MEDIATING ROLE OF ATTITUDES AS A MODERATOR ON THE FACTORS INFLUENCING STUDENTS' INTERACTION AND WILLINGNESS TO USE DIGITAL VIRTUAL REALITY IN CHINA

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UNIVERSITI PENDIDIKAN SULTAN IDRIS

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ABSTRACT

This study investigates the determinants influencing user behaviour and interactive experiences with digital virtual reality (DVR) technology among first-year college students at Gansu Province. While DVR is increasingly used for educational engagement, the factors influencing students' attitudes, interactions, and willingness to use it remain underexplored. Existing research lacks a comprehensive model that considers the mediating role of attitudes and the moderating effect of gender. This study aims to address this gap by identifying key factors, exploring how attitudes mediate these relationships, and examining gender as a moderating variable. The aim of this study is to develop and validate a comprehensive model that identifies and examines the factors influencing students' attitudes, interactions, and willingness to engage with digital virtual reality in educational settings. The study also seeks to explore the mediating role of attitudes in these relationships and investigate the potential moderating effect of gender. A survey was conducted with 1,621 students selected through multi-stage stratified sampling. A structured questionnaire with 28 items across seven variables, demonstrating good reliability and validity, was used. The Structural Equation Modeling (SEM) grounded in the Technology Acceptance Model (TAM) revealed significant insights. Attitude emerged as a strong predictor of both interaction (β=0.55, T=12.84, P<0.01) and willingness (β=0.33, T=8.46, P<0.01). Perceived usefulness significantly influenced attitude (β=0.29, T=6.34, P<0.01), interaction (β=0.18, T=4.27, P<0.01), and willingness (β=0.17, T=3.80, P<0.01). Similarly, perceived reliability had a strong effect on attitude (β=0.49, T=12.77, P<0.01), interaction (β=0.47, T=12.82, P<0.01), and willingness (β=0.60, T=16.78, P<0.01), indicating its central role in shaping user behaviour. The study found that while perceived ease of use and entertainment contributed to DVR engagement, their impact was less significant. Interestingly, gender didn’t significantly moderate these relationships, suggesting consistent factors influencing DVR engagement. Attitudes play a crucial role in enhancing students’ interaction and willingness in DVR environments. The study also challenges the assumption that ease of use directly influences attitude formation. In practice, these insights can guide technology developers and marketers in designing systems that are more likely to be adopted. By improving perceived reliability, usefulness, and entertainment value, developers can foster positive attitudes and increase user engagement with interactive systems, leading to more effective and engaging virtual environments.

PERANAN SIKAP SEBAGAI MODERATOR TERHADAP FAKTOR-FAKTOR YANG MEMPENGARUHI INTERAKSI DAN KESEDIAAN PELAJAR MENGGUNAKAN REALITI MAYA DIGITAL DI CHINA

