the project started. He volunteered to participate in the study because he wanted to have more opportunities in adding to his English vocabulary and in engaging with an English speaker. He is also interested to try new ways of learning English vocabulary.

Mizuki

Mizuki graduated from an international liberal arts university in Tokyo and holds a Master of Arts degree in Education. Thus, she has been exposed to various theories behind technology-enhanced teaching and learning methods and approaches. She was a manager of a cram school in Chiba when this project started, which also required her to have teaching sessions with the school's students. She wanted to participate in the study because of her interest in new ways of teaching and learning English. She also wanted to

continue improving her conversation skills especially after her trip to Europe where she realized that her knowledge of English had been extremely helpful.

Masaki

Masaki is a professor of Psychology in Tokyo, but he resides in Tochigi prefecture. He had been Cher's student for around six years when the project started. He experienced major life events a few months before the study started, which made him quite occupied. Despite that, he volunteered as a participant of the study because he was extremely interested in the research itself as well as in the technology involved in the new lesson structure.

Denis

Denis lives in Grenoble with his wife and two children. His wife is Filipino, and they have raised their eldest child (girl) to be bilingual by communicating with her in French and English. They take turns reading her bedtime stories in English and French. They feel that the strategies they have developed together were effective, and so they planned to do the same with their son who was 3 months old when the project started. Denis has always loved learning English and desires to be a great communicator. This desire led him to work in the US, which allowed him to meet his wife. After marriage, they moved to other English-speaking countries like the UK and Singapore before returning to France where his family eventually settled. He participated in this study because he wanted to acquire more words, which he felt he could use to communicate more with his family and his wife's relatives.

Emma

Emma works for an Engineering firm in Bordeaux, France. She was introduced to Cher and the researcher by another participant who worked in the same company. Emma has very limited English proficiency and had very few opportunities to practice the language at work or at home. However, she really loves traveling and communicating with foreign friends. When she heard about the study, she volunteered to participate as she also wanted to try a new way of learning English.

Charles

Charles lives with his wife and two children in the same neighborhood as Denis in Grenoble. He is a technician at a semiconductor company. He did not really have many opportunities to use English at work as his job did not involve many business trips abroad. However, he wanted to improve his English skills for holiday trips with his family. When he heard about the study, he felt that it could be a good way of learning new words and of improving his English communication skills.

Drop-outs

Two learners dropped out from the course in the middle of the study: Este and Eiman, who were both from France. Though their survey and interview data were not included in the analysis, observation data from their classes were useful in the retrospective analysis.

Este is an Italian architect who grew up in Milan. He was working at a very prestigious firm in Paris that bagged several projects related to the design of its metro system. He was easily the most proficient English speaker among the participants. After

the first lesson, upon consultation with Cher, the researcher decided to stop engaging with Este as his level was too advanced for the lessons in the study.

Eiman graduated from the top engineering university in Paris. She was practicing her profession at an agency based in Bordeaux, France when the project started. During that time, she was also starting a real estate business with her boyfriend. The share houses that they managed usually had foreign tenants mostly from around Europe. She liked conversing and practicing English, but she did not have many opportunities at work. This motivated her to participate in the study. However, she eventually stopped after the fifth teaching experiment because she found herself too busy with work and travel.

Materials

This section describes the learning materials used in the teaching experiments (TE) as well as the instruments designed to collect learner and teacher data. For the sake of brevity, all materials including sample lesson guides, templates for observation notes, interview protocols, teacher reflection guides, and survey forms are included in Appendix G.

The learning materials were developed from May to July of 2019. The learning activities were co-developed with Cher, who is an online English instructor from the Philippines. The instructor had more than three years of experience in conducting online *Eikaiwa* (English Conversation) lessons with Japanese learners using Skype and Zoom.

Instructional Materials

The study utilized materials and instruments for iteratively designing the lesson for the teaching experiments and collecting data from learners, the teacher, and the experience itself. Lesson guides were designed based on the PPP (Presentation, Practice,

Production) paradigm of language teaching. As it was a part of a Design-based Research- (DBR) oriented study, the main structure of the lesson included a pre-test and post-test component. The novel interventions tested in this context: VR photo-based tours, were incorporated mostly in the Presentation and Production phases of the lesson plan. However, the lexical components in the tour were reviewed and utilized in the Practice phase. The learning materials were organized as lesson guides with versions made for the learner and the teacher.

Data Collection Instruments

Observation Notes. Observation notes were collected for TE 1 to 9. A template was designed so that the researcher could focus on important aspects of the experiment for the collection of appropriate data.

Interview Protocol. Interview protocols were prepared for three interview sessions, which were conducted after the first, fifth, and last teaching experiments. They were called initial, midpoint, and final interviews, respectively.

Survey Questionnaire. Survey questionnaires were distributed online after each teaching experiment of lessons 2 to 10, for learners to quantitatively express spatial presence, situational interest, ideal future-self, learner experience, and satisfaction in each lesson and share the reason behind their ratings. The questionnaires included simple ten-point items for measuring spatial presence, situational interest, and ideal future-self as well as open-ended questions.

To maintain brevity, the survey's quantitative items did not follow the items validated in the first three studies. Except for spatial presence, the rest of the items were rough estimates of the variables they were meant to measure.

The single-item scale for spatial presence developed by Bouchard et al. (2004) was used to ask participants to self-report their experience of spatial presence after every teaching experiment. The items for measuring situational interest were operationalized from the definition of triggered and maintained interest by Hidi and Renninger (2006) as interest in the activities (IA) and interest in the topic (IT), respectively. The item used for measuring ideal future-self was based on the second item of the Ideal L2 Future-self scale by Lamb (2012).

Teacher's Feedback Guide. The teacher was asked to write her reflections after each session briefly using a feedback guide. Reflections from the teacher and researcher were then discussed during meetings for retrospective analysis.

Pre-test and Post-test. A pre-test and post-test were given in every lesson. They tested the learners' knowledge of the five target vocabulary words of the lesson. They varied between multiple choice questions that were done orally or written matching type questions. The pre-test scores were subtracted from post-test scores and were pertained to as *score gain* during the data analysis phase.

Design-Based Research Approach

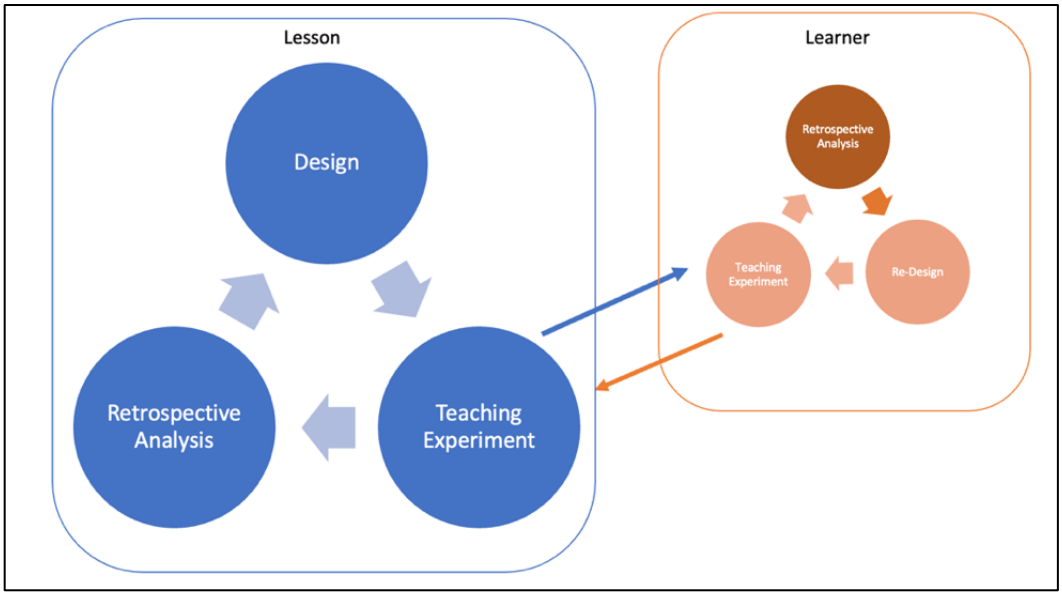
Design-based research (DBR) is a methodological approach in educational research that involves a cycle consisting of designing a solution to a problem based on a set of theories; testing that solution through a real-world teaching experiment; and retrospectively analyzing what has transpired in the experiment to improve the solution while drawing emergent theoretical and pedagogical principles (Collins et al., 2004). Usually, DBR follows a one-level cycle where teaching experiments are implemented in

a class of students. However, as shown in Figure 6.1, this study followed a two-level cycle as each teaching experiment was done with individual learners.

The *learner-level* cycle involved experimentation, analysis, and redesign done for each learner within the same lesson. The teacher conducted and documented retrospective analysis at this level. The *lesson-level* cycle involved design, experimentation, and analysis, done after an encounter with each lesson. Retrospective analysis at this level was done during teacher and researcher meetings.

Figure 6.1.

Two-level DBR Cycle of Study 4



Design

Hypothetical Learning Trajectory

Designing interventions using Design-based research (DBR) utilizes theories through hypothetical learning trajectories (HLT) as basis for the features of those interventions. These are hypothetical assumptions of how a feature provided by the intervention can affect any of the variables of interest in the study.

The initial hypothetical learning trajectories established in designing lessons for this study were based on the initial model that was used as the theoretical framework of the dissertation's studies. More specifically, the rationale for incorporating VR photo-based tours in lessons were due to the hypothesized positive effects of spatial presence on situational interest, ideal future-self, and learning outcomes.

1. SI ← SP. Spatial presence positively influences situational interest.
2. IF ← SP. Spatial presence positively influences ideal future-self.
3. LO ← SP. Spatial presence positively influences learning outcomes.

VR Tours

The ten VR tour lessons were iteratively designed through the DBR cycles from September to December 2019. Vocabulary words selected for each lesson ranged from B1 to C1 as suggested by the English Profile CEFR word list website: (https://englishprofile.org/wordlists). A listing of the VR tour title, the URL of the tour, and target vocabulary words is shown in Table 6.2.

Table 6.2.

Summary of VR Tour Lessons in Study 4

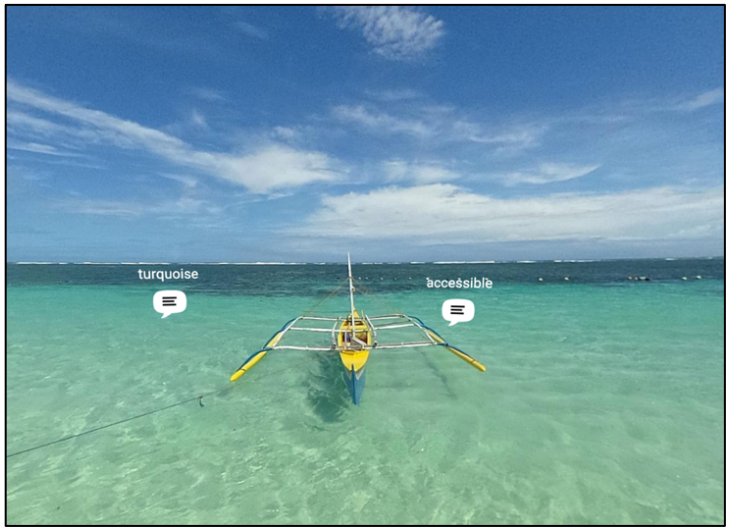
Lesson #	Tour Title	Tour URL	Target Words
1	Autumn in an international university in Japan	bobfigueroajr.com/b1vr1	autumn, exhausted, leaves, surround, building
2	Marketplace in Canada	bobfigueroajr.com/b1vr2	wet market, sweet, shop, basket, lettuce
3	Philippine Forest	bobfigueroajr.com/b1vr3	visible, to clear, shallow, brushes, trunk
4	Homestead in Pennsylvania,	bobfigueroajr.com/b1vr4	homestead, lawn, electricity,

Lesson #	Tour Title	Tour URL	Target Words
	USA		shelter, pole
5	Rizal Monument, Philippines	bobfigueroajr.com/b1vr5	crowd, pose, stroll, wave, focus
6	Seaside in San Francisco, USA	bobfigueroajr.com/b1vr6	ample, exposed, sunburnt, affordable, lively
7	Fort Chambly, Canada	bobfigueroajr.com/b1vr7	outdoor, spacious, vacant, spotless, historic
8	Mall in Makati, Philippines	bobfigueroajr.com/b1vr8	rushing, dallying, wilting, dining, littering
9	Courthouse in Oakland, USA	bobfigueroajr.com/b1vr9	courthouse,passerby, walkway, receptacle, branch
10	Beach in the Philippines	bobfigueroajr.com/b1vrten	turquoise, serene, fine, accessible, isolated

The tours featured VR photos of places known to have a good number of English-speaking locals. A sample of a tour integrated in the last lesson is shown in Figure 6.2. The tours underwent a series of minor modifications based on the findings from retrospective analyses.

Figure 6.2.

VR Photo-based Tour in Lesson 10



Teaching Experiments

Teaching experiments followed the structure of lessons as outlined in the lesson guides (see Appendix G*)*. Table 6.3 presents a summary of the frequency of each learner's participation in the teaching experiments, the usual time they participated, the average duration of their session, the CMC tool they often used, and their usual learning space.

Table 6.3.

Learner's Contextual and Temporal Details

Learner	Frequency	Time	Duration	Technology	Learning Space
Eito	Bimonthly	Morning or afternoon	41.3 minutes	Skype (Video)	House, Japan
Eiji	Bimonthly	Morning	19.8 minutes	Skype (Video)	Café, Japan
Masaki	Weekly; then monthly with large gaps	Afternoon	22 minutes	Zoom (Video)	House, Japan
Emma	Weekly	Lunchtime	19.2 minutes	Facebook Messenger (Audio)	Workplace, France

Learner	Frequency	Time	Duration	Technology	Learning Space
Mizuki	Weekly	Morning	20.6 minutes	Skype (Video)	House, Japan
Charles	Weekly	Lunchtime	22.3 minutes	Skype (Video)	Workplace, France
Denis	Once a month with large gaps	Morning	22.6 minutes	Facebook Messenger (Video)	House, France

While a teaching experiment follows a typical lesson plan. A description of what usually happens is outlined in this section for the benefit of the readers. The description also gives some examples from specific lessons to further concretize it.

The call usually started with the teacher asking a 'how are you?' question. They would then do a pre-test that was given orally. Cher took note of their answers and later marked them. They were then asked to experience the VR-tour for about 10-15 minutes. They were allowed to do it multiple times until they felt confident that they understood it. Whenever there were audio problems, Cher served as the narrator of the VR tour. They were usually given time to ask questions for clarification during the tour experience. After the tour, Cher asked the learners to read the target words and ask them what they learned in the tour and how they understood the target words.

The VR tour activities were followed by four exercises. The exercises varied per lesson but were similar in structure. These exercises included matching-type activities, dialogue reading activities, odd one out, fill in the blanks, and sorting and organizing exercises. A concrete example can be found in Appendix G.

They were then asked to use each word in a sentence as their production activity. The session usually concludes with a post-test which has the same content and structure as the pre-test as well as a request to fill-out the after-lesson survey.

Use of VR HMD

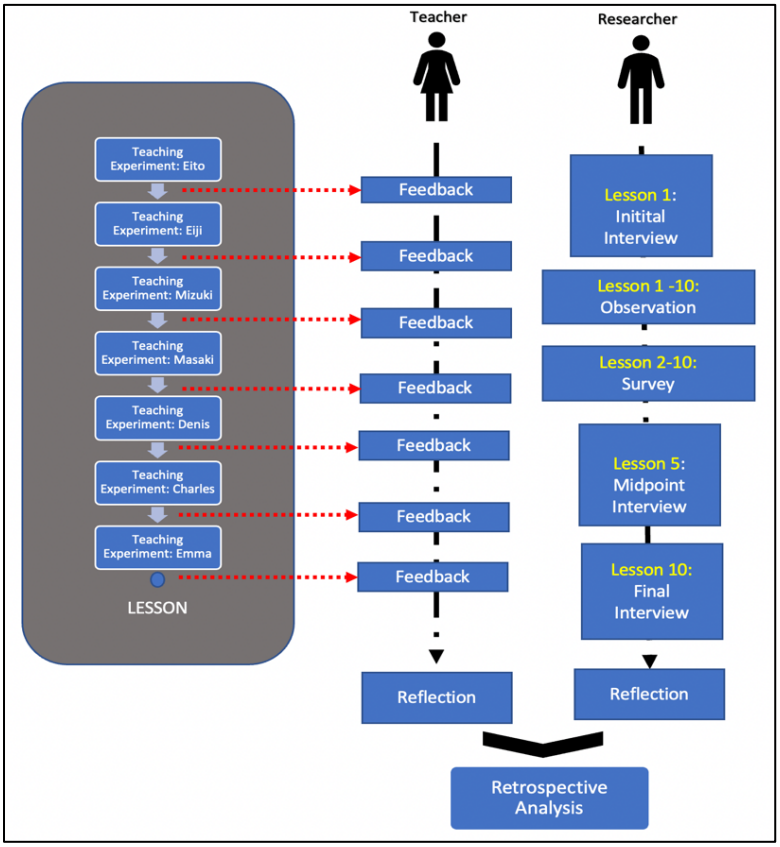
All the France-based learners, except for Denis who was prone to epileptic shock, were given low-cost VR spectacles for their smartphones as a head mounted device (HMD). They were also taught how to use it in-person by the researcher or an assistant. In Japan, Eito was the only one provided with the HMD as he was the only learner that the researcher could physically meet at that time. The learners were asked to use the spectacles from the sixth lesson cycle. However, none of them eventually used it during the teaching experiments for reasons that are shared later in the findings section.

Data Collection

Data collection for the study is summarized in a diagram shown in Figure 6.3. Each teaching experiment was recorded for observation. Furthermore, the teacher wrote her feedback for triangulation. The learners were interviewed initially during the first lesson cycle and then surveyed at the end of the teaching experiments in succeeding lesson cycles. Midpoint interviews were conducted after the fifth lesson cycle, while final interviews were conducted after the tenth lesson cycle. Data from the post-lesson surveys were also collected. These data included spatial presence, ideal future-self, and situational interest ratings. Finally, score gain was computed in each session by subtracting pre-test from post-test scores.

Figure 6.3.

Data Collection Diagram in Study 4



Retrospective Analysis

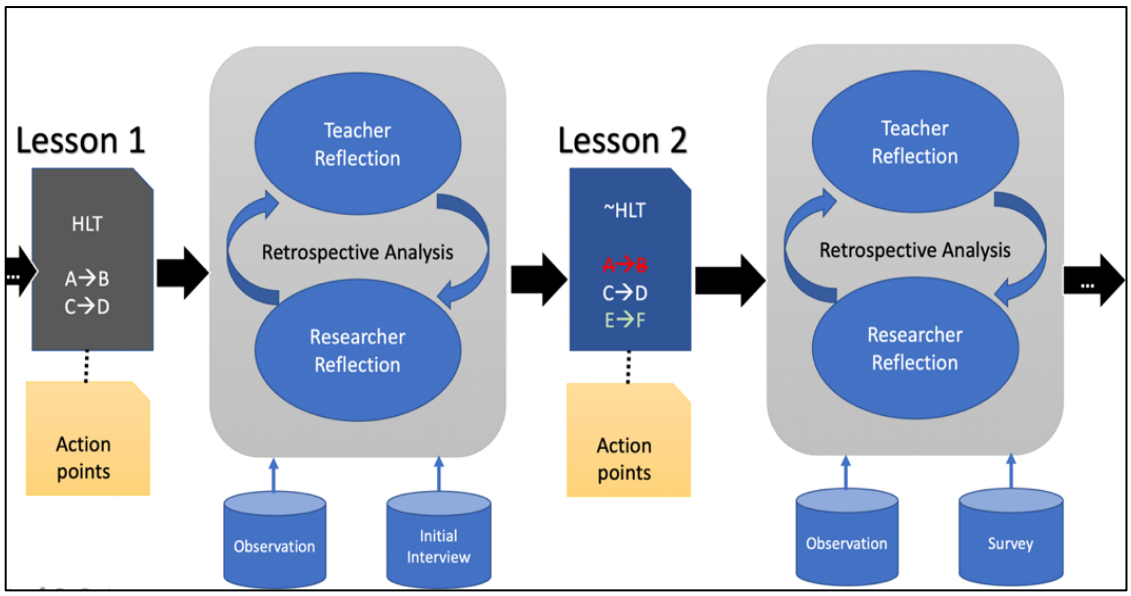
Retrospective analyses were performed during the meetings of the researcher with the teacher after every four or five teaching experiments or learner cycles. During the retrospective analysis, the teacher reviewed her feedback notes for each learner and reflected on them. Meanwhile, the researcher reviewed and reflected on his observations, interviews, and survey data.

