EFFECTIVENESS OF PERSONALIZATION PRINCIPLE IN VIRTUAL REALITY-BASED FIELD TRIPS ON 7TH GRADE STUDENTS' PERFORMANCE, PRESENCE, AND MOTIVATION IN CHINA

CHEN JING

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CHEN JING

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LIST OF ABBREVIATIONS

VR	Virtual Reality
VRFT	Virtual reality-based field trip
VRFTC	Virtual reality-based field trip in a conversational style
VRFTF	Virtual reality-based field trip in a formal style
VFT	Virtual field trip
CAMIL	The Cognitive Affective Model of Immersive Learning
AI	Artificial Intelligence
IPQ	Igroup Presence Questionnaire
IMMS	Instructional Materials Motivation Scale
ARCS	Attention, Relevance, Confidence and Satisfaction
ICH	Intangible Cultural Heritage
CAVE	Cave Automated Virtual Environment
HMD	Head-Mounted Display
CAMIL	The Cognitive Affective Model of Immersive Learning
CLT	Cognitive Load Theory
CTML	Cognitive Theory of Multimedia Learning
PEPH	People's Education Publishing House
PAPH	People's Art Publishing House
JCYPH	Jiangsu Children's and Young People's Publishing House
CC	Cultural Computing
3D	Three Dimension
VH	Virtual heritage

LIST OF APPENDICES

KEBERKESANAN PRINSIP PERSONALISASI DALAM LAWATAN MAYA BERASASKAN REALITI MAYA TERHADAP PRESTASI, KEHADIRAN, DAN MOTIVASI PELAJAR TINGKATAN 7 DI CHINA

ABSTRAK

Tujuan kajian ini adalah untuk menyiasat keberkesanan penggunaan prinsip pemperibadian dalam lawatan lapangan berasaskan realiti maya untuk pembelajaran warisan dunia dalam subjek seni visual mengenai prestasi, kehadiran dan motivasi pelajar berlainan jantina. Reka bentuk kuasi eksperimen dengan ujian pra dan ujian pasca telah dipilih untuk kajian ini dan reka bentuk faktorial analitik 2x2 digunakan untuk menguji hipotesis. Pembolehubah tidak bersandar yang digunakan dalam Pembelajaran Warisan Budaya Dunia ialah dua mod gaya bahasa ujian medan maya, iaitu ujian medan berasaskan realiti maya gaya perbualan (VRFTC) dan ujian medan berasaskan realiti maya gaya formal (VRFTF). Pembolehubah moderator ialah jantina pelajar. Pembolehubah bersandar ialah prestasi pelajar, kehadiran, dan motivasi. Seramai 137 pelajar gred tujuh dari sebuah sekolah menengah awam mengambil bahagian dalam kajian ini dan telah ditugaskan untuk dua keadaan pembelajaran VRFT. Data dianalisis menggunakan ANOVA dua hala dan ANCOVA dua hala untuk mengkaji kesan utama dan interaksi.Keputusan menunjukkan bahawa prinsip pemperibadian mempunyai kesan positif yang signifikan terhadap ketiga-tiga pembolehubah hasil. Pelajar yang terdedah kepada bahasa perbualan menunjukkan prestasi pembelajaran yang lebih tinggi secara ketara, kehadiran yang lebih kukuh dan motivasi yang lebih tinggi berbanding dengan mereka yang menerima pengajaran gaya formal. Berkenaan dengan jantina, perbezaan yang ketara diperhatikan hanya dalam kehadiran, dengan pelajar lelaki melaporkan skor kehadiran yang lebih tinggi. Walau

bagaimanapun, tiada perbezaan jantina yang ketara ditemui dalam prestasi pembelajaran atau motivasi. Selain itu, tiada kesan interaksi yang ketara dikesan antara gaya bahasa dan jantina pada mana-mana pembolehubah bersandar. Penemuan ini mengesahkan keberkesanan prinsip pemperibadian dalam meningkatkan hasil pembelajaran dalam persekitaran VR yang mengasyikkan dan melanjutkan prinsip pemperibadian kepada konteks bahasa Cina untuk pelajar remaja. Menggabungkan prinsip pemperibadian ke dalam sistem pembelajaran lawatan lapangan berasaskan realiti maya boleh memudahkan pembelajaran pelajar, meningkatkan kehadiran, dan meningkatkan motivasi untuk bahan pembelajaran, sekali gus mewujudkan persekitaran pembelajaran yang kondusif.

EFFECTIVENESS OF PERSONALIZATION PRINCIPLE IN VIRTUAL REALITY-BASED FIELD TRIPS ON 7TH GRADE STUDENTS' PERFORMANCE, PRESENCE, AND MOTIVATION IN CHINA