ABSTRAK

Kajian ini menyelidik faktor-faktor penentu yang mempengaruhi tingkah laku pengguna dan pengalaman interaktif dengan teknologi realiti maya digital (DVR) dalam kalangan pelajar kolej tahun pertama di wilayah Gansu. Walaupun DVR semakin banyak digunakan dalam konteks pendidikan untuk meningkatkan penglibatan pelajar, faktor-faktor yang mempengaruhi sikap, interaksi dan kesediaan pelajar untuk menggunakannya masih kurang diterokai. Penyelidikan sedia ada kekurangan model komprehensif yang mengambil kira peranan mediasi sikap dan kesan moderasi jantina. Kajian ini bertujuan untuk mengisi jurang tersebut dengan mengenal pasti faktor-faktor utama, meneroka bagaimana sikap pengantara hubungan ini, dan meneliti jantina sebagai pemboleh ubah moderasi. Tujuan kajian ini adalah untuk membangunkan dan mengesahkan model komprehensif yang mengenal pasti dan mengkaji faktor-faktor yang mempengaruhi sikap, interaksi dan kesediaan pelajar untuk terlibat dengan realiti maya digital dalam konteks pendidikan. Kajian ini juga berusaha untuk meneroka peranan mediasi sikap dalam hubungan ini dan menyelidik kesan moderasi jantina yang berpotensi. Satu tinjauan telah dijalankan melibatkan 1,621 orang pelajar yang dipilih melalui pensampelan berstrata pelbagai peringkat. Soal selidik berstruktur yang merangkumi 28 item berdasarkan tujuh pembolehubah telah digunakan dan menunjukkan kebolehpercayaan dan kesahihan yang baik. Analisis Pemodelan Persamaan Berstruktur (SEM) berasaskan Model Penerimaan Teknologi (TAM) telah menghasilkan dapatan yang signifikan. Sikap muncul sebagai peramal kuat bagi kedua-dua interaksi (β=0.55, T=12.84, P<0.01) dan kesediaan (β=0.33, T=8.46, P<0.01). Persepsi terhadap kegunaan secara signifikan mempengaruhi sikap (β=0.29, T=6.34, P<0.01), interaksi (β=0.18, T=4.27, P<0.01), dan kesediaan (β=0.17, T=3.80, P<0.01). Begitu juga, persepsi kebolehpercayaan mempunyai kesan yang kuat terhadap sikap (β=0.49, T=12.77, P<0.01), interaksi (β=0.47, T=12.82, P<0.01), dan kesediaan (β=0.60, T=16.78, P<0.01), sekali gus menunjukkan peranan utamanya dalam membentuk tingkah laku pengguna. Kajian ini mendapati bahawa walaupun persepsi terhadap kemudahan penggunaan dan nilai hiburan turut menyumbang kepada penglibatan dalam persekitaran Realiti Maya Digital (DVR), kesannya adalah kurang signifikan. Menariknya, jantina tidak memoderasi hubungan-hubungan ini secara signifikan, menunjukkan bahawa faktor-faktor yang mempengaruhi penglibatan dalam DVR adalah konsisten merentas jantina. Sikap memainkan peranan penting dalam meningkatkan interaksi dan kesediaan pelajar dalam persekitaran DVR. Kajian ini juga mencabar andaian bahawa kemudahan penggunaan secara langsung mempengaruhi pembentukan sikap. Dari segi amalan, dapatan ini boleh dijadikan panduan oleh pembangun teknologi dan pemasar dalam mereka bentuk sistem yang lebih cenderung untuk diterima pakai. Dengan meningkatkan persepsi terhadap kebolehpercayaan, kegunaan dan nilai hiburan, pembangun dapat memupuk sikap positif dan meningkatkan penglibatan pengguna dengan sistem interaktif, seterusnya mewujudkan persekitaran maya yang lebih berkesan dan menarik.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In this chapter, the research explores the background of the study, tracing its development to the core issues outlined in the problem statement. By identifying these issues, the research objectives are established, guiding the direction of the study. These objectives lead to the formulation of research questions, strengthening the investigation. The perspectives on the subject underscore the importance of advancing interactive display design and addressing the related challenges. This chapter sets the stage for our in-depth exploration of the complex aspects of virtual interaction technology applications.

1.2 Background Study

Digital display is an evolving form of art that arises from the fusion of digital technology and artistic expression (Bishop, 2020). Broadly defined, digital display encompasses artistry in the digital realm, while its narrower interpretation pertains to artworks generated through computer-aided design (Lambert, 2019). The swift progress of digital display owes its momentum to advancements in computer technology and its pervasive integration into various domains (Bolivar & Chang, 2021). The ubiquitous presence of digital display is evident as it permeates diverse industries, generating ripple effects that transcend traditional boundaries. Sectors like clothing art design and environmental art design exemplify the profound impact of digital display (Castro et al., 2018). The infusion of modern virtual reality technology into digital display has further expanded its horizons, seamlessly melding artistic creativity and scientific innovation (Pan & Hou, 2020). This dynamic convergence has engendered a reciprocal relationship, where art and science coalesce, generating synergistic outcomes that redefine the very essence of digital display.