These meetings were conducted to triangulate trends and issues that were noticed by the teacher and researcher leading to lesson improvements and theory building. As illustrated in Figure 6.4, previous hypothetical learning trajectories (HLTs) were verified, refuted, or revised while new ones were added. Furthermore, action points for improving

the next lesson were enumerated. After each retrospective analysis session, a new list of HLTs and action points were incorporated in the design of the succeeding lessons.

Figure 6.4.

Retrospective Analysis: Updating HLTs and Action Points



Note. HLT: Hypothetical Learning Trajectory

Reflexive Thematic Analysis

A reflexive thematic analysis following the guidelines of Braun and Clarke (2006, 2019) was conducted on data from open-ended questions of the nine surveys and the three interviews starting with hypothetical learning trajectories derived from retrospective analyses as initial codes. NVivo (released in March 2020) was used to organize the datasets and codes. More details about this software can be found in the reference written by Jackson and Bazeley (2019). The themes that emerged were analyzed based on the following objectives: 1) To enumerate factors that contributed to the rise and fall of spatial presence, ideal future-self, and situational interest in each lesson, and 2) to identify factors that contributed to learning.

Quantitative Analysis

Themes relating to variation were supported by visualizations of ratings for each variable using *R* for illumination. Since the single-item scale of spatial presence was the only validated scale incorporated in the survey, it was the only variable besides score gain that was considered for hypothesis testing. In other words, hypothesis testing to determine variance in spatial presence and score gain across lessons (1 through 10), age group (20's, 30's, 40 years old and above), culture (Japanese, French, cosmopolitan), and physical learning environment (home, workplace, café) was carried out.

A Friedman rank-sum test and Nemenyi post-hoc test using the *stats* (R Core Team, 2012) and *PCMCR* (Pohlert & Pohlert, 2018) libraries were performed to test hypotheses. The hypotheses set for the Friedman tests can be found in Appendix E.

Findings

Findings from the retrospective, thematic, and quantitative analyses as they met the study's objectives are presented in this section.

Objective 1: Retrospective Analysis Results

Retrospective analyses results contributed to the pedagogical revisions in the design of lessons. Major pedagogical revisions included improving the clarity of instructions, changing some exercises, and providing scaffolds. Minor revisions included fixing typographical errors and enhancing aesthetics. Reflecting on pedagogical revision points often led to the emergence of new hypothetical learning trajectories (HLTs) as it involved revisiting theories that support these revisions.

Table 6.4 lists pedagogical revisions, their corresponding HLT, and lessons where unique instances of such revisions were applied.

Table 6.4.
Pedagogical Revisions

Pedagogical Revisions	Theoretical Revisions	Lesson Instances
Providing text-based scaffolds	LO ← SC	2, 3, 4, 5, 8
Providing image-based scaffolds		3, 6
Presenting vocabulary words in the tour that were of the same part of speech (e.g., nouns, adjectives, verbs)	LO ← PS	4
Reusing words from previous lessons in activities	LO ← RO	4, 6

Legend. LO: Learning Outcomes; SC: Scaffolding; PS: Part of Speech; RO: Retrieval Opportunities

Many of the action points discussed in retrospective analysis meetings involved adding text-based scaffolds like the transcript of the VR tour as suggested by one of the

learners after the first teaching experiment. Succeeding retrospective analyses revealed the need to add additional instructions to support learner understanding of the tasks as well as adding reminders to listen carefully to the VR tours to prepare them for the next activity. It was observed that adding these text-based scaffolds made it easier for the learners to focus on the learning content and gain more understanding by eliminating other sources of confusion.

Image-based scaffolds were observed to facilitate deeper understanding of the words. They were first added in an exercise in Lesson 2 to help learners have a different optical reference of the word aside from what they saw in the VR tour. It appeared to help them confirm or rectify what they initially thought to be the word's meaning after the VR tour.

In Lesson 6, pictures related to words that learners were supposed to define after the tour were added for additional guidance. Thus, a new hypothetical learning trajectory was added based on these observations: LO ← SC. This HLT was meant to guide the design of future lessons in such a way that ample text- and image-based scaffolds are provided to better facilitate learning.

The retrospective analysis in Lesson 3 revealed that learners were confused in the usage of some of the words because they associated them with the wrong part of speech. As an example, the word *clear* was misunderstood as an adjective, while it was presented as a verb in the tour. It was also noticed that it was difficult for learners to learn the words presented in the VR tour because they were of different parts of speech. When all words in the tour were homogenously presented as nouns, adjectives, or verbs, learning became smoother. A new hypothetical learning trajectory emerged from these observations: LO

← PS. This was meant to guide the design of future lessons and remind the teacher to consider the part of speech of vocabulary words presented in the tour.

Finally, during the third retrospective analysis meeting, it was agreed that increasing the occurrence of words from past lessons would be helpful for learners as some of them tried to recall what they have learned in previous lessons but seemed to have forgotten. Except for Eito who actively tried to review the previous lessons in his spare time, many of the other learners failed to remember some of the words. Thus, increasing their retrieval opportunities in the succeeding lessons helped them recall those words. While all succeeding lessons had this feature integrated into exercises, the sixth lesson also offered retrieval opportunities in the tests. A new hypothetical learning trajectory was added from these observations: LO ← RO. This HLT was meant to guide the design of succeeding lessons such that retrieval opportunities for previously learned words were included in different parts of the lesson to help learners remember these words better.

Objective 2: Variable Dynamics

Dynamics refer to forces that produce change or movement in a system. In this study, dynamics were operationalized by hypothetical learning trajectories (HLT). These trajectories reflect factors that influenced changes in key variables. This section reports the factors that influenced situational interest, ideal future-self, spatial presence, and learning outcomes among learners from the results of reflexive thematic analysis and supported by quantitative data.

Situational Interest

Situational interest tended to have generally increased through the lessons with a few exceptions (i.e., Masaki and Mizuki). This was reflected by their answers in both the midpoint and final interviews. This generally positive dynamic was found to come from six main factors as shown in the thematic analysis results in Table 6.5. As expected, spatial presence was reported by learners to affect their interest. However, an aspect of individual interest, which is the interest of the learner in the place being featured in the tour was revealed to also affect their interest in the tour. This was exemplified greatly by Masaki's fluctuating interest in the activity depending on the place being featured in the VR tour lesson.

Actual learning was difficult to measure in this thematic analysis. However, the perceived learning of the learners contributed to the increase in their interest in the activity. Novelty was found to affect the dynamics of situational interest as many of the learners attributed their enjoyment and curiosity to the newness of the technology. However, another aspect of novelty was found to be uniquely provided by VR tours in the online setting. It was the feeling of discovery provided by a new place or scenery. This also appeared together with learners claiming to have enjoyed or liked the lesson because of the beautiful scenery in the tour. Finally, some of the students identified the teacher and her qualities to have contributed to their increased interest.

Table 6.5.

Situational Interest Dynamics in Study 4

Theme	Subtheme	Code	Examples and Patterns	Frequency	Coverage
Situational Interest	Spatial Presence	SI ← SP	• "…I went to the place that was interesting"	36	4(4)

Theme	Subtheme	Code	Examples and Patterns	Frequency	Coverage
Dynamics			• "…It was enjoyable because it was a realistic experience"		
	Individual Interest	SI ← IP	• "I have a dream to go to Canada but not in the marketplace, but nature in Canada..." • "…I would like to visit this place and I would like to stay there for a long time…"	30	8(5)
	Learning Outcomes	SI ← PL	• "…I could enjoy the time to know new vocabulary and things I didn't know…" • "My feeling is good because I have learned a lot of words and synonyms"	26	10(7)
	Novelty	SI ← NT	• "…It's really exciting that I had such a kind of a VR experience in learning English. I was thinking like VR equipment is for only gaming and any other traveling. However, it's also useful and effective for English learning tool. It was awesome." • "…VR Tour is very interesting because it's a new method…"	24	9(5)
		SI ← NP	• "…because I don't know the Philippine hero and I want to know the special area in the foreign country such as the Rizal Monument…"	12	6(3)

Theme	Subtheme	Code	Examples and Patterns	Frequency	Coverage
			• "…especially I enjoyed VR tour because I can see sights which I've never been to..."		
	Teacher Factor	SI ← TF	• "…The explanation was easy to understand…" • "… great teacher!"	11	9(4)
	Aesthetics	SI ← AE	• "...The positive feelings I had were speaker's excellent pronunciation and beautiful scenery…" • "…This time the scenery was very beautiful, and the soundtrack was pleasant."	23	5(4)

Legend. SI: Situational Interest; IF: SP: Spatial Presence; IP: Interest in the Place; NT: Novelty of Technology; NP: Novelty of the Place; TE: Teacher Factor; AE: Aesthetics; x(y): x-number of lessons + interviews (maximum of 11) y- number of learners (maximum of 7)

Ideal Future-self

The dynamics of ideal future-self among learners was difficult to observe in teaching experiments. However, thematic analysis of the results from the survey and interviews revealed a couple of trends. As shown in Table 6.6, perceived learning seemed to have helped the learners see themselves as a better English speaker in the future. Another factor that contributed to the positive dynamic of their ideal future-self was their instrumental motivation for the language.

Table 6.6

Ideal Future-self Dynamics in Study 4

Theme	Subtheme	Code	Examples and Patterns	Frequency	Coverage
Ideal Future-	Learning	IF← PL	• "… [I see myself getting better	10	6(5)

Theme	Subtheme	Code	Examples and Patterns	Frequency	Coverage
self Dynamics	Outcomes		in English in the future because] it helps me in getting more vocabulary. I can say I improved a bit…"		
			• "... [I see myself getting better in English in the future because] I'm sure that my vocabulary is increasing, even though my answer in pre-test is correct, sometimes I don't know the exact meaning and I am not sure if it's correct or not. Vocabulary helps me…"		
		IF ← INS	• "... [I see myself getting better in English in the future because] I want to use English in traveling and maybe a little bit at work, but we don't really work with a foreigner here…"	49	11(7)
			• "… [I see myself getting better in English in the future for] Discussion with my Australian family…"		

Legend. SI: Situational Interest; IF: Ideal Future-self; SP: Spatial Presence; x(y): x-number of lessons + interviews (maximum of 11) y- number of learners (maximum of 7)

While some of them saw themselves as tourists communicating with locals in English, others eyed using English in their jobs or in communicating better with their relatives and foreign friends.

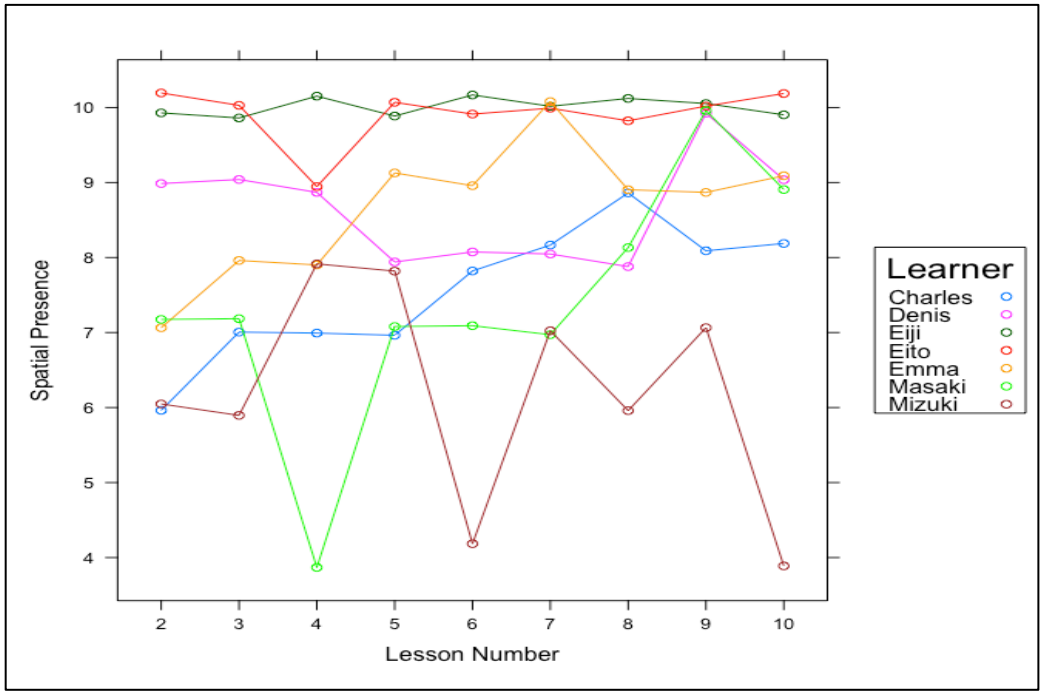
Spatial Presence

None of the codes revealed the factors that led to spatial presence being felt by learners. However, spatial presence ratings were visualized per lesson in a plot presented in Figure 6.5 to find meaningful patterns. Spatial presence trends seemed to be consistently increasing in most of the learners except for Mizuki and Masaki. (Learner differences are discussed further in Objective 3 findings). The increasing trend could be attributed to the better experience of learners in later lessons as they were able to figure out how to comfortably navigate the tours. They were not bothered by the technical or mechanical difficulties they encountered in the earlier lessons. However, the Friedman test yielded a statistically insignificant variation across the lessons $F(8) = 10.43$, $p = 0.24$.

Immersive capability, which could have affected spatial presence among learners, was not hugely observed using HMD because none of the learners used it in the tour. Learners who were offered the HMD shared that using it made them dizzy (e.g., Emma and Eiman). Cedric was not able to use it because he was using his phone in his car during lunch break and did not have the time to setup the HMD. Eito said that he lacked the ability to quickly set up the HMD correctly during the lessons, which made him more distracted. However, he shared that he used the HMD for reviewing the VR tour lessons. When asked for his thoughts during the final interview, he pointed out that using the HMD made the feeling of being in the actual location significantly stronger. However, he noted that sometimes the lens would be blurred resulting to difficulty in looking around the tour. He said that it was inconvenient to use the HMD within the timeframe of the lesson, which usually just ran for 30-40 minutes.

Figure 6.5.

Spatial Presence Experienced by Learners Across Lessons



Score Gain and Perceived Learning

Even though quantitatively, the Friedman sum rank test conducted to determine variance in score gain between lessons resulted in a non-statistically significant result, $F(8) = 13.69$, $p = 0.09$, themes collected from the qualitative data revealed factors that contributed to dynamics of perceived learning. The dynamics of perceived learning were attributed to several factors as shown in Table 6.7. First, they attributed it to spatial presence. They felt that they learned better in a real or realistic situation provided by the tour. Retrieval opportunities were also identified to contribute to learning. References to a combination of verbal (i.e., text and audio) and optical input (i.e., VR photo, picture-based scaffolds) positively affected their learning. Finally, the number of words presented in the lesson was also said to have contributed to their learning.

Table 6.7

Learning Outcomes Dynamics in Study 4

Theme	Code	Examples and Patterns	Frequency	Coverage
Learning Dynamics	PL← SP	• "I learned words on a real situation while feeling immersed in the scenery…"	10	6(5)
	PL ← RO	• " It was filled with information from the previous lessons, and I felt a sense of accomplishment after studying."	8	6(4)
	PL ← VO	• "…The visual helps me imagine the vocabulary." • "…Yes. Of course. Only words and speaking lesson has little effect to visual memory. The lesson has a lot of variety…"	5	3(5)
	PL ← WC	• "…VR Lesson consist of some words but that words are not too much, only 5 or 6 words. The time is so comfortable…"	3	2(2)

Legend. SI: Situational Interest; IF: Ideal Future-self; SP: Spatial Presence; VO: Verbal and Optical input; RO: Retrieval Opportunities; WC: Word Count; x(y): x-number of lessons + interviews (maximum of 11) y- number of learners (maximum of 7)

Objective 3: Learner Differences

Denis and Eiji were considered to have imbibed a cosmopolitan culture as they lived in different English-speaking countries for a significant part of their lives. Hence, they were grouped in the cosmopolitan category. The rest of the learners were compared

based on where they grew up and continued to reside at the time of the study: Masaki, Eito, and Mizuki from Japan; and Emma and Charles from France.

The quantitative findings provided an overview of learner differences in score gain between cultures, age group, and physical learning environment. The Friedman sign-rank test revealed that there were no statistically significant difference in spatial presence between the age groups, $F(2) = 4.34$, $p = 0.11$ and physical learning environment, $F(2) = 1.33$, $p = 0.51$. However, it revealed a statistically significant difference between cultures, $F(2) = 6.61$, $p = 0.04$. Japanese, French, and cosmopolitan learners reported median presence scores of 8, 8, and 10 and mean scores of 7.8, 8.1, and 9.3 respectively. While cosmopolitan learners were observed to have the highest median score compared to the other two groups, the Nemenyi post-hoc test revealed that these differences were not statistically significant. Furthermore, it revealed that while the difference was not statistically significant between cultures, $F(2) = 5.41$, $p = 0.07$ and age group, $F(2) = 0.47$, $p = 0.79$, there was a statistical significant difference in score gain between learners who took the lessons in different learning environments $F(2) = 10.89$, $p < 0.01$. Learners who studied from home, from their work place, and from a cafe achieved median score gains of 1, 2, and 1 and mean score gains of 1.3, 1.4, and 0.7 respectively. The Nemenyi post-hoc test further revealed that the difference between score gains of those who took the lessons from home and those who took the lessons from their workplace was statistically significant, $p < 0.05$. The same post-hoc test revealed that the difference between score gains of those who took the lessons from home and those who took lessons from the café was also statistically significant, $p < 0.05$.

Qualitative findings seemed to have supported the quantitative results. During the interviews, Japanese learners reported to have felt less present in many of the lessons except for Eito. The rest of the learners reported to have felt that they were in the tour based on both the interviews and their answers to the surveys.

Furthermore, the findings also revealed that there were subtle differences in the way they learned. First, verbal self-monitoring was more apparent and regularly observed among the Japanese learners compared to the other two groups. The cosmopolitan and French learners were not as concerned about how they pronounced the words, but the former aimed at improving the depth of their understanding of each word. They often asked about how the target words could be used in different contexts or how they could be used as a different part of speech. Second, the French learners were less inquisitive than the Japanese and cosmopolitan learners. This also led to them committing the most mistakes during the production phase of the lesson. Third, while French and cosmopolitan learners were more creative in their sentences, the Japanese learners were more focused on correctness.

Fourth, while there was no clear indication of cultural differences in how interested the learners were in the VR tour, it was observed that their individual interest, especially their interest in the place being featured, strongly influenced their interest in the lesson. Finally, the vividness and nature of a learner's ideal future-self varied based on how they intended to use their newly learned vocabulary. The cosmopolitan learners talked about their vision of conversing more freely with family and friends. French learners were always mentioning their plans of traveling with their family abroad. Masaki and Mizuki, on the other hand, struggled to imagine their ideal self.

These findings, together with the ones presented in the previous chapters were synthesized to revise the initial model as discussed in detail in the final chapter.

CHAPTER 7: Summary, Integrated Discussion, and Conclusion

This final chapter begins with a summary of four studies conducted to refine a conceptual model that describes the dynamics among features of virtual reality (i.e., immersive capability and spatial presence), motivational variables (ideal future-self and situational interest) and learning outcomes. It discusses key findings of those studies in relation to previous literature and proposes revisions to the model. An in-depth integrated discussion on these findings follows. It concludes with enumerating the theoretical, instrumental, and practical contributions of this dissertation, followed by limitations and recommendations for future research.

Summary of Key Findings

The present research consisting of four studies (see Chapter 3, Chapter 4, Chapter 5, and Chapter 6) aimed to validate and refine a model on the dynamics of situational interest, ideal future-self, and learning outcomes vis-à-vis immersive capability and spatial presence, which are environmental features of virtual reality (VR).

Studies 1 and 2 were survey studies to answer the following question: How are situational interest, ideal future-self, and spatial presence measured and understood in the context of VR photo-based tours experienced by a particular group of adult learners?

Results from the confirmatory factor analysis in Study 1 revealed that the dimensions of spatial presence and its four dimensions as operationalized by the ITC-SOPI had a mediocre fit among adult Filipino learners. Also, results from the exploratory factor analyses in Study 1 and 2 revealed that both situational interest and the ideal future-self were understood as one-dimensional constructs by adult Filipino learners and

were operationalized as four-item and five-item scales, respectively. The validated scales were used to answer the second research question through Study 3.

Study 3 was an experimental study to answer the following question: What is the relationship between the motivational variables (situational interest and ideal future-self), environmental variables (spatial presence and immersive capability), and learning outcomes in the context of VR photo-based tours experienced by a particular group of adult learners?

Results from the t-test in Study 3 showed the statistically significant effect of immersive capability on the sense of physical space, engagement, and negative effects dimensions of spatial presence, but not on ecological validity.

The correlational analyses revealed a strong relationship between the three dimensions of spatial presence, except for negative effects. Similarly, situational interest was found to have moderate correlation with the first three dimensions. On the other hand, the ideal future-self was weakly and positively correlated with sense of physical space and engagement, while being weakly and inversely correlated with negative effects. There was a strong correlation found between the two motivational variables (i.e., situational interest and ideal future-self). Finally, only sense of physical space was found to be weakly correlated with score gain.