ABSTRACT

The purpose of this study was to investigate the effectiveness of using personalization principle in a virtual reality-based field trip for world heritage learning in a visual arts subject on the performance, presence, and motivation of different gendered students. A quasi-experimental design with pre-tests and post-tests was chosen for this study and a 2×2 analytic factorial design was used to test the hypotheses. The independent variables used in World Cultural Heritage Learning were two language style modes of virtual field testing, namely conversational style virtual reality-based fieldtesting (VRFTC) and formal style virtual reality-based fieldtesting (VRFTF) . The moderator variable was student gender. The dependent variables were student performance, presence, and motivation. A total of 137 seventh-grade students from a public secondary school participated in the study and were assigned to two VRFT learning conditions. Data were analyzed using two-way ANOVA and two-way ANCOVA to examine the main and interaction effects. The results revealed that the personalization principle had a significant positive impact on all three outcome variables. Students exposed to conversational language demonstrated significantly higher learning performance, stronger presence, and greater motivation compared to those receiving formal-style instruction. With respect to gender, a significant difference was observed only in presence, with male students reporting higher presence scores. However, no significant gender differences were found in learning performance or motivation. Moreover, no significant interaction effects were detected

between language style and gender on any of the dependent variables. These findings confirm the effectiveness of personalization principle in enhancing learning outcomes in immersive VR environments and extend the personalization principle to the Chinese context for adolescent learners. Incorporating the personalization principle into a virtual reality-based field trip learning system can facilitate student learning, enhance presence, and increase motivation for learning materials, thus creating a conducive learning environment.

CHAPTER 1

INTRODUCTION

1.1 Overview

In the 21st century education, the role of the teacher has evolved to become a collaborative partner in students' learning. Field trips are widely regarded as a comprehensive and interactive student-centered learning approach (Zhao et al., 2020). Organized for educational purposes, school field trips aim to transport students from the confines of the classroom into the real world, providing opportunities for authentic and experiential learning. This experiential learning, which connects students' learning to real-life experiences, enhances their knowledge and motivation (Fitrianto & Saif, 2024). However, practical challenges such as the complexity of travelling, scheduling constraints and difficulties in managing student activities while travelling sometimes hamper the successful implementation of field trips (Seifan et al., 2019).

VFTs provide teachers with the opportunity to guide students in exploring various aspects of learning within a virtual environment. The ongoing advancements in information technology have further expanded the potential benefits of virtual field trips in education (Makransky & Mayer, 2022). These benefits include showcasing expeditions to remote or difficult-to-access locations, presenting scenarios from diverse perspectives and scales, enhancing and broadening the learning experience, offering previews or recaps of authentic field trips, and aiding in the comprehension of complex processes (Zhao et al., 2020). Moreover, VFTs contribute to achieving educational equity, particularly by serving as an alternative for students who face challenges due to economic limitations, illness, limited mobility, or disabilities (Garcia et al., 2023).

In recent years, an increasing number of academic studies have examined the pedagogy and learning outcomes associated with VFTs, spanning a range of disciplines such as Science, Technology, Engineering, and Mathematics (Zhao et al., 2020), geography (Huang, 2022), history (Ofianto et al., 2023), and architectural design (Wen & Gheisari, 2020). However, the majority of these studies have focused on desktop-based or web-based virtual reality (VR) systems (Cheng & Tsai, 2019). Empirical research on employing head-mounted display (HMD)-based VR for delivering VFTs has been relatively sparse, and its application in the realm of visual arts subjects, especially within cultural heritage education, remains largely unexplored. Moreover, with the rapid development of generative artificial intelligence (AI) technologies, the educational potential of AI-generated media, such as virtual instructors, warrants further investigation (Leiker et al., 2023). This study aims to explore how generative AI tools can be better utilized to facilitate the development of educational applications by investigating the use of AI-generated virtual teachers in VR-basd field trip (VRFT).

To enhance the instructional value of VR-based environments, the application of effective instructional design principles is essential (Makransky et al., 2021). Building upon the cognitive theory of multimedia learning, Mayer (2020) proposed fifteen multimedia learning principles that serve as a theoretical foundation for instructional design. Among these, the personalization principle suggests that learning can be improved when content is delivered using a conversational and socially engaging style. The use of informal language, second-person references, and dialogic structure can promote learners' sense of social presence and connection with the material (Mayer, 2020). While this principle has shown promise in multimedia

learning environments, its application in immersive VR-based learning remains underexplored (Brom et al., 2017).

Furthermore, individual learner characteristics, such as gender, may shape how students perceive and respond to VR environments and instructional language style. Although prior studies have examined gender-based differences in technology-mediated learning, the findings remain inconclusive (Jin & Divitini, 2020; Lorenz et al., 2023; Putrawangsa et al., 2023). This highlights the need for further research into how gender may interact with instructional design features in immersive VR contexts.

Therefore, this study investigates the effects of language style (conversational vs. formal) on students' learning performance, presence, and motivation during a VRFT focused on cultural heritage. In addition, it explores whether gender moderates these effects. By combining instructional design with emerging technologies, this research aims to inform the design of more effective and inclusive VR-based learning experiences in cultural heritage education.

1.2 Background of the Study

Cultural heritage constitutes a valuable and unique resource that is irreplaceable and prone to irreversible damage caused by natural erosion and both natural and man-made catastrophic events. Consequently, countries worldwide have increasingly recognized the necessity of sustainable development of cultural heritage and have implemented various measures to this end, including digital preservation, shared databases, and virtual heritage (Öztemiz, 2019). Given the role of education in achieving cultural heritage sustainability, cultural heritage education has received equal attention, particularly at the K-12 level (Tzima et al., 2020). As argued by Barghi et al. (2017), the most effective approach to incorporating cultural heritage education

into the curriculum entails integrating it with existing curriculum materials, wherein all subjects serve as the foundation of cultural heritage education.