The development of digital technology has promoted the widespread use of Virtual Reality in various sectors including the retail sector. According to Cowan and Ketron (2019), major brands have implemented VR in their marketing strategies where they provide virtual experiences to the customers in knowing better their brand. This virtual experience connects consumers and the marketers better and improves better interactions between them.

Clarification Note: For the purpose of this study, a clear distinction is made between *interaction behaviour* and *interactive behaviour*. While *interactive behaviour* is used conceptually to describe broader engagement processes within digital virtual reality (DVR) experiences, *interaction behaviour* specifically refers to the observable, measurable actions of students when interacting with DVR systems. This distinction ensures consistency between theoretical framing and empirical investigation.

1.2.1 Virtual Reality Technology in Human-Computer Interaction

In recent years, virtual reality (VR) technology has developed rapidly. The Ministry of Industry and Information Technology (2018) pointed out that in 2019, the global virtual reality industry is moving from the initial cultivation period to the rapid development period. By 2025, the overall strength of China's virtual reality industry will enter the forefront of the world. Moreover, the virtual reality retail market is expected to increase to US $41.5 billion by 2020 (Blum, 2017). With the development of computer equipment and related technology, the interaction between humans and computers has become a part of daily life. The design of control mode of human-computer interaction should be regarded as an important part of hardware design. Common human-computer interaction is based on two-dimensional user interface of window, icon and menu, and uses mouse and keyboard as interactive equipment (Karambakhsh et al, 2019).

The new generation of human-computer interaction systems represented by virtual reality equipment has the characteristics of people-oriented, multi-mode and intelligence. Formally, virtual reality is a virtual environment (VE) that uses three-

dimensional computer technology to generate user navigation and interaction. A virtual environment is characterized by a continuous human-computer interaction cycle, and the user is closely coupled with the simulated environment to obtain a credible sense of immersion and presence (Cowan and Ketron, 2019). They provide a wide range of appropriate interactions, from gesture based direct manipulation to remote multimodal teaching, and even discourse-based communication with artificial humans. Therefore, in recent years, virtual reality technology has attracted more and more attention in the field of artificial intelligence and artificial interaction and has become an important research object. What is more worth looking forward to is that virtual reality technology may surpass the existing capabilities and realize more dimensional product interaction through more sensors in the next decade.

1.2.2 Digital Display in Teaching Practice

During the last decade, digital technologies have become an indispensable part of the educational process. The quest for educational excellence has been associated with the drive for teaching using digital technologies. The continuing rapid development of digital technologies has created an interesting set of opportunities and challenges for learning and development that has also placed new demands on teachers' and children's knowledge and skills. These technologies have changed the ways teachers and children behave in their everyday lives regarding communicating, entertaining and learning. The ubiquity of the internet and digital technologies has particularly changed their experiences of using the internet. The increasing infusion of digital technologies into educational settings, furthermore, has changed the ways teachers communicate with,

choose, and structure their educational resources and even changed their teaching practices (Kearney et al., 2018; Selwyn, 2012; as cited by Bourbour, 2020).

The use of virtual digital display in teaching has been increasing as education has vastly embraced the new ways of teaching and learning process especially in the application of new technology in increasing students' active involvement in the process. According to Carbonell and Bermejo (2017), the VR technology fully immerses a user in a synthetic environment, using virtual reality glasses. On this immersion, the user cannot see the surrounding real world, with virtual objects overlapped or mixed with the real world. By contrast, AR allows the user to see the real world with virtual objects superimposed on or composited with the real world. Therefore, AR complements reality, rather than completely replacing it.