Path analyses revealed a good fitting model that was consistent with the initial model while also proposing revisions to it. Specifically, it provided evidence of the strong influence of sense of physical space on score gain and its moderate influence on situational interest. Path analyses also supported evidence of a strong inverse direct influence of negative effects on ideal future-self and its weak inverse indirect effect on

situational interest. Moreover, it gave novel empirical evidence to what motivation researchers previously implied on the influence of ideal future-self on situational interest.

Study 4 was a mixed-methods study but largely qualitative study following the design-based research approach that was carried out to answer the following question: How do the levels and relationships among the motivational variables (situational interest and ideal future-self), environmental variables (spatial presence and immersive capability), learning behavior, and learning outcomes change through time among adult learners from different backgrounds?

The study revealed findings consistent with those revealed by the quantitative results of Study 3. However, findings in Study 4 also revealed that an aspect of learning outcomes (i.e., perceived learning) influenced ideal future-self. Multiple exposures to different VR tour-based lessons had a positive influence on the dynamics of situational interest, ideal future-self, and perceived learning due to spatial presence. However, factors provided by the VR tour environment (i.e., novelty of scenery and technology, and aesthetics), factors pertaining to learners (culture, learning context, individual interest), and factors specific to the design of the lessons (chunking, retrieval opportunities, optical and visual scaffolds) somehow influenced these dynamics. These findings led to further revisions to the model.

Discussion

An in-depth analysis of findings from the four studies is presented in this section. These discussions eventually culminate into themes across studies that contribute to the revision of the initial model.

Dimensions of Spatial Presence (Study 1)

Upon conducting CFA to determine whether ITC-SOPI was a reliable instrument for adult Filipino learners, the initial findings showed a mediocre fit based on the recommended fit indices. Despite initially dropping some items using modification indices, it was later decided to keep the original items because of three reasons. First, the modified model had 18 items removed, which was more than 47% of the number of items of the original model. According to Awang (2015), the model is deemed to be invalid if the number of items removed is more than 20% of the original number of items after consulting the modification indices. Second, the same authors (Hu & Bentler, 1999) who proposed the traditional cut-offs also argued that > 0.80 for CFI would be acceptable in some instances. Third, Kenny et al. (2015) also argued that "if the RMSEA for the null model is less than 0.158, an incremental measure of fit may not be that informative." In the results of this study, the RMSEA was .059. The original model was found to be minimally applicable to the context even if both CFI and TLI were found to be lower than the previously recommended cut-off values. With the recommendation of the original authors of the instrument, the same questionnaire was used in the succeeding experiment.

The four dimensions of spatial presence as operationalized by the ITC-SOPI had been validated in Portugal (Vasconcelos-Raposo et al., 2019) and China (Yan et al., 2020). This study was the first attempt to validate the model in the context of a VR photo-based tour experienced by adult Filipino learners. Unlike the two previous studies mentioned, the current study did not translate the questionnaire into Filipino. It used the same ITC-SOPI items in English.

Upon re-investigating the items, one can assume that the mediocre fit could have stemmed from keeping the items the same in English. The declining proficiency of Filipino working professionals (Meniado, 2019) may have caused them to assign a different meaning to a vague or ambiguous term or statement in some of the items in the questionnaire. Thus, Filipino-translated footnotes could have helped in improving the fit for adult Filipino learners by clarifying ambiguous or vague items. It is therefore recommended to have this included in future studies.

Dimensions of Situational Interest (Studies 1 and 2)

The findings from running the EFA in Study 2 revealed a one-dimensional four-item construct of situational interest. Like the findings in Study 1, the participants in this study apparently had little distinction between triggered interest and maintained interest. The adjustments done in the instrument to eliminate wording effect was also found to be effective as the final construct had four distinct amply related items. Even the initial three-diagram model did not have purely positive and purely negative dimensions. This marked a clearer understanding of the items among participants as well as the absence of wording effect while minimizing acquiescence bias.

One-dimensional instruments with few items to measure a construct are not rare. Simons et al. (2011) arrived at mono-dimensional instrument items for measuring bullying among nurses. They started with 22 items from the Negative Acts Questionnaire-Revised. After their analysis, they ended up with a valid and reliable set of four items and concluded that their new questionnaire decreased the burden on participants and the researchers while still being useful for interventional research.

Ending up with a four-item scale was found to be beneficial as there were enough items to identify the construct (Harvey et al., 1985; Raubenheimer, 2004). Furthermore, the brevity of the scale not only leads to higher response rates but also contributes to parsimony (Netemeyer et al., 2003).

The internal consistency, which could have been affected by the lower number of items, was still very good at 0.865. The items were found to be amply correlated with each other and had better internal consistency and reliability than positive situational interest in Study 1. Therefore, the four-item scale was finalized to measure IF in the succeeding study.

SI in the context of Adult Filipino Learners. The findings of this study led to the impression that adult Filipino learners who experienced a VR photo-based tour associated situational interest with the feeling of being entertained (si1p), liking the activity (si2p), not being bored by the activity (si2n), and having an interesting topic (si4p). It also seemed that perceived relevance (si3p), importance (si3n), and usefulness (si4n) of the topic were not considered to be part of situational interest in their psyche.

This could be explained by the Philippines being a society with a low uncertainty avoidance score of 44 and a very low long-term orientation score of 27. Uncertainty avoidance is the tendency of a particular society to be forward-looking or its tendency to control its future through preparation. Long-term orientation refers to how a society deals with the present and the future with respect to its past (Hofstede, 2011).

The Philippines, having low scores in these cultural dimensions, makes it a normative and relaxed society. That means that instead of being more pragmatic, the society, in general, values traditions with less propensity to save for the future than

others. This could explain why participants might have seen entertaining activities as interesting more than the impact of what can be learned from the activities in the future.

Dimensions of Ideal Future-self (Studies 1 and 2)

The findings from running the EFA in Study 2 revealed a one-dimensional four-item construct of the ideal future-self. The five-item scale of IF was deemed to observe brevity and parsimony as each item succinctly expressed an aspect of the ideal future-self. The negatively worded items were not separated from the positively worded ones and were distributed evenly in one factor, thereby avoiding wording-effect while minimizing acquiescence bias.

Cronbach's alpha for this one-dimensional construct was found to be optimum at 0.834. Therefore, the items of IF amply correlated with one another. The revised instrument achieved better internal consistency and reliability than the version used in Study 1.

IF in the context of adult Filipino learners. The final items showed that Filipino adult learners who experienced the VR photo-based tour thought of the ideal future-self as embodied by their preferred future activities (IFS1P), knowledge for accomplishing tasks in the future (IFS2P), vividness of their vision of the future (IFS3P), skills for accomplishing tasks in the future (IFS1N), and skills related to what they have learned (IFS2N).

The concept of relevance was touched upon by the last item (IFS2N) as what can be applied in one's life also establishes relevance. Relevance, as it seems, was viewed by learners as a component of their ideal future-self, rather than situational interest. The eliminated item (IFS3N) was reinspected and was found that the aspect it represented,

which was the degree of uncertainty in relevance, could have been a vague concept among the participants. Furthermore, IFS2N might have been enough to represent the aspect of relevance in ideal future-self in this study.

Relationships among Variables Supporting Past Research (Study 3)

The purpose of Study 3 was to investigate relationships between the environmental, motivational, and learning-related variables among participants who experienced educational VR photo-based tour. Furthermore, the study was meant to confirm assumptions made in the initial model proposed in this dissertation (see Chapter 2), which also served as the theoretical framework of the study.

Major assumptions in the initial model were empirically supported by the results of this study. The statistically significant results from the t-test regarding difference in spatial presence dimensions between participants in high and low immersion supported earlier studies claiming that immersive capability influences spatial presence (Sheridan, 1992; Slater et al., 1994; Steuer, 1992; Witmer & Singer, 1998).

Results from the correlational analysis supported the hypothesized association between ideal future-self and situational interest. It echoed factor inter-correlation between sense of physical space, engagement, and ecological validity (Lessiter et al., 2001). Furthermore, these findings provided evidence to hypothesized associations between dimensions of spatial presence, ideal future-self, and situational interest, which was previously supported, albeit suggestively, by an earlier study (Figueroa et al., 2020).

Finally, while the results from the path analysis supported some of the theoretically supported directional relationships in the initial model. Most of the

confirmed relationships were hypotheses from literature and were hardly supported by empirical studies. These novel findings are explained further in what follows.

Immersive Capability and Ecological Validity (Study 3)

While the effect of immersive capability on sense of physical space and engagement were already expected, it offered novel evidence of its effects on individual dimensions of spatial presence (i.e., sense of physical space, engagement, ecological validity, and negative effects). A recent within-group study by Yildirim et al. (2019) did not find any of the four dimensions to be affected by the type of immersive technique used in the virtual environment and another recent within-group study by Khenak et al. (2019) found among 28 participants higher levels of higher sense of physical space in environments with higher immersive capability levels. While Khenak et al. (2019) gave empirical evidence regarding the influence of immersive capability on sense of physical space, the present study provided evidence of immersive capability's influence on the other two dimensions (i.e., engagement and negative effects)

One study that was found to be closely related to this result dates to 2011, when Gorini et al. (2011) performed a between-group study among 80 participants divided into four groups (k=20) and found that sense of physical space, engagement, and ecological validity were affected by immersive capability. However, unlike the present study, they did not report immersive capability's influence on the *negative effects* dimension.

On the other hand, Lessiter et al. (2001) included a sensitivity study in their seminal paper providing evidence that all four dimensions were affected by different media formats. However, these may have been due to the stark differences in the media formats that were used in their experiment (e.g., IMAX 3D, IMAX 2D, video shorts,

interactive games) and were performed in different experimental studies. Furthermore, they did not include VR in their media. Thus, their study did not test the influence of VR's capability in these dimensions, but just the latter's sensitivity to various media types.

Contrary to the findings of Gorini et al. (2011), the present study was not able to provide evidence of the influence of immersive capability on ecological validity – the level of naturalness or realism of the environment. Looking back at the findings, the boxplots showed that participants in the high immersive group felt higher levels of ecological validity than participants in the low immersive group. Thus, this trend was apparent among the participants.

This discrepancy can be explained in two ways. One probable reason is that the sample size may have been too small to make the evidence generalizable to the population (Kim, 2009). Another possible explanation could come from the notion that ecological validity may not be sensitive to immersive capability in VR photo-based tours as it was originally constructed to detect sensitivity of various media formats and contents. Lessiter and Freeman's (2001) study compared media with different formats and content. Thus, ecological validity or the realness of what they were watching would vary as expected.

Furthermore, Gorini et al.'s (2011) study showed that while using a VR-based application, it severely lacked in realism as shown in Figure 7.1. Thus, experiencing the application using HMD could have significantly increased the environment's realism. On the other hand, the current study featured stereoscopic images of locations taken from the real world. It featured ambient stereophonic audio that changed according to how they

navigated the environment as if they were in a real place. Furthermore, ambient light coming from the sun was also replicated in the virtual tour, which added to the inherent realism provided by the VR tour. Therefore, we argue that these features made the participants think of the place as "real-looking" even without wearing a head mounted device.

Figure 7.1

A Screenshot of the VR Application by Gorini et al. (2011)

To verify this quantitatively, Gorini et al.'s (2011) aggregation and scaling methods were approximated to compare their results with the results of the present study. The former's research showed low levels of environmental validity in their two groups (i.e., 47.95 in the high immersive group and 43.33 in the low immersive group). The present study, however, had higher levels of environmental validity in both groups (i.e., 78.66 in the high immersive group and 72.28 in the low immersive group). These

realizations had implications in the development of the model, which is discussed in the final section of this chapter.

Correlation Between Spatial Presence Dimensions (Study 3)

The results of the correlational analysis revealed that the negative effects dimension was neither positively nor negatively correlated with the other dimensions. This confirms the earlier findings of Lessiter and Freeman (2001). They had similar results despite being a cross-media study not involving VR. In their discussion about the emergence of the four factors from the CFA ITC-SOPI, they mentioned lack of theoretical support for Negative Effects as something that pertains to spatial presence, though they argued that cybersickness and dizziness may accompany the feeling of being there. They concluded their discussion with uncertainty on the contribution of the four factors to spatial presence and even recommended future researchers that "each ITC-SOPI scale be analyzed separately" (p. 294).

This recommendation was followed by previous experimental studies arguing that the "Negative Effects dimension of ITC-SOPI is not a direct measure of presence as it is not conceptually related with the sense of being there" (Yildirim et al., 2019, p. 9). Evidently, Gorini et al. argued that only the sense of physical space, engagement, and ecological validity are spatial presence dimensions thereby ignoring negative effects in their study. Realizations from these arguments led to another modification to the model

Influence of Ideal Future-self on Situational Interest (Study 3)

Findings from the current study did not only confirm association between situational interest and ideal future-self. It also supported hypothesized influence of ideal future-self on situational interest. Dornyei et al. (2013) provided an alternative view of

the ideal future-self and situational interest. They articulated the ideal future-self as the learner's inherent desire to be a proficient L2 speaker. On the other hand, Dornyei et al. encapsulated situational interest in his concept of the L2 learning experience, which is the "actual experience of being engaged in the learning process (2013, p. 439)."

While these were specific to L2 learning, it is not hard to generalize it to other learning contexts such as the present study. The participant's vision of oneself being good at the topic or content makes activities involving that topic enjoyable and therefore interesting. Like mentioned earlier, no empirical study has provided evidence to this directional relationship until now, especially in a generalized notion of an ideal future-self. While the initial model only offered a suggested association, this study's findings has provided empirical evidence of a strong direct effect of the desire to reach one's ideal future-self on situational interest.

Spatial Presence Dimensions and Motivational Variables (Study 3)

While sense of physical space and engagement were found to influence situational interest and ideal future-self, path analysis involving both engagement and sense of physical space revealed bad model fit indices and suggested effects that were conflicting with theory (i.e., sense of physical space became negatively influential to situational interest and lost its effect on score gain). This was identified not to be caused by the data because results of the correlational analysis, which were consistent to theory, had a contrasting result. Only when engagement was removed from the model did the influences and their magnitude become consistent with theory. One reason identified for bad model fit was discriminant validity between variables (Kenny, 2015). This led the researcher to reflect on the scale development process.

The development of situational interest and ideal future-self instruments was performed separately from the adoption of ITC-SOPI. They also passed discriminant validity tests when compared with existing instruments. However, a closer look at the engagement scale and the final items of the situational interest scale revealed that they had items that somehow overlapped.

Although it was confirmed that the majority of the items referred to the psychological involvement of the participant in the VR environment, four of the items seemed to also refer to the *catch and hold* aspect of interest. Particularly B8 (i.e., *I enjoyed myself)* was found to overlap with situational interest as enjoyment was strongly linked with situational interest. The item B17 (i.e., *I paid more attention to the displayed environment than I did to my own thoughts*) though being inspired by flow theory and was indeed descriptive of psychological involvement, also resembled the *hold* aspect of interest.

While the correlational analysis results did not show a very high correlation between situational interest and engagement, it was relatively the highest among the dimensions. While this does not invalidate it as a dimension of spatial presence vis-à-vis ITC-SOPI, it may confound findings that involve situational interest or similar constructs that may pertain to attention and enjoyment. Therefore, in the interest of having a parsimonious model that measures spatial presence in the pure sense that learners feel being in the virtual environment, the removal of engagement together with ecological validity as a dimension of spatial presence was considered.

Spatial Presence, Motivational Variables, and Learning Outcomes (Studies 3 and 4)

Many theoretical and empirical studies have established that situational interest and ideal future-self lead to motivated behavior, which translates into learning achievement (Dornyei, 2006; Renninger et al., 2014; Schiefele et al., 1992; Steinkamp & Maehr, 1983). However, it was surprising to discover that the study did not provide sufficient evidence to support this claim. More importantly, correlational and path analysis results revealed, albeit statistically insignificant, a very weak inverse correlation between situational interest and score gain. This result may be explained by the characteristics of the participants of the study.

As the participants were mostly post-graduate level adult learners in the Philippines, many of them have taken more challenging exams in their respective courses. In comparison, the assessment task was an eight-item multiple choice quiz given to them and after the VR-tour as a learning activity. Participants who had the higher score gains may have thought of the challenge given by the quiz slightly disinteresting. This could be explained by the hypothesized relationship of challenge and situational interest (Rotgans & Schmidt, 2011; Sun et al., 2008). Despite identifying challenge as a source of situational interest in their scale as supported by theory (Harter, 1978), Chen et al. (1999) found in a path analysis study that challenge had little effect on situational interest.

These findings have important implications on future studies attempting to measure learning achievement while investigating its association with situational interest. Furthermore, learning achievement or gain may be observed better in longitudinal studies than one off-experiments, which is the main rationale for conducting Study 4.

Finally, an illuminating finding was the direct effect of spatial presence on score gain, through the sense of physical space dimension. The model had this conjecture based on indirect references to learning achievement like task performance (Ferrel & Sheridan, 1967; Witmer & Singer, 1998). However, the current study empirically supported it through results in the score gain. More specifically, the strong effect of sense of physical space on score gain in the path diagram revealed the potential of spatial presence in explaining why previous studies indicated significant positive effects of using VR-based applications on learning achievement. However, it would be more enlightening to understand the reason behind this from the perspective of the learners. This was further addressed in Study 4.

Theoretical assumptions from the initial model predicted the influence of situational interest and ideal future-self on learning outcomes. However, findings from the Study 4 suggested that perceived learning, a learning outcome felt or believed by the learner, positively influenced their situational interest and ideal future-self. Surprising as it may appear, it could be explained by the concept of self-efficacy, which could be considered as a latent aspect of learning outcomes.

Bandura (1997) defined self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments." Association between situational interest and self-efficacy is widely supported in literature (Hidi et al., 2006) through correlational studies (Bandura & Schunk, 1981; Zimmerman & Kitsantas, 1997, 1999). Past studies also validated reciprocal and uni-directional relationships between the two variables (Hidi et al., 2006; Fastrich et al., 2018; Nuutila et al., 2020). Dornyei (2009) argued that one of the conditions that fosters motivation triggered by the

ideal future-self is the belief of the learner that the future-self is attainable. Thus, he suggested that repeated mastery experiences would further build this belief among learners.

The repeated claims of learners learning new vocabulary contributed to building their confidence, thereby affecting self-efficacy. This is supported by Bandura's (1997) social cognitive theory postulating that mastery experiences positively influence self-efficacy. Perceived learning in the current study was a result of learners being able to effectively and creatively produce sentences that used the words that were taught in the VR tour lessons after the presentation and practice activities. Repeated successful attempts in succeeding lessons may have helped build self-efficacy, thereby reinforcing their belief that they could reach their ideal future-self in these activities leading to heightened interest and motivated behavior.

This reciprocal relationship between the motivational variables and learning outcomes can also be explained by directed motivational currents (DMC), which was proposed by Dornyei et al. (2015) as a framework to explain the occurrence of strong motivational flow that could influence long-term motivated behavior. He identified perceived behavioral control, which refers to the belief of an individual to have sufficient capabilities to perform actions, as one of the key factors for a DMC to begin. Furthermore, a clear perception of progress towards reaching their vision can help sustain it. The DMC could potentially explain why their belief in gaining new knowledge and getting better through the VR tour lessons would allow them to have a sustained interest and an increased belief in the attainment of their ideal future-self.

Immersive Capability, Spatial Presence, and Negative Effects (Studies 3 and 4)

In Study 4, the fact that learners who were offered the opportunity to use HMD to experience the tours did not eventually use them was telling. While experimental results from Study 3 confirmed the theoretical influence of immersive capability on spatial presence as previously reported by literature (Sheridan, 1992; Slater et al., 1994; Steuer, 1992; Witmer & Singer, 1998), its use in a real-world remote environment may have had undesired effects that were otherwise minimized in a controlled environment.

As mentioned earlier, some learners who were given HMDs, experienced dizziness (this was one of the most prominent reasons), hence they declined to use them in teaching experiments. This is one example of how negative effects can dampen the positive influence of spatial presence on motivation and learning. In ITC-SOPI's operationalization of spatial presence, negative effects were presented as a dimension that encapsulated negative physiological reactions like headache, dizziness, and nausea (Lessiter et al., 2001).

However, the current study revealed that there may have been other factors that contributed to the refusal of learners to use the devices. The type of HMD given to them may have made their experience with HMDs less desirable compared to participants in Study 3.

First, the HMD used in experiments in Study 3 was a high-end stand-alone device, while the devices used by the online learners in this study (Study 4) were low-cost smartphone VR spectacles. Studies that compared high-end stand-alone HMDs and low-cost smart phone VR headsets did not find significant differences regarding spatial presence, usability, and cybersickness (Lombard & Ditton, 1997; Nikiforos et al., 2017)

in these devices. However, Nikiforos et al. reported slight differences in user workload, explaining that the physical demand was significantly higher among those who used the low-cost smartphone HMDs compared to Oculus Rift.