Cultural heritage education, according to Copeland (2006), is not an independent curriculum topic in itself, but rather a cross-curricular approach that encompasses various subjects such as history, geography, language, and art. Several countries have already taken proactive steps to integrate cultural heritage education into their existing curriculum subjects. For instance, the National Heritage Board of Singapore has established connections between heritage education, national identity, and civic education in the Heritage Education Highlights 2019 (Hao, 2022). Similarly, the Institute of Cultural Heritage of Spain has designed the National Programme of Education and Heritage with the goal of bridging heritage education with civic education and values education (Estepa Giménez et al., 2008). The Malaysian Ministry of Education, as detailed in the Malaysian Education Blueprint 2013-2025, attaches great importance to the promotion of racial and ethnic unity in order to foster a sense of identity among Malaysians and enable them to embrace the country's diverse heritage (Barghi et al., 2017).

As per the latest Chinese Compulsory Education Curriculum Standards issued by the Chinese Ministry of Education in 2022, cultural heritage is seamlessly incorporated into China's national education system throughout the entire compulsory education period, with clearly defined teaching tasks assigned based on different school years (Underhill & Salazar, 2016; Ye et al., 2020). Compulsory education in mainland China spans nine years, comprising of primary school and junior high school, divided into four stages based on age and cognitive development (Xue & Li, 2022). Of particular relevance is Key Stage 4 (Grades 7–9), where students are expected to develop a deeper understanding of the significance of cultural heritage and a sense of

responsibility for its preservation (Wei, 2022). In this context, Grade 7 marks the onset of adolescence and is a critical developmental phase where students begin to engage with more abstract and socially relevant themes.

According to Dewey (1986), experiential learning holds great significance as it emphasizes the integration of learning environments within the broader social context rather than imposing restrictions. VFTs introduce new virtual spaces, enabling a departure from the conventional boundaries of the physical classroom and expanding learning possibilities across various geographic spaces (Cardullo & Wang, 2022). By participating in VFTs, students can engage in self-directed exploration within the virtual environments provided, enhancing their understanding of the subject matter through experiential learning. Moreover, VFTs facilitate experiential learning and promote student-led discovery by establishing a student- and task-centered learning environment, encouraging active student involvement in the pursuit of knowledge (Brown & Campione, 1994; Han, 2020).

Currently, an increasing number of academic studies are utilizing immersive VR technology and HMDs for the implementation of educational VFTs. VR-based field trips have shown the potential to enhance students' sense of presence, motivation, and enjoyment. For instance, Xie et al. (2019) conducted a study investigating the use of immersive VFTs in college students' Chinese language learning and found that it not only stimulated students' interest in learning but also encouraged them to delve deeper into the target culture. Immersive VFTs provide a high level of immersion, defined as "an objective level of sensory fidelity", which is closely linked to a heightened sense of presence (Makransky & Lilleholt, 2018). The integrating of VR-based field trips in classroom settings also facilitates experiential learning by offering a more authentic first-person experience.

In the research on VR, presence has garnered significant attention due to its immersive and subjective nature, constituting a crucial aspect of alternative experiences. (Witmer & Singer, 1998). In academia and industry, there is often an underlying assumption that the primary goal of designing virtual environments (VEs) is to enhance presence (Brouwer et al., 2020). Cummings & Bailenson (2016) note that presence is critical in education and plays a moderating role in learner performance, where learners should perform in virtual learning environments similarly to how they would perform in the real world. A study by Stevens et al. (2015) investigated the relationship between performance and presence in virtual simulation training, and the results showed that a high level of presence in virtual training was associated with the user's ability to positively correlate with improved performance when performing the trained task in real life.

Motivation plays a crucial role in driving individuals to progress and accomplish tasks. Keller (1983) defines motivation as the inclination of a person to make choices regarding the experiences and goals they wish to pursue, as well as the level of effort required to achieve those choices. In immersive virtual environments, implementing effective teaching methods can lead to students attaining satisfactory levels of motivation, heightened interest in learning, and increased motivation to learn (Mokmin & Jamiat, 2021).

While VR-based field trips hold considerable potential, many existing implementations prioritize technical features such as visual fidelity and interactivity, often at the expense of sound instructional design (Makransky et al., 2021). The effectiveness of such environments depends not only on technological realism but also on how information is structured and communicated. As such, researchers have called for the integration of evidence-based instructional principles into VR learning design.

To inform the design of effective virtual reality learning environments, it is important to examine how instructional design principles developed for multimedia learning work in immersive environments. One such principle is the personalization principle from Cognitive Theory of Multimedia Learning (Mayer, 2020), which posits that learners benefit more from instruction delivered in a conversational style than from formal, impersonal language. Several previous research has demonstrated that personalized instructional texts, which employ the first person "I" or the second person "you" and include sentences that directly address the reader, yield superior learning outcomes compared to non-personalized texts that use more formal language expressions and the third person.

Prior studies in screen-based environments suggest that using second-person voice, informal expressions, and dialogic structure is associated with increased learner engagement and cognitive involvement (Ginns & Fraser, 2010a). From a theoretical standpoint, the potential benefits of personalization have been discussed from both cognitive and motivational perspectives. Cognitively, it is proposed that personalized messages may encourage self-referencing and a deeper connection with the content (Moreno & Mayer, 2000b; Rogers et al., 1977). From a motivational perspective, it is hypothesized that conversational language increases interest in the material, subsequently motivating learners to exert more significant effort in comprehending domain-specific content (Hidi & Baird, 1988). However, these interpretations have largely been derived from studies in traditional digital or text-based formats, and their relevance to immersive virtual learning environments remains uncertain.