1.2.3 Virtual Reality Digital Display as Direction of Display Innovation Mode

From physical display, paper display to electronic digital display, the first thing to solve is the technical problem. Package electronic screen technology, like paper in the era of print media, has laid the carrier foundation for digital display. Bit replacing text is the second feature of digital display. With the continuous enrichment of digital media, rich media is becoming the main content of digital display. Hypertext Technology Based on hyperlink replaces static fixed layout technology in the digital world (Cengzhi et al, 2019).

Interactive communication replacing linear digital display is its third feature, Web1.0 the main task of the 0 period is to move the human knowledge system onto the network with the help of the world wide web, but it is still dominated by one-way digital display; Web2.0 period realizes the interactive sharing between users and content; Developing Web3.0 is expected to realize the wide interconnection and personalized push of information through big data, artificial intelligence, virtual reality and other technologies. The perception brought by VR technology allows users to interact with the digital display screen through limbs and sound, to realize the interaction with the digital display system, such as "Digital Museum". In the virtual digital display, after wearing VR glasses, users experience a new three-dimensional digital display mode which is different from the plane digital display (Honghe, 2019).

Virtual reality technology can make users immerse themselves in digital displays through the creation of a simulation environment and can also transform precious materials into perceptible graphics and texts to attract more users. In other words, when VR technology provides services for users, it also provides users with an almost realistic interactive sensory experience.

1.2.4 The Mediating Role of Attitudes between the TAM Factors and Students' Interaction and Willingness in Digital Virtual Reality

In the ever-evolving landscape of digital virtual reality (VR), the integration of technology acceptance and user behaviour has garnered significant attention. A pivotal concept in this context is the Technology Acceptance Model (TAM), which postulates that individuals' acceptance and utilization of technology are influenced by their

perceptions of its usefulness and ease of use (Davis, 1989). As digital VR gains prominence in various sectors, understanding the factors influencing students' interaction and willingness towards this technology becomes paramount. This exploration is particularly crucial considering the mediating role of attitudes, which act as a bridge between the factors of TAM and subsequent user behaviour.

TAM elucidates the significance of perceived usefulness and perceived ease of use as determinants of technology acceptance (Davis, 1989). In the realm of digital VR, these factors hold profound implications for students' interaction and willingness. Perceived usefulness underscores the extent to which students believe that utilizing digital VR enhances their learning experience and augments their knowledge acquisition (Venkatesh et al., 2003). On the other hand, perceived ease of use pertains to the degree to which students perceive digital VR as user-friendly and convenient (Davis, 1989). These factors jointly shape students' attitudes towards digital VR technology.

The mediating role of attitudes between TAM factors and students' interaction and willingness is crucial in understanding the intricate interplay of psychological processes. Attitudes, as cognitive evaluations of a technology, act as an intermediary through which TAM factors influence students' behaviour (Ajzen, 1991). Positive attitudes towards digital VR foster a more favourable disposition towards using the technology, consequently promoting higher levels of interaction and willingness (Venkatesh & Davis, 2000). Attitudes serve as a cognitive mechanism that processes and translates the perceived usefulness and ease of use into students' intention to engage with digital VR.

Moreover, the mediating effect of attitudes unveils a comprehensive picture of the psychological mechanism underpinning students' engagement with digital VR. As students assess the utility and ease of use of digital VR, their cognitive evaluations culminate in shaping their attitudes towards the technology (Ajzen, 1991). These attitudes, in turn, steer their subsequent behaviour, including interaction patterns and willingness to embrace digital VR (Venkatesh & Davis, 2000).

In conclusion, the mediating role of attitudes between TAM factors and students' interaction and willingness in digital virtual reality illuminates the intricate psychological dynamics at play. This paradigm recognizes the pivotal role of attitudes in translating the perceived usefulness and ease of use into students' behavioural intentions. By dissecting these underlying cognitive processes, educators, practitioners, and researchers gain a more profound comprehension of the factors influencing technology acceptance and usage. Ultimately, this insight is instrumental in fostering a more immersive, engaging, and fruitful learning experience in the realm of digital virtual reality.