Looking back at the experience of the learners in Study 3, having them use a device that demanded less workload was compounded by the support and initial preparation made by the researcher in every experiment. Everything was ready when they were asked to use the device for the tour. However, in this study, the learners had to set it up themselves. The teacher was not able to help them troubleshoot as she was in a remote location. The spectacles were also not made specifically for their type of phone compared to the high-end HMD used in Study 3 where every aspect of the HMD was optimized with its own software.

A methodological implication of these findings is that it highlights the importance of in-situation studies as a preparatory measure for recommending an innovation to practitioners. Though experimental studies can strongly support theory building by providing empirical data, in-situation qualitative studies uncover pedagogical and contextual issues that might have been obscured by controlling variables in experiments.

Experience with the learners in this study implied that in real world situations, the current state of low-cost HMDs may not yet be recommended to adult learners who do not have significant experience in the technology. This is because online learners usually have limited time with their teacher in online sessions and enjoy limited technical support. Teaching them once in-person was insufficient to encourage them to use the HMD as shown by the study. Non-immersive VR tours would be more efficient and beneficial in these kinds of lessons.

However, results may have been different for adult learners who own a high-end HMD and are already VR savvy. Furthermore, it must be different for in-person contexts where high-end integrated HMDs are provided with enough support. Moreover, with the rapid development of low-cost VR HMDs, as well as the increasing familiarity of people with VR technology, future in-situation studies involving low-cost VR HMDs could be expected to yield more positive results.

Novelty and Aesthetics (Study 4)

In hindsight, it was expected that novelty could have played a part in stirring the interest of learners as VR was still considered as a novel technology in education and that teaching experiments involving VR tour lessons were also considered as novel in their design. Novelty is known to be a source of situational interest and is viewed by motivational researchers as one of its dimensions or components (Deci, 1992; Sun et al., 2008). Thus, findings in the study of novelty emerging as a source of situational interest was not surprising.

However, as novelty wanes through time and through multiple exposures, it would be thought to naturally diminish, as there would be no information deficiency (Spielberger & Starr, 1994) regarding the technological innovation. Contrary to this expectation, however, findings from the interviews revealed that the VR Tour Lessons maintained novelty throughout the nine lessons among some of the learners. Therefore, habituation, which is the state where novelty diminishes, might not have taken place yet.

Another aspect of the tour that was thought to contribute to this constant stirring of interest was the novelty provided by encountering new places. In tourism research, it was found that tourists preferred going to places that provided experiences that were

different from prior ones (Blomstervik et al., 2020; Crompton, 1979; Niininen et al., 2004). Hence, spatial presence provided by the virtual tour facilitated the encounter of learners with a new place, thereby tapping this aspect of novelty.

Most of the learners in the study exemplified this phenomenon in the midpoint and final interviews. Most of the time, they mentioned that the beautiful scenery made the tour interesting for them. This amplified interest due to the beauty of the scenery could be explained by the notion that beauty catches and holds attention among humans (Aharon et al., 2001; Markovic, 2012; Sui & Liu, 2009).

Working and Spatial Memory (Study 4)

Findings confirming that text-based and image-based scaffolds facilitated learning are not unique to VR tour lessons. In fact, scaffolding is a well-known strategy in education because of its growing utility in teaching and learning over the years since the time it was inspired by Vygotsky's zone of proximal development and developed into a theory by Bruner (1950). While these scaffolds could be considered as features of the lesson and not the VR tour itself, another theory may offer why learners claimed to have learned the words more easily due to the VR tour.

The said theory is cognitive theory of multimedia learning (Mayer, 2005). This theory assumes that humans have a limit to the amount of information they can process, and that information is processed via two channels: auditory and visual. Thus, providing coherent verbal and visual input to the learners reduces the cognitive load, thereby enhancing learning. The words featured in the VR tours were represented by objects that were stereoscopically experienced by the learners. Textual labels that appeared near the object representing the word served as a text-based scaffold so that when the learners

looked at the object, they could easily associate it with the vocabulary word before it passed through the optical channel while the addition of audio-based narration reinforced this information as it passed through the auditory channel.

However, compared to other multimedia materials, VR could have added another dimension that made the vocabulary words easier to remember. Spatial presence may have caused learners to process the tour as a text-augmented navigable space aside from just it being a set of text and images. Studies that deal with spatial memory attribute it to the hippocampus, which is the portion of the brain that is both responsible for navigation and episodic memory (O'Keefe & Nadel, 1978). Spatial information processed by the hippocampus was proposed to produce a cognitive map or a mental representation of the environment's layout including non-spatial objects (Manns & Eichenbaum, 2009). Therefore, presenting the words as part of the environment in the virtual tour to the learners were also processed by the hippocampus and stored together with spatial information and were associated with landmarks of that location. Therefore, these objects could be more easily remembered by the learners, rather than the images presented with text in a PowerPoint slide or a printed page.

Lesson Specific Factors (Study 4)

Two specific findings were more related to the design of lessons rather than the VR tours themselves. These include chunking and retrieval opportunities. Chunking is a process by which bits of information are grouped based on logical or meaningful relationships for facilitating short-term retention (Neath & Surprenant, 2003). Chunking strategies are based on the idea that the capacity of short-term memory can only store five to nine items at a time (Miller, 1956). An example of a chunking strategy is the finding

in this study that the number of words embedded in the VR tours were easy enough to remember in the allotted time for the learners.

More recent studies have suggested a more limited capacity of four to five items (Covan, 2001). While the VR tour lessons having featured five words could have already passed this requirement, chunking them as members of one group or category somehow helped retention even more. Two logical groupings of words could be recognized in the VR tours. A lesson-based grouping featured words that were of the same parts of speech, while a grouping inherent in the VR tour was the membership of the objects representing the target words in the same scene or location of the tour.

As chunking strategies were proven to decrease the load on working memory, they allowed non-chunked bits of information to be remembered easily as well (Thalman et al., 2019). Therefore, chunking strategies in the VR tour helped learners in learning not just the target words but also the related concepts taught in the lessons as their working memory had ample space to process them.

Another lesson-based factor that facilitated learning was the amount of retrieval opportunities given to learners throughout the practice and production exercises. Furthermore, retrieval opportunities for words learned in past lessons were consciously incorporated in the design of succeeding lessons.

Retrieval refers to accessing stored information from memory. Incorporating retrieval opportunities of information through retrieval practice in lessons was found to improve retention and subsequent recall (Roediger & Butler, 2011; Roediger & Karpicke, 2006; Rowland, 2014). This could explain why some learners have learned the words

more deeply, and this was due to the different ways these words were presented and were asked to be used in the lessons as well as in succeeding lessons.

Learner Factors (Study 4)

One of the learner-related factors that was observed to have moderated the dynamics among variables was the learner's individual interest which is a more dispositional type of interest.

Eito was found to be an outlier among the Japanese learners as he had shown an extremely high individual interest, which was evidenced by his daily routine in actively learning English from various sources and by his consistently high ratings in the variables. His behavior defied demographical and cultural assumptions that were found to be consistent with the other learners. It may also have greatly influenced why he was always very interested in every lesson regardless of the quality of the VR tour. He always found the lessons to be exciting and excellent. This example supports the notion that an initially high individual interest would almost always be motivated in the tasks related to the object of their interest but would amplify the motivational effects of interventions in learning it (Hidi & Renninger, 2006).

An aspect of individual interest was also observed specific to the VR tour. Some of the learners' dispositional interest in the places featured in the VR tour somehow affected their interest in the actual tour as a learning activity. Masaki's lack of interest in most places presented from the USA and his strong interest in the VR tours that presented places in the Philippines exemplified this. Other learners also shared that they inherently liked or desired to go to the place that was featured, which was the reason for their interest in the activity.

Findings from Study 4 further revealed cultural and context-specific factors that could have moderated the dynamics of spatial presence, situational interest, ideal future-self, and learning outcomes.

The difference between Japanese and French learners in actively asking questions or admitting something that they did not understand was surprising. Assumptions based on cultural and cross-cultural studies among Japanese and French students appeared to be quite the opposite of what was observed among the learners. Japanese students were found to seldom ask questions or initiate discussions (Anderson, 1993) due to their generally shy disposition, unwillingness to speak (Mayer, 1999; Miller, 1995; Nimmannit, 1998; Williams, 1994), and teacher-centric educational upbringing (Williams, 1994). While French classrooms exhibited similarity in having highly structured classes and tight curricula (Zanten, 2002), French pedagogy was found to be conducive for student expression as compared to their Asian counterparts (Charlesworth, 2008).

One way to explain this deviation was the unique context of the learners in the study. Shyness among Japanese learners was associated with the culture's high uncertainty avoidance, which is reflected by their reluctance to make mistakes (Ferndandez et al., 1997). Japan is also known for its shame culture where mistakes can be magnified in public (Zimbardo et al., 1977). The online learning context in the study allowed the Japanese learners to freely make mistakes without fear of being mocked or shamed. However, their strong culture of uncertainty avoidance made them bold enough to ask the teacher to help them correct these mistakes while they were in a safe environment to avoid committing them in public. This suggests that VR tour lessons

could be more effective in one-one-one online learning contexts in Japan rather than in class-based ones as it lessens the effect of its shame culture.

As for the French learners, rather than shame, their spatial and temporal contexts could have explained their reluctance to ask questions or clarify topics they did not understand. Charles and Emma took the lessons during their lunch break at work. They only had one hour, and they allocated half of that to their online lessons. Charles was in his car while Emma was in her office during the lessons. The setting from where they chose to learn may have limited them from asking questions or admitting misunderstanding a topic that would have extended their time with the teacher.

During the interviews, Charles mentioned that learning in the car also affected how he felt in the VR tours. He said that he could have felt more present and relaxed if he was in a more comfortable environment. Emma's reluctance to use the VR goggles also came from being in the office aside from reporting dizziness. This implies that the learners' cultural tendencies may have been moderated by their physical learning environment. Furthermore, it suggested that the benefits provided by spatial presence experienced in VR tours can be nullified or moderated by the physical learning environment of the remote learner. A contrasting finding revealed that those who studied in their workplace vicinity had the highest score gain. The statistical significance of this result, however, cannot be generalized because of the extremely low number of participants. Furthermore, incidentally, those who took the lessons at their workplace had lower English proficiency compared to the home-based learners. However, home-based learners having had better score gains from the learners who took lessons from a

cafe supported the notion that the physical learning environment can have a moderating effect on VR-based interventions in online lessons.

On the other hand, the study did not reveal any cultural differences in ideal future-self. However, the study revealed that instrumentality may have influenced the variation in vividness of the learners' ideal-future self. There are some reasons why Masaki and Mizuki had lower levels of awareness and vividness of an ideal future-self compared to the others. Mizuki studied in an international university in Japan and traveled abroad. She was also able to make friends from the countries she visited as well as foreign students who studied at her university. As she did not feel a great need to be a better English-speaker, her vision of herself as a better English-speaker followed.

Masaki, on the other hand, has reached a point in his profession where he felt content despite being less proficient in the language compared to Mizuki. Though he still felt that he needed English for his improvement, it was not as critical or urgent. He was also busy taking care of his toddler, which also meant less opportunities to travel abroad.

The two other French learners, Charles and Emma, were planning to go abroad that year with their family and envisioned themselves being able to speak with locals abroad while they improved their English skills through the VR tour lessons. The cosmopolitan learners, Eishi and Denis, both had and were expecting even more frequent encounters with English speakers either by living abroad or by speaking with bilingual relatives.

While instrumentality was presented as an orientation in Gardner and Lambert's integrative approach, Dornyei (2009) saw instrumental motives linked to career as a manifestation of an idealized future-self. This was supported by evidence of the

promotional dimension of instrumentality as associated to the ideal future-self (Taguchi et al., 2009).

International posture could explain the reason behind the vivid ideal future-selves of cosmopolitan learners and French learners who were planning to travel abroad. It refers to a learner's attitude towards English as an international language and towards the international community, which was also found to be highly associated with the ideal future-self as its representative or manifestation in various learning contexts (Csizer & Kormos, 2009; Yashima, 2002, 2009).

Synthesis of Findings and Revision of the Initial Model

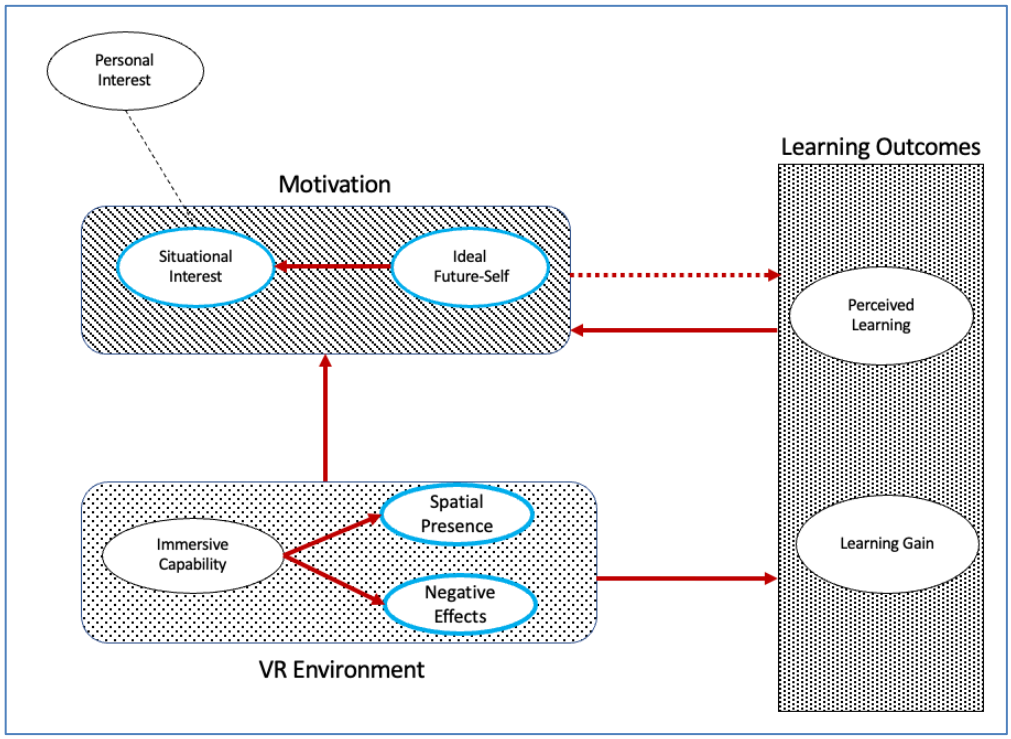
Findings from the studies helped clarify relationships between variables, which helped refine the initial model. Reflecting on the findings led to a new model that was called the Environment-Motivation (EM) Model of VR-based Learning as shown in Figure 7.2.

The new model illustrates the clarified relationships among variables of the VR environment, motivation, and learning outcomes. First, the lack of evidence for the influence of motivational variables on learning outcomes was attributed to the nature of the tests in the experiment and to the lack of challenge that it provided. However, since this relationship was already supported strongly by literature, it was kept as a theoretical link (broken lines) rather than an empirically supported one, which calls for further studies. Furthermore, the influence of perceived learning on situational interest and ideal future-self gave evidence to the reciprocal relationship between motivational variables and learning outcomes even in the context of VR tour-based learning. This reciprocal relationship was discussed to have reflected propositions regarding self-efficacy and

directed motivational currents (DMCs). Specifically, the ideal future-self could eventually lead to learning achievement, a clear perception of reaching that vision being brought about by self-efficacy and perceived behavioral control. Both self-efficacy and perceived behavioral control are attained through repeated mastery experiences leading to the perception of learning or growth.

Figure 7.2

Environment-Motivation Model VR-based Learning



Second, findings in Study 3 yielded empirical evidence to the previously hypothesized association between situational interest and the ideal future-self and confirmed the direction of this relationship. Surprisingly, evidence also showed the notion that the ideal future-self has a strong influence on situational interest. Though this could be a parallel to Dornyei's (2009) earlier proposition that the ideal future-self has a synergetic relationship with learning experience within which situational interest was

described, the study illuminated the strong influence of ideal future-self on situational interest.

Finally, the direct effect of spatial presence as both suggested by findings in Study 3 and Study 4 supported the researcher's initial proposition that spatial presence could explain why VR-based interventions in past studies contributed to learning achievement. Reflection from findings further explained that the feeling of translocation may have led the participants to use the hippocampus, the part of the brain that is responsible for spatial and episodic memory. Both studies also made a similar contribution on the proposed effect of spatial presence on the motivational variables. The feeling of being in a place that they liked or wanted to visit was proposed to have amplified their interest and the vividness of their ideal future-self, which led them to stay motivated in the lessons. Thus, previously hypothesized directional relationships (i.e., dashed arrows) were replaced by empirically supported ones (i.e., solid arrows).

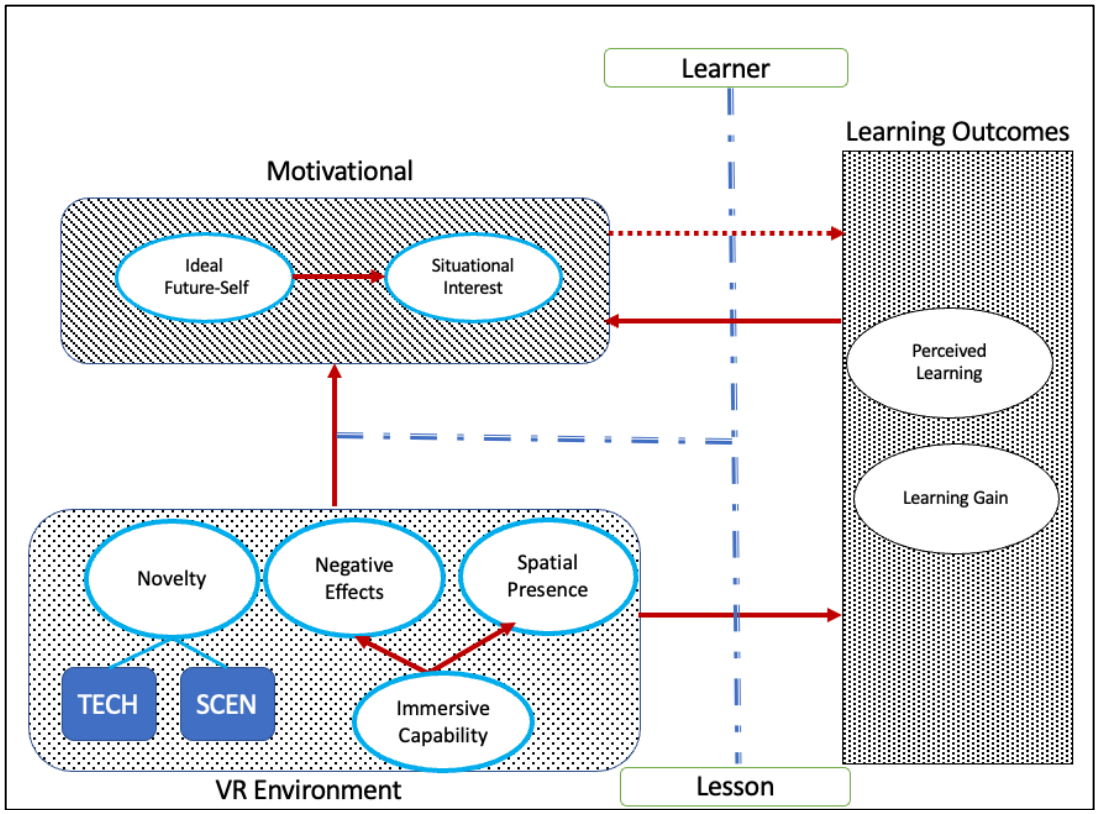
The EM Model can provide guidance to future researchers in observing key environmental, motivational, and learning variables in the context of VR-based learning activities. But Study 4 revealed other variables that could affect long-term dynamics of motivation and learning in VR-based activities that are incorporated in recurring online lessons. These variables and their relationship with the original ones were conceptualized in an extended model called Environment-Motivation-Lesson-Learner (EMLL) Model of VR-based online learning as shown in Figure 7.3.

Technological novelty was assumed to have influenced motivation, especially on situational interest even though it was not conceptualized in the initial model. It was also expected that it would wane when learners achieve a state called *habituation* after they

have used the technology several times. However, findings from Study 4 revealed otherwise. This was explained by another aspect of novelty that was found to be unique in the VR tours: *novelty in scenery,* which was also somehow amplified by the aesthetic quality of the places featured in the tours. The researcher also realized that the situational interest gained from these novel sceneries paralleled the numerous reports in tourism research of tourists preferring places that provide a different experience than prior ones and that includes visual experience (i.e., what people see during the tour) as well as the catch-and-hold effect of beauty on humans according to research in aesthetics.