In recent years, significant strides in various generative AI tools have garnered global attention. Tasks once deemed beyond the capabilities of AI are now feasible, presenting new avenues to enhance the productivity of creative media and educational

content (Leiker et al., 2023). Research by Pataranutaporn et al. (2021) suggests that AI-generated characters can create engaging learning materials suitable for all age groups. Leveraging state-of-the-art algorithms, these avatars seamlessly integrate with educational content in textbooks, museums, historical sites, and natural environments. Similarly, research by Leiker et al. (2023) indicates that both traditionally produced teacher videos and composite videos featuring realistic AI-generated characters notably enhance student performance, with no discernible difference between the two, and similar learner perceptions. Vallis et al. (2023) further explores students' perceptions of AI-generated characters, revealing that students generally find them suitable and sometimes preferable for lectures, albeit with room for improvement. Therefore, this study aims to determine the pedagogical feasibility of using AI-generated virtual teachers in VR environments and to examine their effectiveness in supporting student learning.

Finally, adolescence is a critical phase where pronounced disparities emerge between males and females in physical attributes, behavioral tendencies, and vulnerability to psychopathology (Lenroot & Giedd, 2010). This period witnesses the development of distinct gender-specific characteristics, including cognitive and academic disparities. Research indicates that gender differences during adolescence can manifest in academic performance and learning preferences, with variations influenced by cultural, environmental, and individual factors (K & Gopal, 2020; Marcenaro–Gutierrez et al., 2018). A prevalent stereotype holds that males are often perceived as better suited for STEM subjects, while females tend to favor arts and social sciences (Gao, 2022). Therefore, gender is included as a moderator variable in this study to explore whether learners of different genders respond differently to two language styles in VR-based virtual field.

1.3 Statement of Problem

Cultural heritage education plays a significant role in promoting the sustainable development of cultural heritage (Estepa Giménez et al., 2008; Trabajo-Rite & Cuenca-López, 2020). Its objectives extend beyond providing historical context and cultural affinity. Equally important is the cultivation of aesthetic skills, humanism, and the enhancement of cultural identity (Delgado-Algarra & Cuenca-López, 2020; Ye et al., 2020). Despite growing global attention to this domain, cultural heritage education in many school systems, particularly in middle school, remains limited to passive knowledge delivery using expository texts, static images, and videos (Camuñas-García et al., 2023; Valencia Arnica et al., 2023). This traditional model often fails to stimulate student engagement or foster deep comprehension (Theodoropoulos & Antoniou, 2022).

One pressing issue is the lack of student motivation in cultural heritage education (Ye et al., 2020). Without a sense of personal connection to cultural content, students struggle to appreciate its relevance or significance. Research shows that motivation is a prerequisite for meaningful learning, especially in abstract or historically distant subjects (Villena Taranilla et al., 2022; Yücesan et al., 2023). Cultural heritage topics often involve symbolic meaning, conceptual complexity, and distant historical contexts, which make them harder to internalize through conventional instruction. Prior studies suggest that such content is often perceived as boring or difficult to relate to , leading to superficial understanding and low learning outcomes (Paolanti et al., 2023; Röll & Meyer, 2020).

Virtual Reality-basd Field Trips (VRFT) have emerged as a promising tool for enhancing student learning by simulating authentic, immersive experiences(Cheng & Tsai, 2019; Han, 2021; Mead et al., 2019). However, despite their potential, the

pedagogical application of VRFT in secondary-level cultural heritage education remains limited and insufficiently explored. In addition, many existing VR- learning environments implementations tend to emphasize technical features such as visual realism, spatial navigation, or interactivity (Bekele et al., 2018; Chen et al., 2024; Gamito et al., 2017). While these elements may contribute to initial engagement, they are often not supported by well-grounded instructional strategies aligned with established learning theories (Makransky & Petersen, 2021). This gap may result in visually engaging but cognitively shallow experiences with minimal impact on motivation, retention, or immersive presence.

The success of VR-based learning environments depends not only on the sophistication of the technology itself but also on the instructional strategies embedded within the system, particularly, how learning content is structured and delivered (Makransky & Mayer, 2022; Makransky & Petersen, 2021). Previous research has shown that redesigning content using a conversational style approach significantly enhances student performance and learning experiences (Mayer et al., 2004; Schrader et al., 2018; Yang et al., 2023). The the personalization principle in multimedia learning emphasizes the positive impact of providing instructional guidance through a dialogic approach (Mayer, 2020). While the multimedia learning principles proposed by Mayer have been widely applied in the development and design of various media courseware and applications, empirical evidence regarding its effectiveness in VR-based environments remains limited (Brom et al., 2017). Furthermore, existing studies on the personalization principle have predominantly been conducted in Western, adult, or higher education settings, leaving a gap in understanding its effectiveness among secondary school students in Eastern cultural contexts (Lin et al., 2020). Moreover, while visual arts and cultural heritage subjects rely heavily on emotional and aesthetic

engagement, the impact of instructional language style on students' learning in such domains remains underexplored.