1.2.5 User Interaction Experience in Virtual Reality Technology Service Innovation

Interactivity is a variable of great concern in the research of computers and other devices with strong interaction. Virtual reality technology provides more interactive content and allows users to interact at a higher level (Kang et al, 2020). VR not only allows users to watch the immersive virtual reality experience through the display, but also provides them with tools (usually through tracking sensors and hand controllers)

to enable them to interact in the virtual environment and have agency rights. Users can explore and control the free movement of the virtual world and interact with virtual objects, to improve the user experience. The key to user virtual reality experience is multimodal interaction involving multiple senses (Somrak et al, 2020).

The human brain plays a crucial role in processing real-time visual, auditory, and proprioceptive inputs, resulting in a captivating sense of immersion within a virtual reality environment (VE) (Llobera et al., 2017). Interacting with objects in the virtual world is central to the experience of VR users. The quality of user interaction profoundly influences the advancement and unique features of virtual reality technology, acting as a fundamental driver for innovation (Sengupta & Chaudhury, 2019). Achieving a convincing sense of immersion involves engaging other human senses such as hearing, touch, and even taste to create a truly immersive and lifelike experience (Freina & Ott, 2015). Moreover, the integration of gesture recognition systems and optical eye tracking technology within virtual reality equipment has garnered significant consumer attention and interest (Habib & Chua, 2019).

In the realm of education, the rapid development of digital technologies has revolutionized teaching methods worldwide, introducing advanced tools like computer interaction technology and computer networks (Bai & Wei, 2018). The digital interactive teaching approach has gained traction as a valuable pedagogical tool, aiding classroom instruction through dynamic presentations and animations that enhance student comprehension and learning efficiency (Lei et al., 2020). As educational systems undergo information-driven transformations, digital multimedia courseware has emerged as an integral component in modern teaching practices (Xiao et al., 2019).

Interviews and investigations have revealed that interactive teaching's intuitive and vivid nature enhances students' grasp of complex concepts, while its interactive nature fosters active interest and empowers students to direct their learning process (Zhang et al., 2021). Consequently, interactive teaching has gained popularity among educators as a potent method to engage students. However, the creation of effective interactive teaching platforms remains a challenge, demanding thoughtful design and development to align with pedagogical goals and requirements (Chang et al., 2017).

The concept and scope of virtual reality digital display require comprehensive exploration through empirical practices and research to establish a solid theoretical framework that can guide subsequent endeavours (Yi et al., 2020). Constructing a theoretical foundation is imperative to provide systematic guidance for the unfolding practices and investigations in this field. This study adopts a multi-faceted approach to lay the groundwork for understanding and harnessing the potential of virtual reality digital display within students' human-computer interaction processes.

Firstly, the study explores the intricacies of the mechanism through which virtual reality digital display influences students' human-computer interaction, substantiating the rationality and indispensability of formulating virtual reality digital display services (Kumar & Saha, 2021). This analysis offers insights into the synergy between technological aspects and user behaviour, shedding light on the role of virtual reality digital display in enhancing interaction experiences.

Secondly, the investigation employs clustering analysis to decipher distinctive human-computer interaction behaviour patterns exhibited by students interacting with

virtual reality digital displays (Lee & Li, 2019). This approach unveils inherent behavioural tendencies and nuances in student interactions within virtual reality environments, contributing to a comprehensive understanding of user engagement.

Furthermore, the research intricately dissects the factors that shape students' human-computer interaction behaviour while engaging with virtual reality digital display. By quantitatively probing these factors, a comprehensive model is constructed, providing a structured framework for comprehending the complex interplay between technological components and user actions (Saraswathi & Ramakrishnan, 2021). This model offers a valuable perspective on the underlying dynamics that drive students' behaviour during their virtual reality digital display interactions.