Figure 7.3

Extended EMLL Model of VR-based Online Learning



Legend. TECH: Technology; SCEN: Scenery

Despite not showing the effect of habituation on waning technological novelty through time, the study provided evidence to novelty's positive contribution to motivation through situational interest. Therefore, it was added to the extended model as a guide for researchers to observe when doing longitudinal studies.

Moreover, the findings in Study 4 revealed that the dynamics of environmental, motivational, and learning variables in VR tour-based activities that are incorporated in online lessons may be moderated by the following: 1) learner characteristics such as their culture and individual interest, and 2) strategies incorporated in the design of the lesson like scaffolding, chunking, and increasing retrieval opportunities. Therefore, it is important to include them in observing long-term motivation and learning in VR-based online lessons.

More particularly, learner characteristics were found to be extremely important in one-on-one online lessons vis-à-vis choosing content. In the more specific instance of a VR tour-based lesson, the choice of scenery containing the topic being taught would influence the learning experience and the motivation of learners positively if it was a place that was inherently interesting for them or coincided with their ideal future-self.

Conclusion

"The world is a book and those who do not travel read only one page."

– Saint Augustine

The quote above encapsulates what inspired the idea behind this whole research journey. The researcher experienced traveling abroad after college graduation for the first time and realized how much he didn't know about life and the world. The more he

traveled, the more he learned and realized how ignorant and prejudiced he was about people and about many aspects of life.

Living in a country where the majority of the population might not even have the chance to leave their place of birth burdened him. Hence, he tried to look for ways to share this joy of wonder and discovery with others through other means. When *Google Cardboard* started to gain popularity in the Philippines, he led a small outreach project with his parents to enable children in the neighborhood to experience going to different places abroad through virtual reality.

The results, albeit anecdotal, were exciting. The participants were brimming with joy. They wanted to see more and learn more. It was then that the desire to learn more about this phenomenon of 'learning by VR' burst aflame in his heart. This flame, however, was doused gradually by the daily grind of work. Hence, the chance of a scholarship abroad to conduct four studies and in the process, learn and share more about this phenomenon has been extremely rewarding. It is therefore the researcher's hope that despite being imperfect, the humble contributions of this research could help expand possibilities for the underprivileged to *read more pages of this wonderful book* we live in.

Theoretical Contributions

The theoretical contributions of the four studies range from dimensionality of spatial presence factors that were earlier identified by Lessiter et al in 2001 and empirical evidence of the complex relationship between environmental, motivational, and learning variables to updating theories in novelty and multimedia learning in the context of VR tour-based online learning

In Study 1, findings from the confirmatory factor analysis provided insight to Lessiter's call to further investigate dimensionality of sense of physical space, engagement, ecological validity, and negative effects vis-à-vis spatial presence. While the reliability of these dimensions in the context of Filipino learners was explored, the findings from the study also provided a context-specific perspective regarding the meaning of spatial presence to these group of learners.

In Study 2, findings from the exploratory factor analysis gave deeper insight as to how Filipinos understand the concept of situational interest and ideal future-self. It also provided a cultural perspective on how both constructs arrived at their item compositions and the nature of their mono-dimensional nature.

Study 3 addressed the gap characterized by the absence or lack of research investigating the influence of immersive capability and spatial presence on situational interest, ideal future-self, and learning outcomes. More specifically, findings from the experimental study provided empirical evidence of the positive influence of immersive capability on spatial presence in the context of a VR photo-based tour. Furthermore, findings from the path analyses clarified the dimensionality of engagement, ecological validity vis-à-vis spatial presence in the context of educational VR photo-based tours. The study also contributed to theory building by re-organizing negative effects and sense of physical space vis-à-vis spatial presence where the former has been found to be a separate but related construct while the latter has been found to fully embody spatial presence in the said context. In the same study, findings provided empirical evidence of the magnitude of correlational relationships among spatial presence, situational interest,

ideal future-self, and learning gain while synthesizing findings gave rise to new hypotheses that could potentially update the theory of multimedia learning.

In Study 4, the findings exemplified how perceived learning could positively influence ideal future-self among adult learners taking online VR tour-based language lessons. Furthermore, findings from the study introduced the two aspects of novelty (i.e., technological and scenic novelty) and presented a theory on how they would interact to influence situational interest in online VR tour-based language lessons taken by adult learners in the span of several months. Findings from this qualitative study unearthed how cultural aspects and personal preferences among Japanese and French adult learners as well as their physical learning contexts influenced situational interest and learning outcomes in online VR tour-based language lessons while revealing the role of instructional design and pedagogical strategies in promoting positive dynamics among these variables.

Finally, while the four studies empirically supported various theoretical propositions that were validated in previous studies, they were the first to confirm these hypothetical relationships in a unified model for learning in a VR-based learning activity. Furthermore, relationships were validated not only in a one-time experiment but also in a long-term context-specific study, which resulted to an extension of the model describing lesson- and learner-related variables that could influence situational interest among learners. The models could be used to guide future researchers who are interested in observing motivation and learning in other contexts of VR-based learning.

Instrumental and Methodological Contributions

The instruments developed and validated for situational interest and ideal future-self were found to observe parsimony and brevity. Thus, they present an opportunity for future researchers to measure these two variables together without worrying about its toll on participants who would otherwise suffer from fatigue in answering long surveys.

The two-level cyclic implementation of design-based research in Study 4, including instruments and templates included in the study, can guide future researchers who plan to use the same approach in a longitudinal mixed methods study involving learners that are taught individually and not as a class.

Practical Contributions

The studies may contribute to teaching practice by providing templates for making VR photo-based tours in the fields of open and distance education, sustainability science, and language learning. Further, the actual tours developed in the studies can be freely used by other educators under the Creative Commons attribution license 4.0. The principles identified in designing effective VR Tour lessons for vocabulary acquisition were proven to be supported by well-established theories and exemplified by the lesson templates that were made available with this research.

Limitations

Several limitations were identified while implementing the studies and after analyzing the data collected from them. First, the single dimension of situational interest and ideal future-self were revealed by exploratory factor analyses. They were, in fact, validated in a different study using confirmatory factor analysis, but it was not included

in the scope of this research. Further confirmatory factor analysis studies are highly recommended.

Second, the mediocre fit of ITC-SOPI calls for more CFA studies in the adult Filipino learners' context. However, it may be better to have native language scaffolds like translations of each item to meet language gaps or ambiguities brought about by the culture's variant of English. As discussed earlier, a CFA without negative effects as a dimension may help contribute to a better model fit.

Third, the sample size of the participants in Study 3 limited the researcher from performing structural equation modelling. While path analysis indicated the magnitude of effects of hypothesized directional relationships, it was not strong enough to make the actual direction conclusive. Thus, while the models in Study 3 empirically supported hypothesized effects by determining the magnitude of these effects and its statistical significance, causation needs to be further validated by experimental studies. Therefore, it is recommended for future researchers to conduct survey studies with an ample number of participants. Such sampling is amenable to structural equation modeling that would make the validation of hypothetical causal relationships in the model more conclusive and increase its statistical power.

Fourth, except for the spatial presence scale, the one-item scales used to measure situational interest, ideal future-self Study 4, were roughly based on established scales and not as rigorously validated as the scales used in Study 3. Thus, the study was not able to maximize the trends that were revealed through quantitative analysis. Therefore, it is recommended that future researchers use the recently validated scales for situational

interest and ideal future-self, together with the existing single-item scale for spatial presence, in future design-based research studies.

Finally, illuminating findings regarding learner and lesson factors should be more thoroughly explored both qualitatively and quantitatively as they can provide more insights into how learner characteristics and lesson design can moderate the dynamics between the VR environment, motivation, and learning outcomes.

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Appendices

Appendix A: Items of Instruments in Literature

Total Interest Items from Slater, Usoh, and Chrysanthou's Situational Interest Scale (1995).

Item Number	Item Description
1	Please rate your sense of being there in the virtual reality.
2	To what extent were there times during the experience when the virtual reality became the "reality" for you, and you almost forgot about the "real world" of the laboratory in which the whole experience was really taking place?
3	When you think back about your experience, do you think of the virtual reality more as images that you saw, or more as somewhere that you visited ?
4	During the course of the experience, which was strongest on the whole, your sense of being in the virtual reality, or of being in the real world of the laboratory?
5	When you think about the virtual reality, to what extent is the way that you are thinking about this similar to the way that you are thinking about the various places that you've been today?
6	During the course of the virtual reality experience, did you often think to yourself that you were actually just standing in a laboratory wearing a helmet, or did the virtual reality overwhelm you?

Kim and Biocca's telepresence questionnaire items (1996)

Item Number	Item Description
1	When the broadcast ended, I felt like I came back to the "real world" after a journey.
2	The television came to me and created a new world for me, and the world suddenly disappeared when the broadcast ended.
3	During the broadcast, I felt I was in the world the television created.
4	During the broadcast, I NEVER forgot that I was in the middle of an experiment.
5	During the broadcast, my body was in the room, but my mind was inside the world created by television.
6	During the broadcast, the television-generated world was more real

	or present for me compared to the "real world."
7	The television-generated world seemed to me only "something I saw" rather than "somewhere I visited."
8	During the broadcast, my mind was in the room, not in the world created by television.

Whitmer and Singer's PQ Items and their subscale (1998).

Item Number	Item Description	Subscale
1	How much were you able to control events?	Involved/Control
2	How responsive was the environment to actions that you initiated (or performed)?	Involved/Control
3	How natural did your interactions with the environment seem?	Natural
5	How much did the visual aspects of the environment involve you?	Involved/Control
7	How natural was the mechanism which controlled movement through the environment?	Natural
10	How compelling was your sense of objects moving through space?	Involved/Control
12	How much did your experiences in the virtual environment seem consistent with your real-world experiences?	Natural
13	Were you able to anticipate what would happen next in response to the actions that you performed?	Involved/Control
14	How completely were you able to actively survey or search the environment using vision?	Involved/Control
18	How compelling was your sense of moving around inside the virtual environment?	Involved/Control
23	How involved were you in the virtual environment experience?	Involved/Control
25	How much delay did you experience between your actions and expected	Involved/Control

	outcomes?	
26	How quickly did you adjust to the virtual environment experience?	Involved/Control
27	How proficient in moving and interacting with the virtual environment did you feel at the end of the experience?	Involved/Control
28	How much did the visual display quality interfere or distract you from performing assigned tasks or required activities?	Interface Quality
29	How much did the control devices interfere with the performance of assigned tasks or with other activities?	Interface Quality
30	How well could you concentrate on the assigned tasks or required activities rather than on the mechanisms used to perform those tasks or activities?	Interface Quality
32	Were you involved in the experimental task to the extent that you lost track of time?	Involved/Control

Schubert, Friedmann, and Regenbrecht IPQ items (2001).

Item Number	Item Description	Anchors
1	In the computer generated world I had a sense of "being there"	not at all--very much
2	Somehow I felt that the virtual world surrounded me.	fully disagree--fully agree
3	I felt like I was just perceiving pictures.	fully disagree--fully agree
4	I did not feel present in the virtual space.	did not feel--felt present
5	I had a sense of acting in the virtual space, rather than operating something from outside	fully disagree--fully agree
6	I felt present in the virtual space.	fully disagree--fully agree
7	How aware were you of the real world surrounding while navigating in the virtual world? (i.e. sounds, room temperature, other people, etc.)?	extremely aware-moderately aware-not aware at all

8	I was not aware of my real environment.	fully disagree--fully agree
9	I still paid attention to the real environment.	fully disagree--fully agree
10	I was completely captivated by the virtual world.	fully disagree--fully agree
11	How real did the virtual world seem to you?	completely real--not real at all
12	How much did your experience in the virtual environment seem consistent with your real world experience?	not consistent-moderately consistent-very consistent
13	How real did the virtual world seem to you?	about as real as an imagined world--indistinguishable from the real world
14	The virtual world seemed more realistic than the real world.	fully disagree--fully agree

Situational Interest Items from Mitchell's Situational Interest Survey (1993).

Item Number	Item Description
1	Our class is fun.
2	I actually look forward to going to math class this year.
3	Our math class is dull.
4	This year, I like math.
5	I don't find anything interesting about math this year.
6	My other classes are more interesting than math.

Perceived Interest Items from Schraw, Bruning, and Scoboda's Sources of Interest Questionnaire (1995).

Item Number	Item Description
1	I thought the story was very interesting.
2	I'd like to discuss this story with others at some point.
3	I would read this story again if I had the chance.
4	I got caught-up in the story without trying to.
5	I'll probably think about the implications of this

	story for some time to come.
6	I thought the story's topic was fascinating.
7	I think others would find this story interesting.
8.	I would like to read more about this topic in the future.
9.	The story was one of the most interesting things I've read in a long time.
10.	The story really grabbed my attention.

Total Interest Items from Chen, Darst, and Pangrazi's Situational Interest Scale (2001).

Item Number	Item Description
1	The activity is interesting.
2	The activity looks fun to me.
3	It is fun for me to try this activity.
4	This is an interesting activity for me to do.

Situational Interest Items by Rotgans and Schimdt (2009).

Item Number	Item Description	Dimension
1	I am fully focused on today's topic. I am not distracted by other things.	Focused Attention
2	I think today's topic is interesting.	Focused Attention
3	I will enjoy working on today's topic.	Affect
4	Presently, I feel bored.	Affect

Situational Interest Items by Linnenbrink-Garcia, et. al. (2010)

Item Number	Item Description	Dimension
1	I think the field of psychology is very interesting	Maintained Interest
2	Psychology fascinates me	Maintained Interest
3	I'm excited about psychology	Maintained Interest
4	I think what we are learning in this	Maintained Interest

	course is important	
5	I think what we are studying in Introductory Psychology is useful for me to know	Maintained Interest
6	I think the field of psychology is an important discipline	Maintained Interest
7	To be honest, I just don't find psychology interesting	Maintained Interest
8	I find the content of this course personally meaningful	Maintained Interest
9	I think this class is interesting	Maintained Interest
10	I see how I can apply what we are learning in Introductory Psychology to real life	Maintained Interest
11	This class has been a waste of my time	Maintained Interest
12	I don't like the lectures very much	Triggered Interest
13	The lectures in this class aren't very interesting	Triggered Interest
14	The lectures in this class really seem to drag on forever	Triggered Interest
15	I like my instructor	Triggered Interest
16	I am enjoying this psychology class very much	Triggered Interest

Ideal L2 Future-self items by Lamb (2012).

Item Number	Item Description
1	The things I want to do in the future involve English
2	I often imagine myself as someone who's able to speak English
3	I want to be the kind of Indonesian who speaks English well.
4	I think that what we are learning in the activity is important see myself one day speaking English with other young people from all over the world.
5	It is easy to think of myself as a future user of English.
6	If my dreams come true, I'll one day use English

	effectively.

Ideal Future-self Items by Papi, et. al. (2018)

Item Number	Item Description	Dimension
1	I can imagine a day when I speak English like a native speaker of English.	Ideal L2 Self (Own)
2	I can imagine a day when I speak English fluently with international friends/colleagues.	Ideal L2 Self (Own)
3	I can imagine a day when I write effectively and read fluently in English.	Ideal L2 Self (Own)
4	I can imagine a day when I use English effectively to communicate with people from all around the world.	Ideal L2 Self (Own)
5	My family hopes that one day I will speak English fluently.	Ideal L2 Self (Others)
6	My family will be proud of me if one day I master the English language.	Ideal L2 Self (Others)
7	It is my parents' hope that one day I will speak English fluently.	Ideal L2 Self (Others)
8	The people who are important to me hope that one day I will master the English language	Ideal L2 Self (Others)

Appendix B: Study 1 Questionnaire without ITC-SOPI Items

VR Tour Survey on Situational Interest, Ideal Future-self, and Presence
Situational Interest and the Ideal Future-self in a Virtual Reality-Integrated Learning Activity: A Pilot Study for Instrument Validation.

You are being asked to participate in a research study. Before you give your consent to volunteer, it is important that you read the following information to be sure you understand what you will be asked to do. Please ask the researcher if there is anything that is not clear or if you need more information.

Researcher

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Purpose of the Research

The purpose of this study is to confirm the validity and reliability of the instruments that were developed to measure situational interest, the ideal future-self, and presence.

Procedures

A. Before accomplishing this survey, please make sure that you have one of the following:

1.Oculus Go / HTC Vive / Oculus Rift
2. Desktop Computer / Laptop with Google Chrome as browser
3. Mobile Phone with Google Chrome as browser
4. Mobile Phone with Google Chrome as browser with VR glasses / goggles or Google Cardboard

Step 1A: When using a computer, click on the speech bubble to hear the audio explanation of each element in the tower.

Step 1B: When using a VR-viewer, just gossip on the speech bubble to hear the audio explanation of each element in the tour.

Please listen to all explanations of all elements of the survey before completing the survey. You may want to understand the explanation of the first time. Please let the explanation finish before gazing at or clicking on a new speech bubble.

Virtal Tour: http://bobfigueroajr.com/esvr2 (5 minutes)
Virtual Tour Topic: Ecosystem Services

B. Fill out a survey questionnaire that will take around 15 minutes.
The survey has five sections:

Demographics - 4 items
Technology Experience - 5 items
Situational Interest - 8 items
Ideal Future-self - 6 tems
Feelings - 10 items
Presence and Negative Effects- 6 items
Your participation will take approximately 15 minutes.

Potential Risks or Discomforts

Minor side effects

It is not anticipated that you will experience any discomfort from the testing procedures. However, when using virtual reality systems, some people sometimes experience some degree of nausea. There have been various reported side effects of using virtual reality equipment such as "flashbacks".

Epilepsy

With and type of video equipment, there is a possibility that an epileptic episode may be generated. This, for example, has been reported for computer video games. Because of this, we regret that we are unable to accept volunteers who are known to have suffered from epilepsy.

Termination

Testing will be terminated immediately upon your request due to any indication of discomfort / undue fatigue or if any abnormal responses occur.

Potential Benefits of the Research

The potential benefits that you may gain from this study include learning about and experiencing VR tours using a head-mounted device (i.e., Oculus Go). This study will help make the instrument for measuring situational interest, the ideal future-self, and presence in VR valid and reliable so that it can be used for empirical studies.

Confidentiality and Data Storage

Anonymity will be preserved throughout the study. Email addresses will be collected just for future reference in case data needs to be verified, but will be strictly kept confidential.

The data for analysis will be stored on the researcher's computer and used exclusively for research purposes. For future reference and auditing, a copy of the electronic data will be carefully stored as a confidential file in the USB memory stick. The USB memory stick and the paper-based questionnaires will be stored in a locked drawer. The data will be discarded after 10 years.

Participation and Withdrawal

Your participation in this research study is voluntary. You may refuse to participate or stop participation at any time without penalty. To cease participation, simply stop filling out the survey, tell the researcher about it, or send an email to Roberto B. Figueroa Jr. (rjbfigueroa@gmail.com).

There are 15 questions in this survey.

Consent Form

Please read each item carefully and tick the checkbox below if you agree to participate in this study.

Consent and Non-disclosure Form

Please read each item carefully and tick the checkbox below if you agree to the following:

1. I have read the information sheet about this study.
2. I have received enough information about this study.
3. I understand that I am free to withdraw from this study at any time.
4. I understand the risks associated with the use of virtual reality equipment.
5. I confirm that I do not have epilepsy
6. I will keep all the items on this survey confidential.
7. I agree to take part in this study.

I agree to all statements above. I want to participate in this study ☐
Email Address or Cellphone Number for Future Contact:

Demographics

Gender *
Choose one of the following answers
Please choose **only one** of the following:

- Male
- Female
- Other

What is your occupation (work / job)? *
Please write your answer here:

Which age range does your age belong to? *
Please choose **only one** of the following:

- 29 and below
- 30 to 39
- 40 to 49
- 50 to 59
- 60 and above

Technology Experience

Besides your experience on this tour, have you viewed 360-degree images or videos before? *
Please choose **only one** of the following:

- Yes
- No

How would you rate your knowledge of how 360-degree images are produced? *
Please choose **only one** of the following:

- None (I have no idea)
- Basic (I have a general idea of how it is produced, but I have not produced any image yet)
- Intermediate (I can take 360-degree images using my smartphone)
- Expert (I can take 360-degree images using 360-degree cameras)

Besides your experience on this tour, have you used a virtual reality system before? *
Please choose **only one** of the following:

- Yes
- No

How would you rate your knowledge of virtual reality (i.e., how it works)? *

Please choose **only one** of the following:

- None (I don't have any idea of what VR is before this tour)
- Basic (I have just read about it before this tour)
- Intermediate (I know how to use it and the concept behind it)
- Expert (I know how to use it and create virtual reality applications as well)

Please indicate the activity that you have completed. *

Please choose **only one** of the following:

- Website Navigation
- Virtual Tour (Desktop Computer / Laptop / Smartphone without viewer)
- Virtual Reality Tour (Oculus Go)

Situational Interest

Please indicate HOW MUCH YOU AGREE OR DISAGREE with each of the following statements by selecting just one of the numbers using the 5-point scale below:

1 - Strongly Disagree
2 - Moderately Disagree
3 – Slightly Disagree
4 – Neither Agree nor Disagree
5 - Slightly Agree
6 – Moderately Agree
7- Strongly Agree

Item	1	2	3	4	5	6	7
The virtual tour was entertaining.							
I did not enjoy doing the virtual tour							
I liked the virtual tour.							
I felt bored when doing the virtual tour.							
I can see how I can apply what we are learning in the virtual tour in real life.							
What we are learning in the virtual tour is not important							
The topic of the virtual tour was interesting.							
The topic of the virtual tour is not useful							
I see how I can apply what we are learning in the activity in real life.							