In addition, considering the rapid development of generative AI technologies and their transformative impact on various aspects of daily life, it is crucial to consider their implications for the field of education. AI-generated characters as virtual teachers remain to be explored, and it is important to understand whether the personalization principle can be extended to the conditions involving AI-generated pedagogical agents.With the rapid advancement of generative AI technologies and their significant impact on various aspects of daily life, it becomes imperative to consider their implications for the field of education. Previous studies have revealed that educators hold diverse views regarding generative AI (Montenegro-Rueda et al., 2023). While some educators perceive AI as a potent tool for driving transformative advancements in education, others approach it with skepticism, viewing it as a potential risk (Danry et al., 2022; Pataranutaporn et al., 2021; Vallis et al., 2023). However, the effectiveness of AI-generated personas as virtual teachers requires further exploration, and whether the personalization principle can be extended to the conditions associated with AI-generated virtual personas remains unexplored.

Additionally, student characteristics such as gender may also play a moderating role in VR-based learning experiences. Prior research suggests that gender differences can affect cognitive and emotional responses in technology-mediated learning, including differences in spatial ability (Bartlett & Camba, 2023), learning preferences (Aloni et al., 2024), and affinity with technology (Jin & Divitini, 2020). However, the findings are inconsistent, and there is limited evidence on how gender influences outcomes in VR-based learning environments (Lorenz et al., 2023; Putrawangsa et al., 2023) . Understanding whether gender moderates the effects of the personalisation

principle in VR-based learning environments is essential to ensuring equity and inclusiveness in instructional design.

1.4 Research Objectives

This study aimed to investigate the impact of the personalization principle on student performance, student presence and student motivation when utilizing VR-based field trip to explore cultural heritage in a visual arts classroom. The independent variable was two different VR-based field trip, VR-based field trip in a conversational language style (VRFTC) and VR-based field trip in a formal language style (VRFTF). The dependent variables for this study were (i) student learning performance, (ii) student presence, and (iii) student motivation. The moderator variable is the gender of students.

The following are the research objectives of this study：

i. To design and develop two different VR-based field trip learning system (VRFTC & VRFTF) to teach about the Classical Gardens of Suzhou, a World Heritage Site, in 7th grade visual arts education.

ii. To investigate the difference and interaction effects of two VR-based field trip learning systems (VRFTC & VRFTF) with gender on students' learning performance.

iii. To investigate the difference and interaction effects of two VR-based field trip learning systems (VRFTC & VRFTF) with gender on students' presence.

iv. To investigate the difference and interaction effects of two VR-based field trip learning systems (VRFTC & VRFTF) with gender on students' motivation.

1.5 Research Questions

The objectives trigger the following research questions:

A. How does using two VR-based field trip learning systems (VRFTC & VRFTF) affect students' learning performance based on genders? The subsidiary research questions are:
   1) Is there a significant difference in learning performance between students using VRFTC and VRFTF?
   2) Is there a significant difference in learning performance in VR-based field trip for students based on gender?
   3) Is there a significant interaction effect difference between the two VR-based field trip learning systems (VRFTC & VRFTF) and gender (male & female) on students' learning performance?

B. How does using two VR-based field trip learning systems (VRFTC & VRFTF) affect students' presence based on gedner? The subsidiary research questions are:
   1) Is there a significant difference in presence between students using VRFTC and VRFTF?
   2) Is there a significant difference in presence in VR-based field trip for students based on gender?
   3) Is there a significant interaction effect difference between the two VR-based field trip learning systems (VRFTC & VRFTF) and gender (male & female) on students' presence?

C. How does using two VR-based field trip learning systems (VRFTC & VRFTF) affect students' motivation based on gedner? The subsidiary research questions are:

1) Is there a significant difference in motivation between students using using VRFTC and VRFTF?
2) Is there a significant difference in motivation in VR-based field trip for students based on gender?
3) Is there a significant interaction effect difference between the two VR-based field trip learning systems (VRFTC & VRFTF) and gender (male & female) on students' motivation?

1.6 Research Hypotheses

These study research hypotheses are formulated as null hypotheses. The research null hypotheses will be rejected when the p-value is less than the significance level, 0.05 ($p<0.05$). The hypotheses are formed based on the research objectives and questions as follows:

A. The effect of using two VR-based field trip learning systems (VRFTC & VRFTF) towards students' learning performance based on gender. The subsidiary null hypotheses are as follows:

$H_{0.A.1}$: There is no significant difference in learning performance between students using the VRFTC and those using the VRFTF.

$H_{0.A.2}$: There is no significant difference in learning performance in VR-based field trip for students based on gender.

$H_{0.A.3}$: There is no significant interaction effect between the two VR-based field trip learning systems (VRFTC & VRFTF) and gender (male & female) on students' learning performance.

B. The effect of using two VR-based field trip learning systems (VRFTC & VRFTF) towards students' presence based on gender. The subsidiary null hypotheses are as follows:

$H_{0.B.1}$: There is no significant difference in presence between students using the VRFTC and those using the VRFTF.

$H_{0.B.2}$: There is no significant difference in presence in VR-based field trip for students based on gender.

$H_{0.B.3}$: There is no significant interaction effect between the two VR-based field trip learning systems (VRFTC & VRFTF) and gender (male & female) on students' presence.

C. The effect of using two VR-based field trip learning systems (VRFTC & VRFTF) towards students' motivation based on gender. The subsidiary null hypotheses are as follows:

$H_{0.C.1}$: There is no significant difference in motivation between students using the VRFTC and those using the VRFTF.

$H_{0.C.2}$: There is no significant difference in motivation in VR-based field trip for students based on gender.

$H_{0.C.3}$: There is no significant interaction effect between the two VR-based field trip learning systems (VRFTC & VRFTF) and gender (male & female) on students' motivation.