Additionally, an exploration of the impact of virtual reality digital display on students' human-computer interaction experience further underscores the significance of this emerging technology (Koehler et al., 2018). By evaluating the quality of interaction experiences, this analysis underscores the pivotal role virtual reality digital display plays in enhancing engagement, thereby highlighting its potential as an effective educational tool.

Lastly, building on previous research, this study proposes an innovative service strategy for virtual reality digital display tailored to student interactions. Collectively, the study advances the understanding of human-computer interaction processes in virtual reality settings, laying a robust theoretical foundation for continued exploration in this dynamic domain and the formulation of a comprehensive theoretical framework.

Drawing upon the theory of human-computer interaction processes and integrating distributed cognitive theory, rational behaviour theory, and visual perception theory, this study embarks on an in-depth analysis of the intricate mechanisms through which virtual reality (VR) digital displays influence students' human-computer interaction behaviours (Bolchini et al., 2020; Fuchs et al., 2017; Sengupta & Chaudhury, 2019). Employing cluster analysis, the research delves into the nuanced characteristics underlying VR digital displays' impact on students' human-computer interaction behaviours, uncovering patterns that shed light on the interaction dynamics (Hu & Sun, 2018).

Venturing deeper into the realm of human-computer interaction, this paper scrutinizes the determinant factors underpinning VR digital displays' influence on students' human-computer interaction behaviours, offering a holistic understanding of the intentions that drive these behaviours (Llobera et al., 2017; Sengupta & Chaudhury, 2019). Furthermore, this study differentiates between gender groups and distinct interaction modes, elucidating how VR digital displays' impact on human-computer interaction behaviours can diverge based on these contextual variables (Freina & Ott, 2015; Habib & Chua, 2019).

Simultaneously, with a focus on students' experiential facets, the research examines VR digital displays through a multidimensional lens encompassing interactive systems, content, functions, interfaces, and the subjects' perspectives (Sengupta & Chaudhury, 2019; Zhang et al., 2021). By engaging with these diverse dimensions, the study constructs an evaluative index system for students' experiences

with VR interactive digital displays, enhancing the ability to predict and enhance students' engagement and satisfaction in the VR environment (Xiao et al., 2019).

In a broader context, this study contributes to the burgeoning field of virtual reality digital display research by providing an innovative lens to comprehend students' interactions and experiences within this immersive technology (Chang et al., 2017; Lei et al., 2020). Through an interdisciplinary framework that encompasses human-computer interaction theories, cognitive perspectives, and visual perception principles, this research not only enhances the theoretical understanding of VR's impact on human-computer interaction behaviours but also offers practical insights for innovative student services within the realm of virtual reality digital displays.

This study serves as a pivotal pillar in constructing and refining the virtual reality (VR) digital display platform by offering a solid theoretical underpinning. In today's dynamic landscape, virtual reality has seamlessly integrated itself into students' lives as an indispensable platform for communication, learning, and leisure (Xiao et al., 2019; Zhang et al., 2021). Recognizing the significance of utilizing the virtual reality platform to provide tailored, interactive, captivating, and immersive digital display services, this research addresses a central challenge in shaping the landscape of virtual reality digital display services (Freina & Ott, 2015). The culmination of these endeavours not only contributes to optimizing current virtual reality digital display systems but also lays a robust theoretical groundwork for the construction and evolution of virtual reality digital display service platforms, thus carving a path towards an enriched immersive experience for users.

The field of digital display is still in its nascent stage when it comes to virtual reality (VR) technology, with its product formulations and service models yet to mature. This necessitates substantial time and effort for exploration and advancement (Freina & Ott, 2015; Sengupta & Chaudhury, 2019). A primary challenge hampering the broader adoption and progress of VR digital displays lies in the intricate and multifaceted nature of the systems involved (Chang et al., 2017).