Please indicate HOW MUCH YOU AGREE OR DISAGREE with each of the following statements by selecting just one of the numbers using the 5-point scale below:

1 - Strongly Disagree
2 - Moderately Disagree
3 – Slightly Disagree
4 – Neither Agree nor Disagree
5 - Slightly Agree
6 – Moderately Agree

7- Strongly Agree

Item	1	2	3	4	5	6	7
The things I want to do in the future involve the topic of the virtual tour.							
I do not imagine myself as someone who can practice skills related to the topic of the virtual tour.							
I aspire to be someone who can accomplish tasks requiring knowledge of the topic of the virtual tour.							
I do not see myself applying the topic of the virtual tour in any aspect of my life.							
I have a clear vision of myself doing something related to the topic of the virtual tour.							
When I imagine the future, I am uncertain as to how the topic of the virtual tour can be relevant in my life.							

If there is anything else you would like to add, please use the space below:
Please write your answer here:

Appendix C: Studies 2 and 3 Simplified Questionnaire without ITC-SOPI Items

VR Tour Survey on Situational Interest, Ideal Future-self, and Presence

Situational Interest and the Ideal Future-self in a Virtual Reality-Integrated Learning Activity: A Pilot Study for Instrument Validation.

You are being asked to participate in a research study. Before you give your consent to volunteer, it is important that you read the following information to be sure you understand what you will be asked to do. Please ask the researcher if there is anything that is not clear or if you need more information.

Researcher

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Purpose of the Research

The purpose of this study is to confirm the validity and reliability of the instruments that were developed to measure situational interest, the ideal future-self, and presence.

Procedures

If you volunteer to participate in this study, you will be asked to do the following:

- Experience a simple VR tour for about five minutes. (http://bobfigueroajr.com/study1vr)
- Fill out a survey questionnaire that will take around 20 minutes.
- The survey has five sections:
    - Demographics - 3 items
    - Technology Experience - 5 items
    - Situational Interest - 15 items
    - Ideal Future-self - 10 items
    - Presence - 42 items

Your participation will take approximately 25 minutes.

Potential Risks or Discomforts

Minor side effects

It is not anticipated that you will experience any discomfort from the testing procedures. However, when using virtual reality systems, some people sometimes experience some degree of nausea. There have been various reported side effects of using virtual reality equipment such as "flashbacks".

Epilepsy

With and type of video equipment, there is a possibility that an epileptic episode may be generated. This, for example, has been reported for computer video games. Because of this, we regret that we are unable to accept volunteers who are known to have suffered from epilepsy.

Termination

Testing will be terminated immediately upon your request due to any indication of discomfort / undue fatigue or if any abnormal responses occur.

Potential Benefits of the Research

The potential benefits that you may gain from this study include learning about and experiencing VR tours using a head-mounted device (i.e., Oculus Go). This study will help make the instrument for measuring situational interest, the ideal future-self, and presence in VR valid and reliable so that it can be used for empirical studies.

Confidentiality and Data Storage

Anonymity will be preserved throughout the study. Email addresses will be collected just for future reference in case data needs to be verified, but will be strictly kept confidential.

The data for analysis will be stored on the researcher's computer and used exclusively for research purposes. For future reference and auditing, a copy of the electronic data will be carefully stored as a confidential file in the USB memory stick. The USB memory stick and the paper-based questionnaires will be stored in a locked drawer. The data will be discarded after 10 years.

Participation and Withdrawal

Your participation in this research study is voluntary. You may refuse to participate or stop participation at any time without penalty. To cease participation, simply stop filling out the survey, tell the researcher about it, or send an email to Roberto B. Figueroa Jr. (rjbfigueroa@gmail.com).

There are 15 questions in this survey.

Consent Form

Please read each item carefully and tick the checkbox below if you agree to participate in this study.

Consent and Non-disclosure Form

Please read each item carefully and tick the checkbox below if you agree to the following:

1. I have read the information sheet about this study.
2. I have received enough information about this study.
3. I understand that I am free to withdraw from this study at any time.
4. I understand the risks associated with the use of virtual reality equipment.
5. I confirm that I do not have epilepsy
6. I will keep all the items on this survey confidential.
7. I agree to take part in this study.

I agree to all statements above. I want to participate in this study ☐
Email Address or Cellphone Number for Future Contact:

Demographics

Gender *

Choose one of the following answers

Please choose **only one** of the following:

- Male
- Female
- Other

What is the name of your your university, college, or institution? *

Please write your answer here:

Which age range does your age belong to? *

Please choose **only one** of the following:

- 29 and below
- 30 to 39
- 40 to 49
- 50 to 59
- 60 and above

Technology Experience

Besides your experience on this tour, have you viewed 360-degree images or videos before? *

Please choose **only one** of the following:

- Yes
- No

How would you rate your knowledge of how 360-degree images are produced? *

Please choose **only one** of the following:

- None (I have no idea)
- Basic (I have a general idea of how it is produced, but I have not produced any image yet)
- Intermediate (I can take 360-degree images using my smartphone)
- Expert (I can take 360-degree images using 360-degree cameras)

Besides your experience on this tour, have you used a virtual reality system before? *

Please choose **only one** of the following:

- Yes
- No

How would you rate your knowledge of virtual reality (i.e., how it works)? *

Please choose **only one** of the following:

- None (I don't have any idea of what VR is before this tour)
- Basic (I have just read about it before this tour)
- Intermediate (I know how to use it and the concept behind it)
- Expert (I know how to use it and create virtual reality applications as well)

Please indicate the activity that you have completed. *

Please choose **only one** of the following:

- Website Navigation
- Virtual Tour (Desktop Computer / Laptop / Smartphone without viewer)
- Virtual Reality Tour (Oculus Go)

Situational Interest

Please indicate HOW MUCH YOU AGREE OR DISAGREE with each of the following statements by selecting just one of the numbers using the 5-point scale below:

1 - Strongly Disagree
2 - Disagree
3 - Neither Agree nor Disagree
4 - Agree
5 - Strongly Agree

Item	1	2	3	4	5
I think that the topic of the activity (Open and Distance Education) is very interesting.					
Open and Distance Education fascinates me.					
I am excited about Open and Distance Education.					
I think that what we are learning in the activity is important.					
I think that what we are studying in the activity is useful for me to know.					
I think that Open and Distance Education is important to learn.					
To be honest, I just don't find Open and Distance Education interesting.					
I find Open and Distance Education personally meaningful.					
I see how I can apply what we are learning in the activity in real life.					
This activity has been a waste of my time.					
I don't like the activity very much					
The activity is not very interesting					
I enjoy doing tasks in the activity					
The activity seems to drag on forever.					
I am enjoying the activity very much.					

Ideal Future-self

Please indicate HOW MUCH YOU AGREE OR DISAGREE with each of the following statements by selecting just one of the numbers using the 5-point scale below:

1 - Strongly Disagree
2 - Disagree
3 - Neither Agree nor Disagree
4 - Agree
5 - Strongly Agree

Item	1	2	3	4	5
The things I want to do in the future involve Open and Distance Education					
I imagine myself as someone who will be able to practice skills in Open and Distance Education					
I aspire to be someone who can accomplish tasks requiring knowledge of Open and Distance Education					
I see myself as one day effectively applying Open and Distance Education-related knowledge and skills					

If my dreams come true, I'll one day practice the skills and apply knowledge related to Open and Distance Education effectively					
I clearly see myself in the future practicing the skills and applying knowledge related to Open and Distance Education					
The vision of myself practicing the skills and applying knowledge related to Open and Distance Education is vivid.					
The vision of myself accomplishing tasks requiring knowledge of Open and Distance Education is very clear.					
I strongly envision myself as someone who can use Open and Distance Education-related skills and knowledge effectively.					
It is easy to think of myself as a future user of Open and Distance Education-related skills and knowledge.					

If there is anything else you would like to add, please use the space below:
Please write your answer here:

Appendix D: Study 3 Quiz

Ecosystem Services
Sample Number :
Tour Type: ○ Slides ○ VR Tour –PC/Laptop/iPad ○ VR Tour- Oculus Go

1. Water for Drinking is an example of a _____.
   a. Provisioning Service
   b. Regulating Service
   c. Supporting Service
   d. Cultural Service

2. Religious Benefits can be obtained from the ecosystem's _____ services.
   a. Provisioning
   b. Regulating
   c. Supporting
   d. Cultural

3. Moderating the effects of human induced climate change is part of the forest's _____ services.
   a. Provisioning
   b. Regulating
   c. Supporting
   d. Cultural

4. Nutrient cycling is a part of the forest's _____ services.
   a. Provisioning
   b. Regulating
   c. Supporting
   d. Cultural

5. The benefits that humans get from ecosystems are called _____.
   a. Ecosystem Services
   b. Ecospherical Services
   c. Ecological Services
   d. Eco-valid Services

6. Logs that are harvested from the forest are part of _____ services.
   a. Provisioning
   b. Regulating
   c. Supporting
   d. Cultural

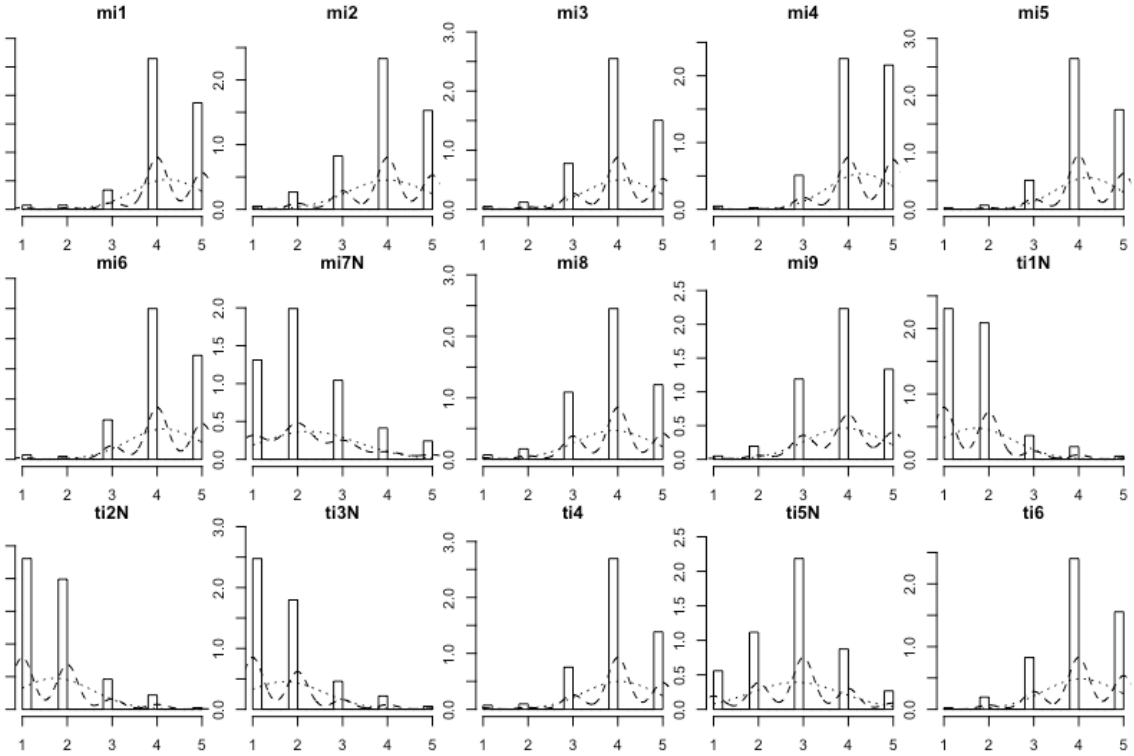
7. Sites for educational tours in the forest are part of its _____ services.
   a. Provisioning
   b. Regulating

c. Supporting
d. Cultural

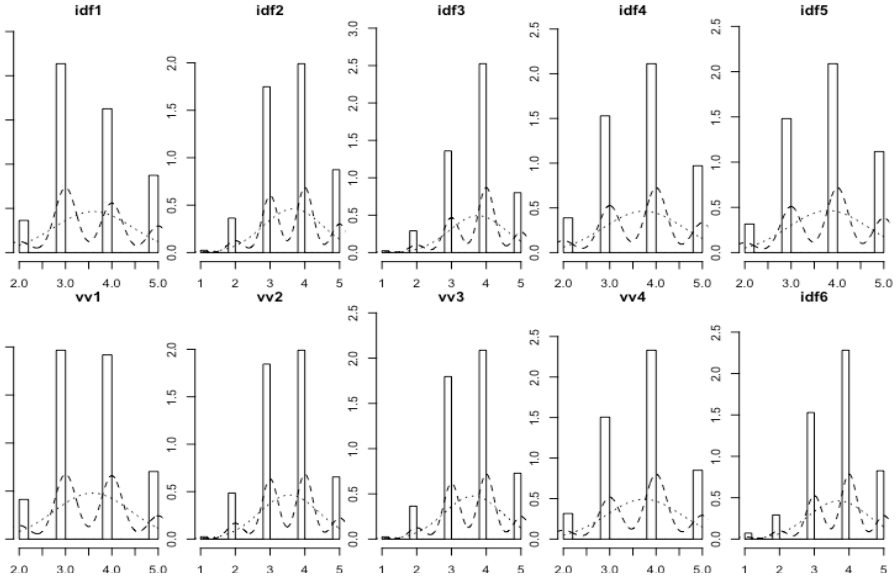
8. Fruites that are obtained from trees are part of the forest's ____ services.
   a. Provisioning
   b. Regulating
   c. Supporting
   d. Cultural

Appendix E: Statistical Artifacts

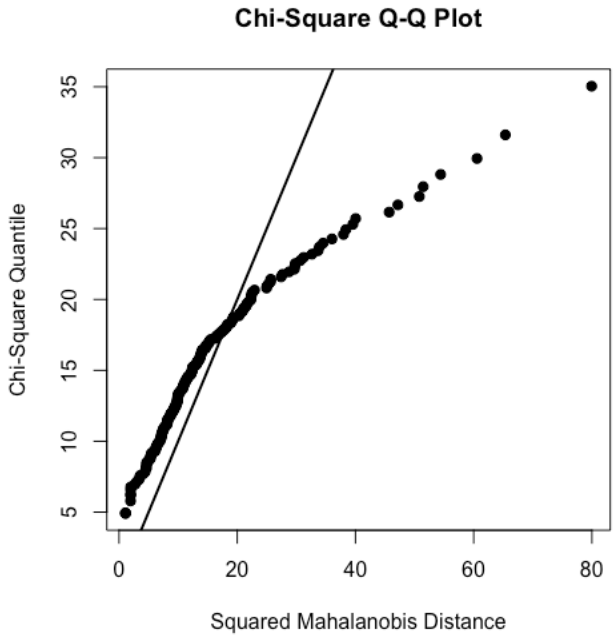
Histograms of Situational Interest items in Study 1



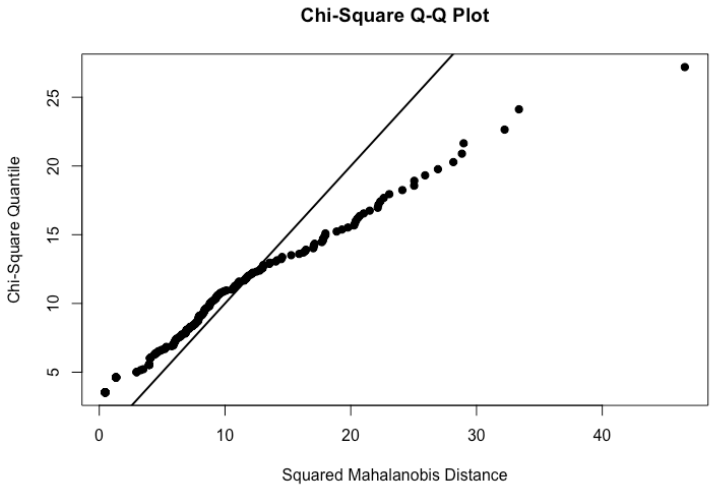
Histograms of Ideal Future-self items in Study 1



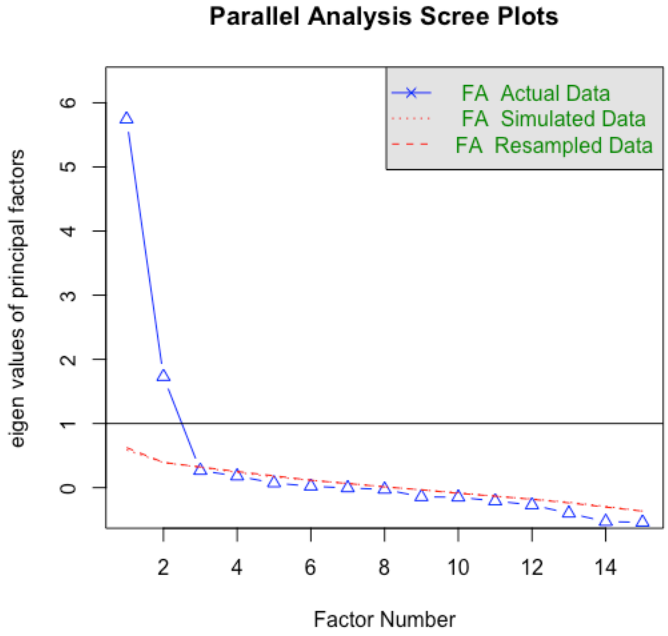
Q-Q Plot of Situational Interest in Study 1