1.7 Significance of the Study

The present study holds both theoretical and practical significance as it aims to enhance students' learning of cultural heritage in visual arts subjects, thereby contributing to the sustainable development of cultural heritage. The developed VRFT

learning system is designed to improve students' performance in acquiring knowledge related to cultural heritage, particularly in the aesthetic appreciation of art. By employing appropriate theories, the VRFT learning system seeks to enhance students' presence and motivation, specifically targeting seventh-grade secondary school students. The findings of this study can also provide valuable insights to ministries of education, schools, teachers, and relevant governmental and non-governmental organizations involved in education and cultural heritage preservation.

Additionally, this study contributes to the existing knowledge of multimedia learning, and offers partial support for the personalization principle. While the conversational approach has previously been demonstrated in many ways in Western cultural contexts (Dutke et al., 2016; Ginns & Fraser, 2010b; Moreno & Mayer, 2000a; Riehemann & Jucks, 2018). This study validates the effectiveness of the conversational approach to teaching and learning in the Chinese context and extends its application to testing it in a multimedia learning environment embedded with AI-generated characters as a virtual teacher. With the advancement of generative AI technology, the creation of virtual characters using generative AI tools has the potential to serve as an alternative to traditional authoring methods, and this study examines how an AI-generated virtual teacher can better assist students in their learning, providing inspiration for the subsequent use of an AI-generated virtual teacher to create learning materials.

Furthermore, the study delved into potential disparities in the utilization of VRFT by students of different genders in visual arts education, and their preferences for different conversational-styled modes. The findings and theoretical principles employed in VRFT development can guide instructional designers in designing engaging and impactful virtual experiences.

1.8 Theoretical Framework

The following theories and models serve as the foundation for this study:

i. Cognitive Theory of Multimedia Learning (Mayer, 2021)

ii. Experiential Learning Theory (Kolbe, 1984).

iii. Cognitive Affective Model of Immersive Learning (Makransky & Petersen, 2021)

The design and development of the learning system for this study followed the the instructional design and development model by Alessi & Trollip's (2001), and referenced Design Guidelines for teens (Joice & Harley, 2012), as detailed in Chapter 4. The Chapter 2 offers a comprehensive discourse on the relevant theories. The theoretical framework illustrated in Figure 1.1 elucidates the theoretical foundation of this study.

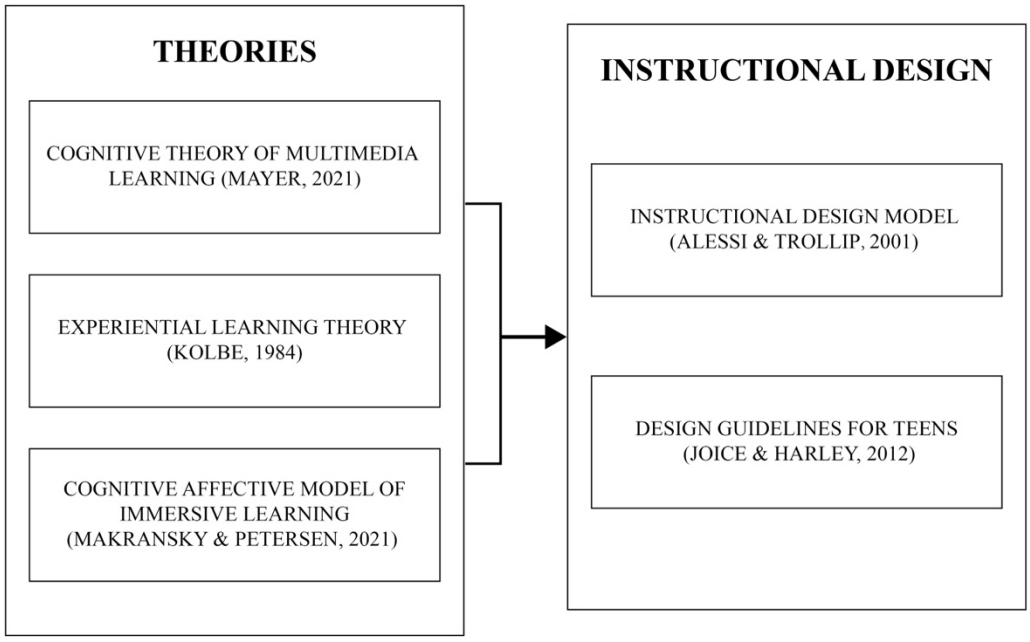

Figure 1.1 Theoretical Framework

1.8.1 Cognitive Theory of Multimedia Learning

According to Mayer (2021), the cognitive theory of multimedia learning is based on three key assumptions: the dual-channel principle, the limited-capacity principle, and the active learning principle. It posits that the human information processing system consists of two channels, one for visual/image processing and the other for auditory/linguistic processing. Each channel has limited capacity for processing. Furthermore, active learning, which involves engaging in cognitive processes during the learning process, is considered appropriate for effective learning. When individuals learn knowledge or information presented in multimedia format, it enhances their learning outcomes. In order to connect this new information with relevant knowledge retrieved from long-term memory, there are three stages of the learning process in multimedia presentations.