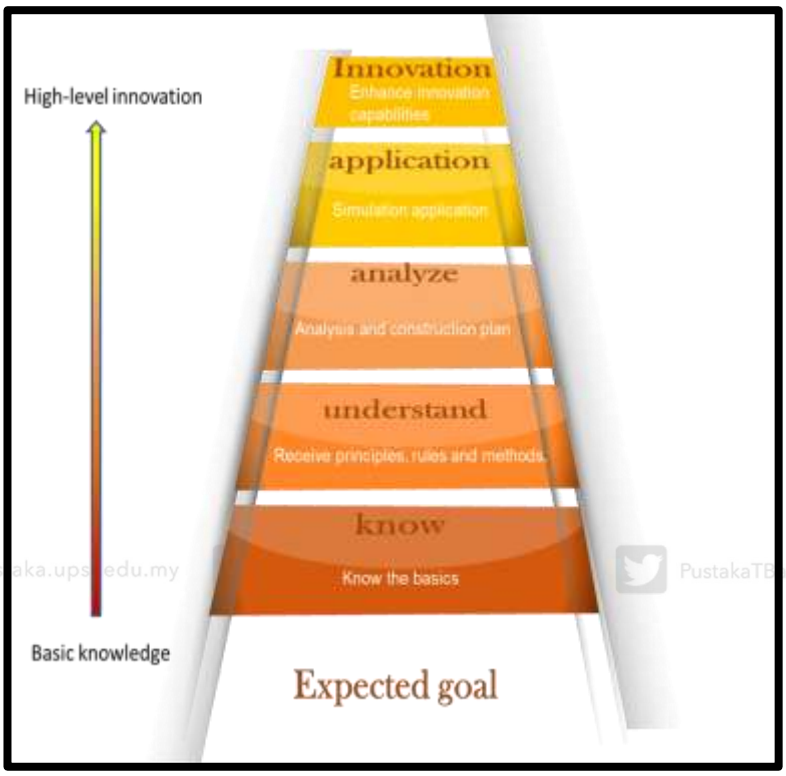
This study undertakes a systematic analysis of students' interactive behaviours in the VR environment, while simultaneously proposing an evaluation framework to assess each facet of students' interactive experiences (Llobera et al., 2017). The aim is to comprehend the efficacy of VR digital display interactive systems in the context of student engagement. Consequently, the insights drawn from this research are poised to substantially benefit VR digital display service providers by informing the optimization of their interactive systems.

In the virtual reality domain, the interaction between students and VR devices significantly hinges on students' information requirements and their capacity to assimilate information. Given the diverse forms and carriers of information within the virtual environment, students must not only possess competencies in information processing but also adeptness in information technology (Hu & Sun, 2018). This study's analysis of VR's influence on students' interactive behaviours allows for the identification of patterns, enabling personalized guidance for students. Leveraging the identified influencing factors of VR digital display on students' human-computer interaction behaviours, this research also offers valuable insights to enhance the

dissemination of VR technology and augment students' prowess in the realm of virtual reality (Bolchini et al., 2020; Lei et al., 2020).

Figure 1.1

Expected Goal



From Figure 1.1, the influence of VR on students are based on their expectation goal. Student's basic knowledge will increase towards the high-innovation level when students are able to gain basic knowledge on VR. Later, when students are able to receive principles, rules and methods of VR, their understanding increase their level of knowledge about VR and it enhances students' ability to analyse and construct plan and through the application of VR in teaching and learning, it aids towards students'

innovation capabilities through their experiences in the simulation at the application level.

Conventional display has been used to display a single message and can only be updated with great time and effort as compared to digital display which can rotate through multiple messages to attract the attention of numerous audiences. Digital display offers a variety of information and messages that enables users to have interactive experiences. Conventional display offers similar information yet it is limited and constrained. Users may not be able to experience real-situation experiences and this leads to the vast use of digital display nowadays. Based on TAM model theory, the acceptance of the technology by users are dependent on factors such as perceived usefulness and perceived ease of use. Through this model, the digital display will be fully accepted by users if they perceive that this technology is useful and easy to be used in their daily life.