Q-Q Plot of Ideal Future-self in Study 1



Scree Plots in the Parallel Analysis for Situational Interest in Study 1



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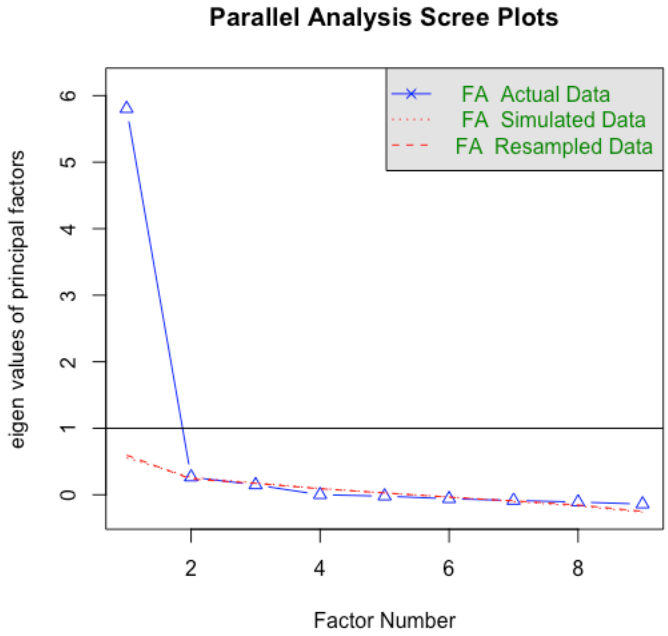
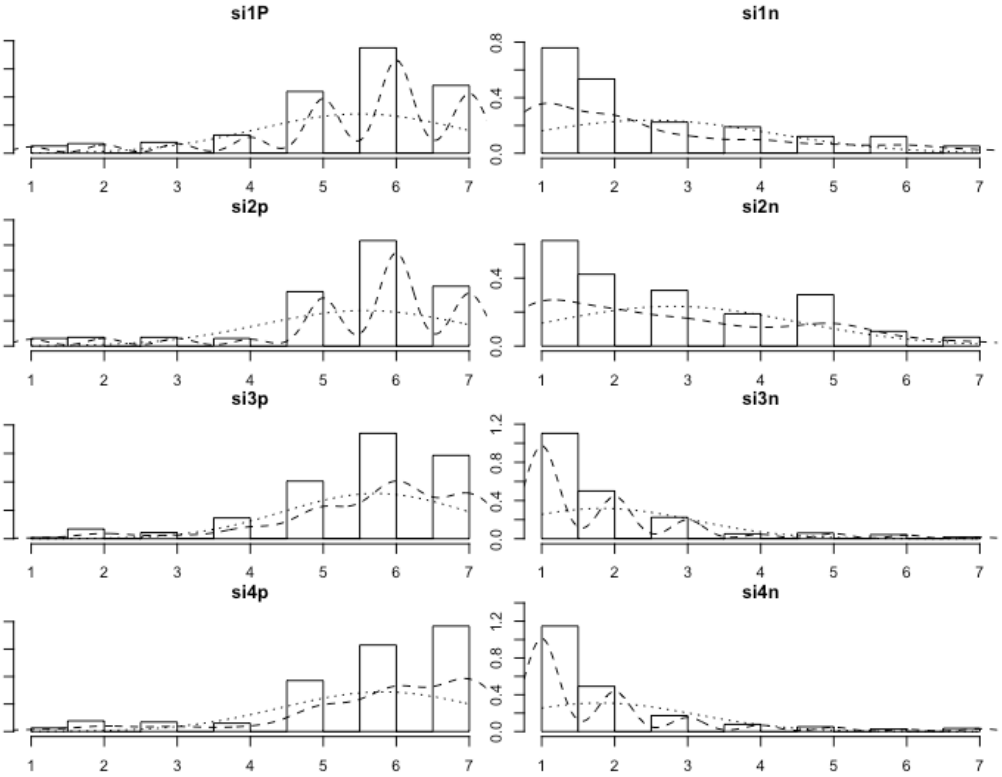
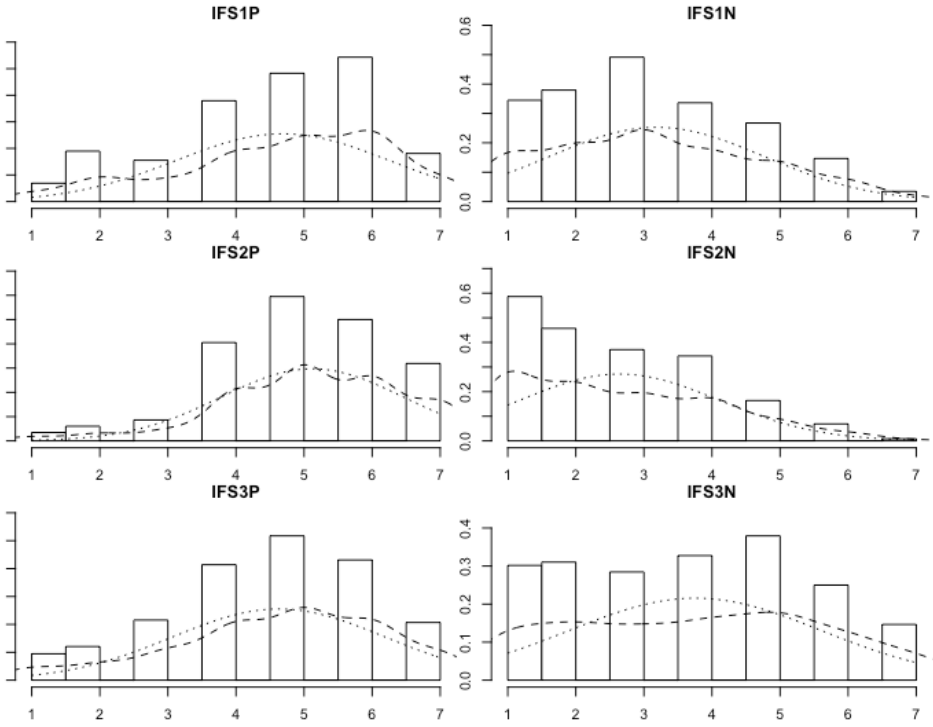


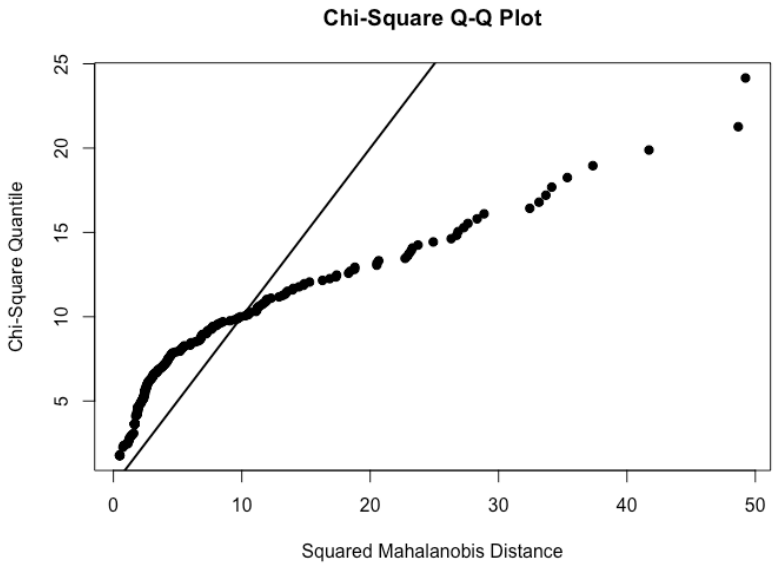
Histograms of Situational Interest items in Study 2



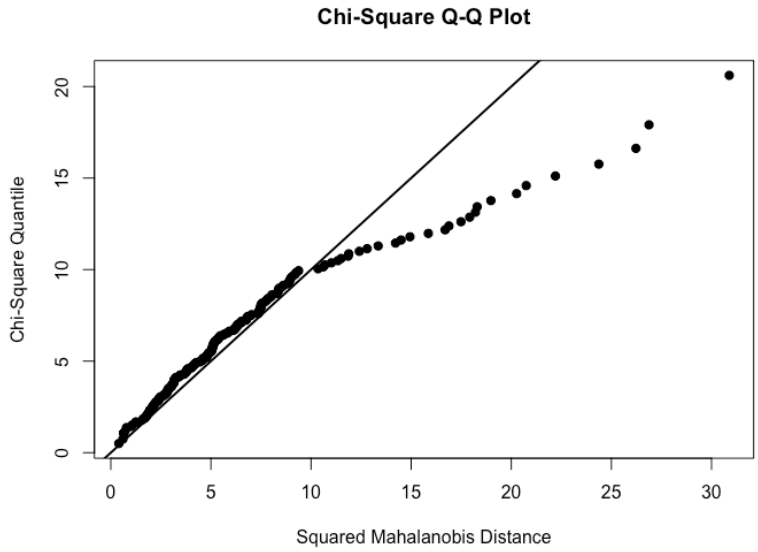
Histograms of Ideal Future-self in Study 2



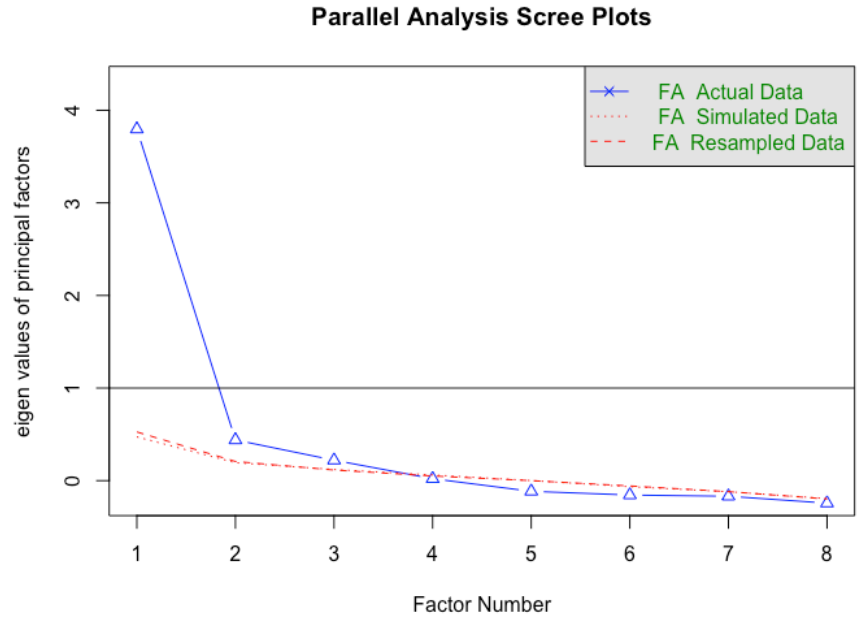
Q-Q Plot of Situational Interest in Study 2



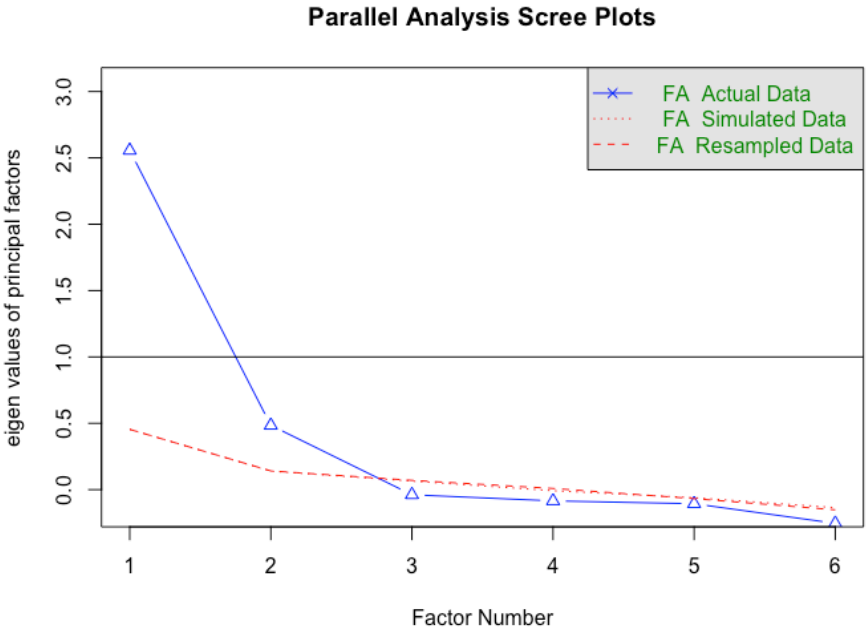
Q-Q Plot of Ideal Future-self Study 2



Scree Plots in the Parallel Analysis for Situational Interest in Study 2



Scree Plots in the Parallel Analysis for Ideal Future-self in Study 2



Hypotheses Statements in Study 3
Objective 1: To investigate the effect of immersive capability on the dimensions of spatial presence. 1.1 Immersive Capability and Sense of Physical Space H_0: There is no difference in sense of physical space between participants in the high immersive capability group and the participants in the low immersive capability group. Ha: There is a difference in sense of physical space between participants in the high immersive capability group and the participants in the low immersive capability group. 1.2 Immersive Capability and Ecological Validity H_0: There is no difference in ecological validity between participants in the high immersive capability group and the participants in the low immersive capability group. Ha: There is a difference in ecological validity between participants in the high immersive capability group and the participants in the low immersive capability group. 1.3 Immersice Capability and Engagement H_0: There is no difference in engagement between participants in the high immersive capability group and the participants in the low immersive capability group. Ha: There is a difference in engagement between participants in the high immersive capability group and the participants in the low immersive capability group. 1.4 Immersice Capability and Negative Effects H_0: There is no difference in negative effects between participants in the high immersive capability group and the participants in the low immersive capability group. Ha: There is a difference in negative effects between participants in the high immersive capability group and the participants in the low immersive capability group.
Objective 2: To investigate the effect of immersive capability on situational interest and ideal future-self. 2.1 Immersive Capability and Situational Interest H_0: There is no difference in situational interest between participants in the high immersive capability group and the participants in the low immersive capability group. Ha: There is a difference in situational interest between participants in the high immersive capability group and the participants in the low immersive capability group. 2.2 Immersive Capability and Ideal Future-self H_0: There is no difference in ideal future-self between participants in the high immersive capability group and the participants in the low immersive capability group.

Ha: There is a difference in ideal future-self between participants in the high immersive capability group and the participants in the low immersive capability group.

Objective 3: To investigate the effect of immersive capability on learning outcomes.

3.1 Immersive Capability and Score Gain

H_0: There is no difference in score gain between participants in the high immersive capability group and the participants in the low immersive capability group.

Ha: There is a difference in score gain between participants in the high immersive capability group and the participants in the low immersive capability group.

Objective 4: To determine the correlations between the dimensions of spatial presence, situational interest, ideal future-self, and learning outcomes.

4.1 Sense of Physical Space and Ecological Validity

H_0: There is no association between sense of physical space and ecological validity

Ha: There is an association between sense of physical space and ecological validity

4.2 Sense of Physical Space and Engagement

H_0: There is no association between sense of physical space and engagement

Ha: There is an association between sense of physical space and engagement

4.3 Sense of Physical Space and Negative Effects

H_0: There is no association between sense of physical space and negative effects

Ha: There is an association between sense of physical space and negative effects

4.4 Ecological Validity and Engagement

H_0: There is no association between ecological validity and engagement

Ha: There is an association between ecological validity and engagement

4.5 Ecological Validity and Negative Effects

H_0: There is no association between ecological validity and negative effects

Ha: There is an association between ecological validity and negative effects

4.6 Engagement and Negative Effects

H_0: There is no association between engagement and negative effects

Ha: There is an association between engagement and negative effects

4.7 Situational Interest and Sense of Physical Space

H_0: There is no association between situational interest and sense of physical space

Ha: There is an association between situational interest and sense of physical space

4.8 Situational Interest and Ecological Validity

H_0: There is no association between situational interest and ecological validity

Ha: There is an association between situational interest and ecological validity

4.9 Situational Interest and Engagement

H_0: There is no association between situational interest and engagement

Ha: There is an association between situational interest and engagement

4.10 Situational Interest and Negative Effects

H_0: There is no association between situational interest and negative effects

Ha: There is an association between situational interest and negative effects

4.11 Ideal Future-self and Sense of Physical Space

H_0: There is no association between ideal future-self and sense of physical space
Ha: There is an association between ideal future-self and sense of physical space

4.12 Ideal Future-self and Ecological Validity

H_0: There is no association between ideal future-self and ecological validity
Ha: There is an association between ideal future-self and ecological validity

4.13 Ideal Future-self and Engagement

H_0: There is no association between ideal future-self and engagement
Ha: There is an association between ideal future-self and engagement

4.14 Ideal Future-self and Negative Effects

H_0: There is no association between ideal future-self and negative effects
Ha: There is an association between ideal future-self and negative effects

4.15 Score Gain and Sense of Physical Space

H_0: There is no association between score gain and sense of physical space
Ha: There is an association between score gain and sense of physical space

4.16 Score Gain and Ecological Validity

H_0: There is no association between score gain and ecological validity
Ha: There is an association between score gain and ecological validity

4.17 Score Gain and Engagement

H_0: There is no association between score gain and engagement
Ha: There is an association between score gain and engagement

4.18 Score Gain and Negative Effects

H_0: There is no association between score gain and negative effects
Ha: There is an association between score gain and negative effects

4.19 Score Gain and Situational Interest

H_0: There is no association between score gain and situational interest
Ha: There is an association between score gain and situational interest

4.20 Score Gain and Ideal Future-self

H_0: There is no association between score gain and ideal future-self
Ha: There is an association between score gain and ideal future-self

4.21 Situational Interest and Ideal Future-self

H_0: There is no association between situational interest and ideal futures-self
Ha: There is an association between situational interest and ideal future-self

Hypotheses Statements in Study 4
1. Variation Among Lessons 1.1 Spatial Presence and Lessons H_0: There is no variation in spatial presence experienced by participants among the ten lessons. Ha: There is at least one lesson that was different regarding spatial presence experienced by participants among the ten lessons. 1.2 Score Gain and Lessons H_0: There is no variation in score gains achieved by participants among the ten lessons. Ha: There is at least one lesson that was different regarding score gains achieved by participants among the ten lessons.
2. Variation Among Age Groups 2.1 Spatial Presence and Age Groups H_0: There is no variation in spatial presence experienced by participants among the three age groups Ha: There is at least one lesson that was different regarding spatial presence experienced by participants among the three age groups. 2.2 Score Gain and Age Groups H_0: There is no variation in score gains achieved by participants among the three age groups. Ha: There is at least one lesson that was different regarding score gains achieved by participants among the three age groups.
3. Variation Among Culture 3.1 Spatial Presence and Culture H_0: There is no variation in spatial presence experienced by participants among the three cultures Ha: There is at least one lesson that was different regarding spatial presence experienced by participants among the three cultures 3.2 Score Gain and Culture H_0: There is no variation in score gains achieved by participants among the three cultures Ha: There is at least one lesson that was different regarding score gains achieved by participants among the three cultures
4. Variation Among Physical Learning Environments 4.1 Spatial Presence and Culture H_0: There is no variation in spatial presence experienced by participants in three different physical learning environments Ha: There is at least one lesson that was different regarding spatial presence experienced by participants in three different physical learning environments 4.2 Score Gain and Culture H_0: There is no variation in score gains achieved by three different physical learning environments

Ha: There is at least one lesson that was different regarding score gains achieved by participants three different physical learning environments

Appendix F: Study 4 Pre-Study Questionnaires and Materials

Interview Protocol for Interest and Future-self Vision among English as a Foreign Language (EFL) Online Learners

Times of Interview:
Date:
Place:
Interviewee:
Position of Interviewee:

(Briefly describe the project and show consent form and ask him/her to sign)

During the first half, I am going to ask you about four main questions on your interest in learning English and how you envision yourself in the future regarding your command of the language. On the second half of the interview, I will be asking you to try something and ask you six more questions.

First Half:

1. First, can you tell me more about yourself?
    a. How long have you been living in France/Japan ?
    b. What do you do for a living?
    c. How often do you travel?
        i. Are they mostly domestic trips?
        ii. If not, which countries have you visited?

2. Now, I will be asking questions related to English.
    a. Do you know your English level based on tests? (CEFR, IELTS, TOEFL, EIKEN)
        i. If the answer is yes, then ask what the level is and what year the last test was taken.
        ii. If it was more than 2 years (test should be administered)
        iii. If not (test should be administered)
    b. Are you satisfied with your current English level? Why or why not?
    c. What made you interested in learning English?
    d. In which areas of your life to you use English?
    e. Do you think that being fluent in English is beneficial in your life? How?

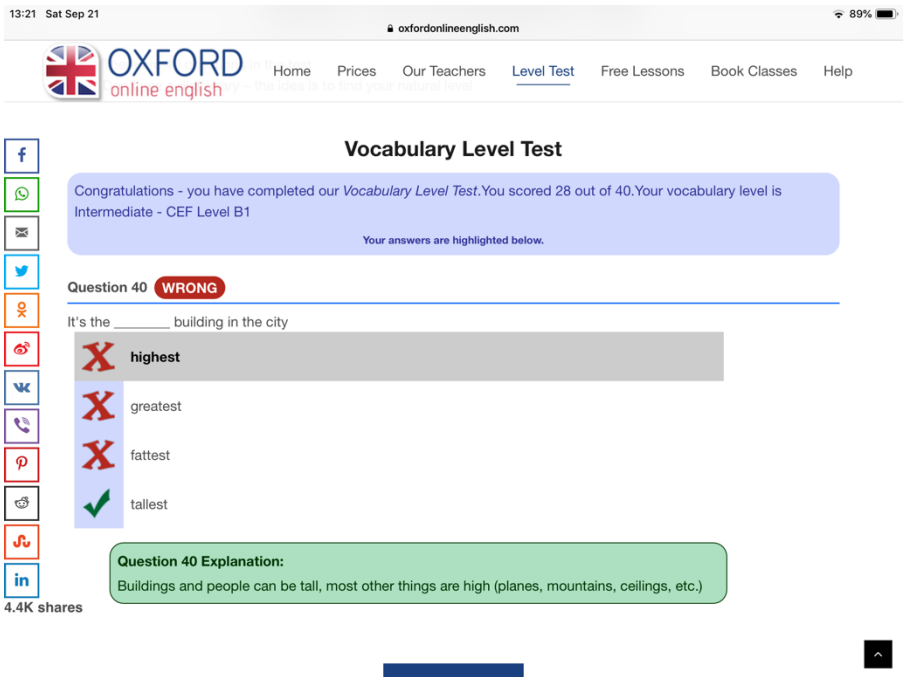
3. Now let us talk about how you see yourself in the future in relation to English.
    a. How do you see yourself after five years in terms of your English proficiency? Do you envision yourself as someone who can speak comfortably with other English speakers?