Based on the coordination of cognitive processes in the learning process, Mayer (2020) integrated cognitive theories and pertinent experimental research into the 12 multimedia instructional design principles originally introduced by Mayer (2009). These additions resulted in a total of 15 multimedia instructional design principles that have been widely embraced by multimedia instructional designers and researchers worldwide. Although almost all of these principles are implicitly applied in the developed applications, such as the multimedia principle, the signaling principle, and the segmentation principle, only the personalization principle has been selected as the focal point of this study. The personalization principle posits that individuals can enhance their learning by employing conversational styles rather than formal ones.

In this study, the personalization principle serves as the core instructional variable. It guides the design of Instructional language used within the VR-based field

trip learning system. Specifically, the study compares two versions of instructional delivery: one employing a conversational language style and the other using a formal language style. The aim is to investigate the effects of this instructional manipulation on students' learning performance, motivation, and sense of presence. Previous research (Moreno & Mayer, 2000b; Ginns & Fraser, 2010) has shown that conversational instructional styles can enhance learner engagement and cognitive processing. However, these findings are primarily drawn from studies conducted in screen-based, non-immersive settings and with college and high school learners. This study seeks to extend the applicability of the personalization principle by exploring its effects in the VR-based cultural heritage learning environment among Chinese secondary school students.

1.8.2 Experiential Learning Theory

Experiential learning theory originates from early humanist theories, notably the writings of Dewey (2013) and Piaget (2007). Dewey (1903) asserted that learning exceeds the mere reception of information; instead, it should involve an active and interactive process where learners comprehend and solve problems through reflection and hands-on experiences. Kolbe (1984) conceptualized this as an iterative cycle that engages learners through reflection, theory generation, and the application of knowledge, known as the experiential learning cycle. Kolb's model is widely acknowledged as the most influential and frequently cited representation of experiential learning theory. It encompasses four sequential processes: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Preceding all other steps is the requirement for direct and contextually relevant concrete experiences in the learning environment.

In this study, experiential learning theory serves as a design rationale for using VR-based immersive experiences to simulate authentic field trips in cultural heritage settings. By immersing students in virtual environments that replicate significant cultural landmarks, the VR system provides rich, context-specific sensory input that serves as a concrete experience. Students are then encouraged to observe, reflect, and apply the cultural knowledge acquired. This experiential cycle supports deeper cognitive processing, especially when students are allowed to navigate and interact with the environment autonomously.

1.8.3 The Cognitive Affective Model of Immersive Learning

Makransky & Petersen (2021) introduced the Cognitive Affective Model of Immersive Learning (CAMIL) which aims to provide a research-based theoretical framework for understanding learning in immersive environments. The CAMIL describes the learning process in immersive VR and builds on existing immersive education research on the VR learning process and established psychological theories such as self-determination theory (Deci & Ryan, 2015), cognitive load theory (Sweller, 2011), cognitive theory of multimedia learning (Mayer, 2021), and embodied cognition (Wilson, 2002). It is evident that CAMIL is applicable to current and forthcoming immersive learning technologies and is not limited to any specific technology, although the present emphasis lies on immersive learning experiences accessed through head-mounted displays (HMDs), known as IVR.

In this study, the CAMIL informs the selection and interpretation of the dependent variables (presence, motivation, and learning performance) by emphasizing how immersive technologies can enhance learners' cognitive engagement, emotional

involvement, and attentional focus. CAMIL also provides a theoretical basis for understanding how the VRFT may improve learning outcomes by fostering experiential involvement and affective engagement, particularly in the context of cultural heritage education, where emotional resonance and cultural significance play a critical role in shaping the learning experience.

1.9 Conceptual Framework

This study adopts a quasi-experimental design to examine the effects of instructional language style in a virtual reality-based field trip learning system. The conceptual framework includes three types of variables: independent, dependent, and moderator. The independent variable is the language style used in VRFT, with two modes: conversational (VRFTC) and formal (VRFTF). The dependent variables were the students' performance, presence, and motivation. In addition, the study considered students' gender as moderator variable. Figure 1.2 outlines the research framework employed in this study.

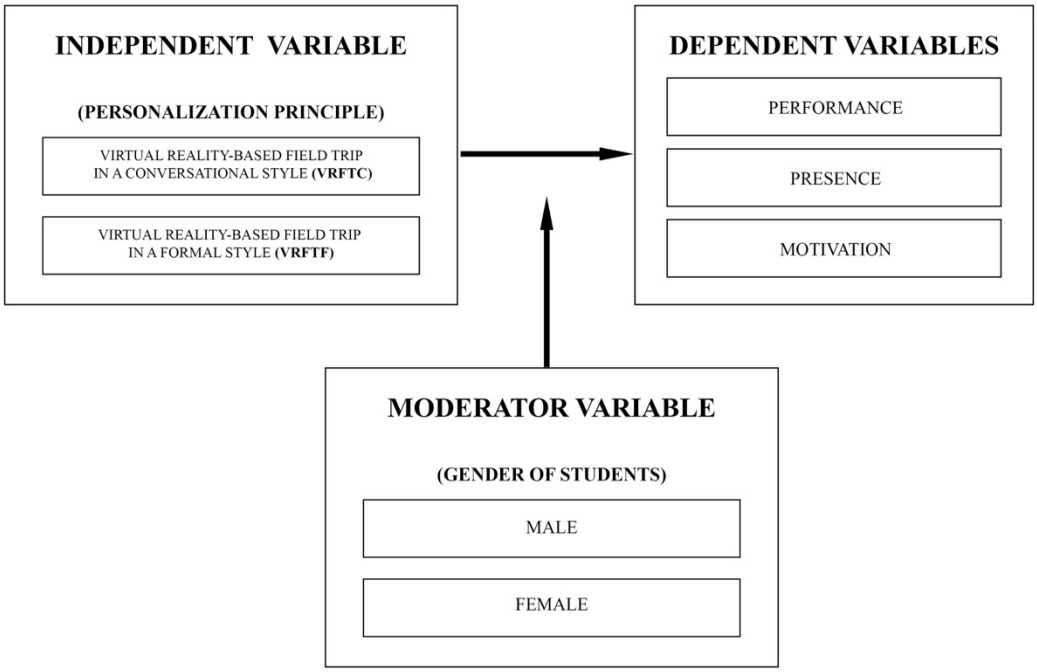

Figure 1.2 Conceptual Framework

1.10 Research Framework

This study is divided into two parts: the first part is the design and development of the VR-based virtual field trip; the second part examines the effects of the independent and moderator variables on the dependent variable.

In the first phase, the design of the VRFT system was guided by three theoretical foundations: the Cognitive Theory of Multimedia Learning (Mayer, 2021), the Experiential Learning Model (Kolb, 1984), and the Cognitive Affective Model of Immersive Learning (Makransky & Petersen, 2021). These theories informed the instructional approach, learning process, and expected affective and cognitive outcomes. The development process followed Alessi and Trollip's instructional design model (2001) and incorporated age-appropriate design guidelines for adolescents proposed by Joice and Harley (2012), particularly in multimedia, interaction, and visual design. Two versions of the VRFT system were created: one with conversational

language style and one with a formal language style, aligned with the personalization principle. Chapter 4 provides detailed descriptions of the system design and developmen.

In the second phase, the study adopted a quasi-experimental 2 × 2 factorial design to investigate how instructional language style (personalized vs. formal) and gender (male vs. female) influenced students' on students' learning performance, presence, and motivation within the VRFT. Through rigorous experimentation and data analysis, the study aimed to generate empirical evidence on the role of personalization principle and learner gender in VR learning environments.

Based on these variables and theoretical foundations, Figure 1.3 illustrates the research framework of this study. The framework represents the integration of the selected theories, instructional design principles, and the hypothesized relationships among the variables.

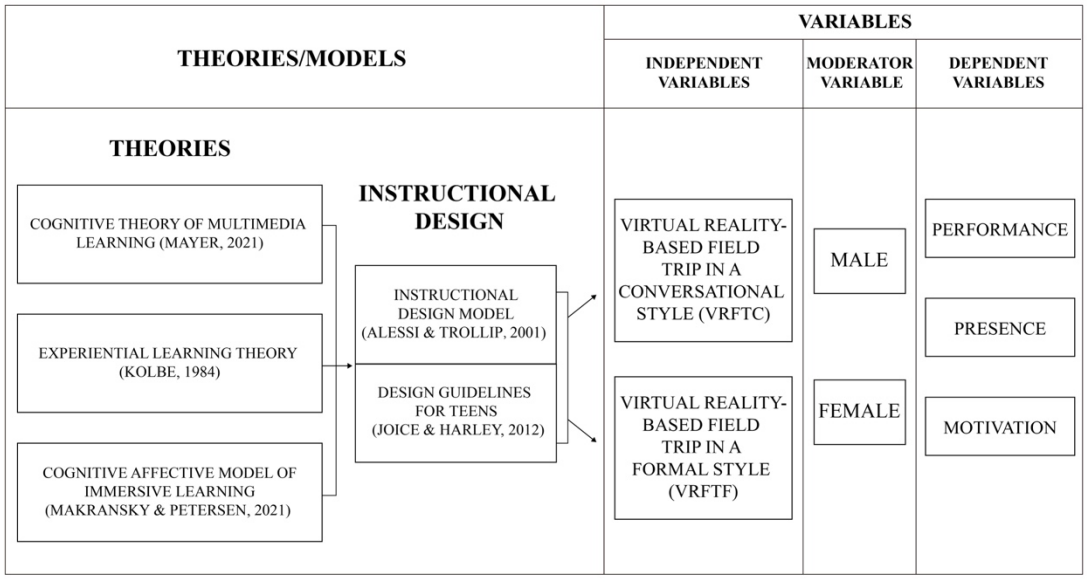

Figure 1.3 Research Framework

1.11 Definition of Operational Terms

In this study, a number of operational terms that need to be clearly defined are used, and for the avoidance of ambiguity, these terms are explained below.

1.11.1 Virtual Reality

Virtual Reality (VR) is a computer-generated simulation that enables users to interact with immersive three-dimensional environments as if they were physically present (Bowman & McMahan, 2007). VR creates a sense of presence by combining visual, auditory, and sometimes tactile feedback, and it is widely used in education to enhance experiential and active learning (Makransky et al., 2021). In this study, virtual reality refers to the use of head-mounted displays (HMDs) and handheld controllers to enable seventh-grade students to interact with the learning system.

1.11.2 Virtual Reality-Based Field Trip

A VR-based field trip (VRFT) refers to an educational experience where students use VR technology to explore and interact with virtual environments that simulate real-world locations or scenarios (Dolphin et al., 2019). VRFT is commonly used to provide immersive learning in settings where physical field trips are difficult or impossible (Mead et al., 2019). In this study, VRFT refers to a virtual learning environment simulating the classical gardens of Suzhou, designed to support middle school students' understanding of cultural heritage content through interactive exploration.