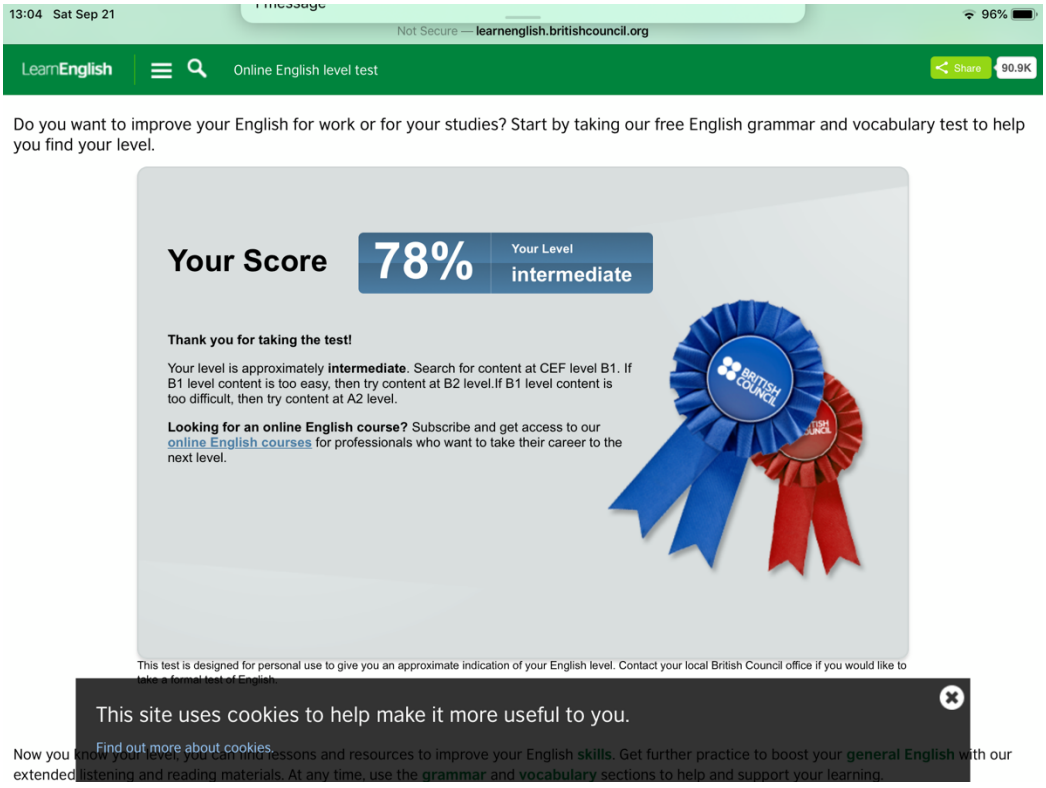
b. Where do you see yourself using English more often? Traveling? Day to day living? At Work?
c. Which places do you see yourself visiting where you will be able to practice speaking English more often?
1.

4. Let us talk about your experience in learning English online.
    a. How long have you been learning English online?
        i. Can you tell me more about your experience? Please describe how you learn English online.
        ii. How was it?
        iii. What are the main challenges you've encountered in this mode of learning?
        iv. How can it be improved?

Second Half:
We will introduce a virtual reality tour as an integrated activity in your weekly English tutorials. We want to know what you think about it. Before that, we would like to know if you have any medical conditions that prevents you from using this technology (vertigo, motion sickness, epilepsy). — If not, then we proceed to the tour and ask the questions.

CEFR Approximation Tests




13:04 Sat Sep 21
96%
Not Secure — learnenglish.britishcouncil.org
LearnEnglish
Online English level test
Share
90.9K
Do you want to improve your English for work or for your studies? Start by taking our free English grammar and vocabulary test to help you find your level.
Your Score
78%
Your Level
intermediate
Thank you for taking the test!
Your level is approximately intermediate. Search for content at CEF level B1. If B1 level content is too easy, then try content at B2 level.If B1 level content is too difficult, then try content at A2 level.
Looking for an online English course? Subscribe and get access to our online English courses for professionals who want to take their career to the next level.
BRITISH COUNCIL
This test is designed for personal use to give you an approximate indication of your English level. Contact your local British Council office if you would like to take a formal test of English.
This site uses cookies to help make it more useful to you.
Find out more about cookies.
Now you know your level, try Learning lessons and resources to improve your English skills. Get further practice to boost your general English with our extended listening and reading materials. At any time, use the grammar and vocabulary sections to help and support your learning.

Appendix G: Study 4 Sample Materials and Data Collection Instruments

Student Guide Sample (Lesson 10)

PART 1: CHECK
Match the **adjectives** with their correct meaning.

1. turquoise a. made of small particles
2. serene b. greenish-blue color
3. fine c. likely to spread or to affect others 4. accessible d. slow in movement
5. isolated e. feeling or causing great pleasure and happiness f. alone, far away from other places, buildings or people
g. calm, peaceful
h. nearby, easy to go to, easy to get

PART 2: VR TOUR
Click the link for the VR Tour: **bobfigueroajr.com/b1vrten**

Today we're going to visit the Jomalig Beach in the Philippines. Try to look at the 5 hotspots in order and listen to your tour guide's voice.

PART 3: PRESENT

Exercise 1. Guess the meaning.
Using the picture as a clue, choose the correct meaning of the words from the box.

a. made of small particles
b. calm, peaceful
c. greenish-blue color
d. nearby, easy to go to, easy to get
e. alone, far away from other places, building or people

1. isolated -

Photo by Hieu Vu Minh on Unsplash

2. fine -

Photo by Markus Spiske on Unsplash

3. turquoise –

Photo by Marie-Michèle Bouchard on Unsplash

4. accessible –

Photo by Herson Rodriguez on Unsplash

5. serene –

Photo by bady qb on Unsplash

Exercise 2. Pronounce the words.

serene /suh-REEN/
fine /fayn/
accessible /ak-SEH-sih-buhl/
isolated /AY-suh-ley-tid/
turquoise /TUHR-koys/

PART 4: PRACTICE

Exercise 1. Fill in the blanks.
Fill in the blank with the correct adjective. Choose from the adjectives below: **accessible, isolated, turquoise, fine, serene**

1. Taking yoga classes keep me _____.

Photo by Jared Rice on Unsplash

2. The water is and is breathtaking.

Photo by Bryce Evans on Unsplash

3. Bled Island is _____ by boat.

Photo by Daniil Vnoutchkov on Unsplash

4. Spices are crushed into _____ powder.

Photo by Pratiksha Mohanty on Unsplash

5. Some patients need to be _____ to stop the spread of

disease. Photo by v2osk on Unsplash

Exercise 2. Choose the picture.

Choose the picture that matches the sentence. Briefly explain why you chose the picture.

1. This garden is **not accessible** and is a private property.
- *Picture A, B, or C? Why*

2. He looked **serene** as he stared at the beautiful view.
- *Picture A, B, or C? Why*

3. This place is famous for its **fine** sand and **turquoise** waters.
- *Picture A, B, or C? Why*

4. This place makes me feel **isolated** and out of reach.
- *Picture A, B, or C? Why*

A

B

Photo by Simon Migaj onUnsplash

C

Photo by Sasha • Stories on Unsplash

PART 5: PRODUCE

Create your own sentence using the nouns that we studied today.

1. accessible -
2. turquoise -
3. serene -
4. fine -
5. isolated -

PART 6: CHECK

Match the **adjectives** with their correct meaning.

1. turquoise a. made of small particles
2. serene b. greenish-blue color
3. fine c. likely to spread or to affect others 4. accessible d. slow in movement

5. isolated e. feeling or causing great pleasure and happiness f. alone, far away from other places, buildings or people
g. calm, peaceful
h. nearby, easy to go to, easy to get

Transcript for the VR Tour:

1. turquoise
**** Welcome back to the Philippines! Look at this amazing beach! The turquoise sea looks so warm and inviting!*

2. serene
**** The sea looks serene. It makes me feel sleepy. Would you like to rest on the beach?*

3. fine
***** The fine white sand makes the beach soft . It makes it easy for us to talk barefoot.*

4. accessible
**** This island is accessible by ferry or boat, like the one you see here.*

5. isolated
**** The island is just full of trees and plants. There are no houses or people here. It looks isolated*

Obervation Notes Example (Eito – Lesson 1)

LESSON 1

Learner: Etsuo (Eito) **Teacher: Rachel (Cher)** **Topic for the Day:** Autumn in Japan **Communication Technology Used**: Skype Lesson (video class) **VR Technology Used:** smartphone (non-immersive) **Material:** Lesson 1 Student's Copy JP V1 Pre-test: 5/5 Post-test: 4/5	**Date: 9/27/2019** **Time: 17:00 JP** **Length: 36m 46s**
Before the Lesson: The call started with a brief 'how are you?'. Eito was very communicative and proactive. He took advantage of the questions to share a lot of things about his day. It gives me the impression that he is a highly motivated learner of English. He did the pre-test orally and got	

everything correctly. I noticed that he was apologizing a lot when he was not sure about the answer.		
	Experience	**Important Findings / Comments**
Presentation	**A. What happened?** Eito was asked to experience the tour using his phone. He clicked on the hotspots sequentially as suggested by the teacher. He was confirming if he was doing it correctly from time to time. **B. What were the challenges encountered?** There was no technical problem encountered in the tour. It was only done once. **C. How were they solved?**	It would be expected for Eito to encounter technical problems on the first lesson as it is a new technology, and he is not that technically adept. However, before the first lesson started, he met with the researcher and was taught how to use the technology. That moment was a bit stressful for him, but he said he will practice using it. It seems that his hard work paid off.
Practice	**A. What happened?** There were four exercises for practice. Exercise 1 and 3 were straightforward. Exercise 4 started out as a bit challenging, but he was able to understand it eventually. **B. What were the challenges encountered?** Exercise 4's (Odd one out) instructions are a bit confusing. For low-level learners, the vagueness of what is odd, could lead them to committing mistakes that are not due to knowledge or mastery but sheer misunderstanding.	Eito noticed that he mispronounced 'sturdy' in the script even when it was not a problem with the teacher. He monitors himself and gives himself feedback. He then confirms his observation with the teacher. He evaluates himself after reading (Exercise 1). When there are things he could not understand, he shares it honestly with the teacher. It happened during the 'synonyms' (Exercise 2). He was also having a hard time

<table>
<tr><td></td><td>C. How were they solved? It took a lot of follow-up explanation and additional support from the teacher before he was able to understand it. He was able to get it after clarification questions were addressed.</td><td>pronouncing ‘synonym’. He was able to swiftly finish exercise 3, which asked him to select the correct word to complete sentences. Exercise 4 was difficult because of the instructions being a bit vague.</td></tr>
<tr><td>Production</td><td>A. What happened? He was asked to create his own sentences as a tour-guide using the same tour and the five words while viewing the tour.
B. What were the challenges encountered?
C. How were they solved?</td><td>Eito didn’t just make one sentence per target word. He narrated as if he was a real tour guide. He also did it on the fly. He did not have to write it down first. He just kept on talking. The sentences that he made were creative, but also very relevant to the tour. It was amazing.</td></tr>
<tr><td>HLT</td><td>Before:</td><td>After:</td></tr>
<tr><td>Teacher’s feedback</td><td>Highlights: Asked what sturdy means and was able to answer exercise 4 correctly
Produce: Used the 5 words properly, good understanding of the words, several grammar lapses
Post-test: Had difficulty at first but after a brief review he was able to answer item 4 correctly

Sentence Construction: 10 pts.<table><tr><td></td><td>Score</td></tr><tr><td>Correct usage of words (max. 4 pts.)</td><td>4</td></tr><tr><td>Originality of sentences (max. 4 pts.)</td><td>4</td></tr></table></td><td>Post: He made a mistake with ‘surrounded’. It seems that he forgot the meaning of surrounded. The options were also confusing: ‘be available’, ‘be open’ baited him into thinking that surrounded was synonymous to them.</td></tr>
</table>

	<table><tr><td>Confidence in using the words/following instructions correctly (max. 2 pts.)</td><td>2</td></tr><tr><td>**Total**</td><td>**10**</td></tr></table>	
Changes	Some typographical errors were detected. The format needed to be improved. We realized that Eito was not asked about what he learned from the actual tour before doing the practice exercises. That is why we missed the part where he did not understand surrounded that much. The teacher and researcher felt that limiting learners to use the same words to describe the same tour may be limiting so they agreed to offer that as an option instead.	Will change the format and rectify the errors. Asking them to define the words based on what they learned from the tour or doing a review before the practice exercise will be implemented in the succeeding lessons. The instructions were not changed for "Odd one out" but the teacher will be giving follow-up instructions during the lesson as some advanced learners might not have a problem with it.

Initial, Midpoint, and Final Interview Question Guides

Initial Interview Questions
1. Can you briefly tell me about your experience? 2. Were you interested in the actual experience? 3. What were the most interesting parts for you? 4. Do you think that this experience will help you use English more fluently in the future? Why? 5. Can you tell me about the positive feelings and the negative feelings that you had during the lesson? 6. Did you feel like you were just looking at a photo or did it feel lik you were at an actual place? 7. Would you like to do more of these tours in future online classes?
Midpoint Interview Questions
1. After taking the five tutorials, how are you feeling about the lessons so far?

2. After the 5 tutorials, has your interest in learning using the VR lessons increased or decreased? Why or why not?
3. Which was the most interesting activity in the lesson (choose from a to i)? Why?
    a. VR Tour
    b. Pronunciation – Repeat after the tour
    c. Reading Exercise – Dialogue
    d. Fill in the blanks
    e. Odd one out
    f. Create sentences using the words learned
    g. Synonyms/Idioms/New Expressions
4. Which is the least interesting activity in the lesson (choose from a to i)? Why?
    a. VR Tour
    b. Pronunciation – Repeat after the tour
    c. Reading Exercise – Dialogue
    d. Fill in the blanks
    e. Odd one out
    f. Create sentences using the words learned
    g. Synonyms/Idioms/New Expressions
5. Which was the most interesting session among the 5 tutorials? Why?
    a. Autumn at ICU
    b. Marketplace in Canada
    c. Philippine Forest
    d. Homestead in Pennsylvania
    e. Rizal Monument
6. Which was the least interesting session among the 5 tutorials? Why?
    a. Autumn at ICU
    b. Marketplace in Canada
    c. Philippine Forest
    d. Homestead in Pennsylvania
    e. Rizal Monument
7. After the five tutorials, did you see yourself getting better in English in the future? Why or why not?
8. After the five tutorials, did you see yourself going to the places that were featured in the sessions? Why or why not?
9. What were the problems that you encountered in the tutorials?
10. Did you use the VR goggles? Why or why not?

Final Interview Questions

1. Please describe your experience in general.
2. Which features in the virtual tours made them interesting? Why?
3. Which features in the virtual tours helped you see yourself speaking English fluently in the future? Why?
4. Which parts of the lesson materials did you like? Why?
5. Which parts of the lesson materials did you not like? Why?
6. How did the lesson materials complement the VR tours?

7. What impact would it bring if the lesson materials were taught with only photos or videos instead of VR tours?
8. How did the tours help you learn new words?
9. What were your positive feelings during the VR tours?
10. What were your negative feelings during the VR tours?
11. What problems did you encounter in the tours?
12. What negative effects did the tours have on you?
13. Would you recommend English learners to take the VR lessons? Why or why not?
14. If you could change or improve something in the VR lesson, what would it be?

Lesson Feedback Example: (Lesson 1)

Link for the Materials
https://drive.google.com/drive/u/0/folders/1NedcafdJ2Q3TkW811e6rJ6-UyJfdCpQn

1. **Eito (9/27/19 at 5 p.m. JP Time | 36m46s)**
Background: Skype Lesson (video class)
Material: Lesson 1 Student's Copy JP V1

Pre-test: 5/5
Post-test: 4/5

Highlights: Asked what sturdy means and was able to answer exercise 4 correctly
Produce: Used the 5 words properly, good understanding of the words, several grammar lapses
Post-test: Had difficulty at first but after a brief review he was able to answer item 4 correctly

2. **Eiji (9/28/19 at 11 a.m. JP Time | 25m32s)**
Background: Skype Lesson (video class)
Material: Lesson 1 Student's Copy JP V2 (Update: typographical errors removed, adjusted format)

Pre-test: 5/5
Post-test: 5/5

General: Did all the exercises with ease
Produce: Used the 5 words properly, good understanding of the words, minimal grammar lapses

3. **Este 9/30/19 at 10:30 a.m. FR Time | 30m)**
Background: FB messenger (audio lesson), 28 y/o from Milan, living in France, architect
Material: Lesson 1 Student's Copy FR V1 (without transcript for VR tour)

Pre-test: 5/5
Post-test: 5/5

General: Did all the exercises with ease
Produce: Used the 5 words perfectly, good understanding of the words, grammatically-sound sentences
Others: Enjoyed exercise 4, suggested to add the transcript of the tour

4. **Masaki (10/1/19 at 2:30 p.m. JP Time | 34m09s)**
Background: Zoom (video class)
Material: Lesson 1 Student's Copy JP V3 (Update: with transcript of VR tour)

Pre-test: 5/5
Post-test: 5/5

Highlights: Asked what sturdy, gloomy and chilly mean, struggled with exercise 4
Produce: Used the 5 words properly, good understanding of the words, several grammar lapses
Others: Appreciated the VR tour very much

5. **Eiman (10/3/19 at noon FR Time | 25m01s)**
Background: Skype (video class)
Material: Lesson 1 Student's Copy FR (old one)

Pre-test: 5/5
Post-test: 5/5

General: Did all the exercises with ease
Produce: Used the 5 words perfectly, good understanding of the words, minimal grammar lapses
Others: Likes the speaking exercises, describes the VR tour as "something for children"

6. **Emma (10/7/19 at noon FR Time | 22m)**
Background: Facebook (audio class)
Material: Lesson 1 Student's Copy FR V2

Pre-test: 2/5
Post-test: 5/5

Highlights: Got 2 correct answers during the pre-test. Answered all the post-test items correctly after the tour and exercises.
General: Had difficulty answering some exercises, needed clarification (especially in exercise 4)
Produce: Skipped produce (did not understand the instruction)

Others: Audio of the VR tour did not work on the student's end. Tutor played as the VR Tour guide.

7. **Mizuki (10/8/19 at 11 a.m. JP Time | 25m)**
Background: Skype (video class)
Material: Lesson 1 Student's Copy JP V3

Pre-test: 5/5
Post-test: 5/5

Highlights: Answered the exercises with ease. Asked what gloomy, chilly and sturdy mean.
Produce: Used the 5 words perfectly, good understanding of the words, minimal grammar lapses

8. **Charles (10/9/19 at 12:30 p.m. FR Time | 27m41s)**
Background: Skype (video class)
Material: Lesson 1 Student's Copy FR V2

Pre-test: 4/5
Post-test: 5/5

Highlights: Answered the exercises with ease.
Produce: Used the 5 words perfectly, several grammar lapses
Others: Audio of the VR tour did not work on the student's end. Tutor played as the VR Tour guide.

9. **Denis (10/17/19 at 9:30 a.m. FR Time | 23m01s)**
Background: FB (video call)
Material: Lesson 1 Student's Copy FR V2

Pre-test: 5/5
Post-test: 5/5

Highlights: Answered the exercises with ease, asked what sturdy means, was excited about encountering new words (gloomy as sad, sturdy, tough)
Produce: Used the 5 words perfectly, made grammatically-sound sentences

Simplified Post-Lesson Survey Sample (Lesson 2: Canada)

URL of the Actual Online Form :

https://docs.google.com/forms/d/e/1FAIpQLSfFLBU9uxxQVUlUHQnQ-rsrKSZ7DOnStYeagESZvqz9vETIrA/viewform?usp=sf_link

Initial Interview Questions
1. Name/Nickname
2. How would you rate your experience? 1 2 3 4 5 6 7 8 9 10 Lowest (Mauvaise | 良くなかった)) ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Highest (Bonne | 良かった)
3. What is the reason for your rating in number 2?
4. How much interested were you in the actual experience? 1 2 3 4 5 6 7 8 9 10 Lowest (Mauvaise | 良くなかった)) ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Highest (Bonne | 良かった)
5. How much interested were you in the lesson's content (target vocabulary)? 1 2 3 4 5 6 7 8 9 10 Lowest (Mauvaise | 良くなかった)) ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Highest (Bonne | 良かった)
6. What were the most interesting parts of the lesson? *Check all that apply.* ☐ VR Tour ☐ Dialogue ☐ Synonyms ☐ Fill in the blanks ☐ Odd one out ☐ Using the vocabulary words in sentences Other: ☐ _____
7. Did you see yourself speaking English in the future after the tour? If yes, how?
8. How much did you see yourself speaking English in the future after the tour? 1 2 3 4 5 6 7 8 9 10 Lowest (Mauvaise | 良くなかった)) ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Highest (Bonne | 良かった)
9. What positive feelings did you experience during the VR tour?

10. What negative feelings did you experience during the VR tour?

11. Choose one:

- ◯ During the VR Tour, I felt like I was just looking at a photo. (Fr: J'avais l'impression de regarder des images | Jp: VRツアー中、ただの写真を見ているだけのように感じた)
- ◯ I felt like I was in an actual tour. (Fr: Je me sentais réellement dans un tour | Jp: ツアーを本当に体験しているかのように感じた)
- ◯ Other: _____

12. How much did you feel that you were in the tour and not just looking at a photo?

	1	2	3	4	5	6	7	8	9	10	
Lowest (Mauvaise | 良くなかった))	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Highest (Bonne | 良かった)

13. Would you like to do more of these tours in future online classes? Why or why not?

14. Please share other comments, suggestions, or questions regarding the whole experience.