Thus, the acceptance of the technology among users will determine their behaviour and interactive experiences which lead to their willingness to accept the technology implementation in their life. However, certain users who prefer the conventional display may have a sceptical point of view towards the digital display. There are issues on the digital display which may become the obstacles in the acceptance of technology.

VR digital display can be regarded as a behaviour of digital display in a virtual environment. In this environment, virtual reality technology provides students with immersive experience through the depth and breadth of sensory information and

interactive student interface. Student interactive behaviour is the basis of student experience. Although virtual reality technology can enhance student experience, it should make effective use of technology and be easy for students to obtain and adopt. The traditional digital display only transmits information through pictures and words. Some scenes can only rely on imagination. Students can't understand the world described by words. VR digital display shows richer and wider information and enhances the visual effect of information. When students use virtual reality technology, their vision, hearing, even touch, smell and taste are stimulated by the virtual environment, eliminating the cognitive block caused by time and space, and making many details clearer. At the same time, interactivity is also an important feature of VR digital display. Virtual reality technology provides consumers with a more vivid and interactive experience than traditional media.

Embedded within the dynamic tapestry of the Technology Acceptance Model, the intricate interplay between perceived usefulness, perceived ease of use, content engagement, interactivity design, attitudes, and gender in the digital virtual reality domain emerges as a critical focal point, shaping the contours of effective pedagogical strategies, immersive learning experiences, and the unfolding narrative of technology's role in advancing educational landscapes.

1.3 Problem Statement

Traditional education in many Chinese universities has long relied on didactic teaching and rote learning (Chang et al., 2020), which often results in limited student

engagement and underdeveloped critical thinking. Similarly, conventional design education especially in the context of exhibition design requires physical setups that are time-consuming, costly, environmentally unsustainable, and space-restrictive (Pang et al., 2019; Zhao et al., 2019). These challenges constrain experiential learning and limit innovation among students.

The integration of digital virtual reality (DVR) in education has emerged as a promising alternative, offering immersive and interactive learning environments that overcome physical limitations and support creative expression (Kang et al., 2021; Lei et al., 2020). For example, VR displays allow students to experience dynamic 3D exhibitions, simulated environments, or narrative worlds that enhance interaction and conceptual understanding. In this study, students from first-year design-related programmes in Gansu Province experienced similar DVR environments featuring educational VR content delivered through head-mounted displays in guided sessions. However, despite growing access to such technologies, the extent to which students engage with DVR along with their willingness to adopt it remains poorly understood.

Current literature has yet to provide a comprehensive model explaining how various factors including perceived usefulness, perceived ease of use, content engagement, and interactivity design influence students' attitudes and interaction behaviours in DVR settings (Baker et al., 2020; Bae, 2019). Moreover, there is limited understanding of how gender may moderate these relationships (Chang et al., 2017). Prior studies have primarily focused on general technology acceptance, often neglecting the nuances of immersive VR environments and students' behavioural responses within them (Ijsselsteijn et al., 2016; Nacke & Lindley, 2018).

Thus, there is a clear need to explore how these interrelated factors shape student experiences and adoption behaviours in educational VR settings. This study addresses that gap by developing and validating a survey-based model grounded in the Technology Acceptance Model (TAM). It specifically investigates the influence of students' attitudes on their interaction behaviour and willingness to use DVR, and explores gender as a potential moderating variable. The findings are expected to inform the design of more effective, inclusive, and engaging DVR learning environments.

1.4 Research Objective

To guide the direction of this study, a set of research objectives has been formulated based on the Technology Acceptance Model (TAM) and the unique characteristics of digital virtual reality (DVR) in educational settings. These objectives aim to investigate the key factors influencing students' interaction behaviour and willingness to use DVR, while also exploring the mediating role of attitudes and the moderating influence of gender. The following objectives have been structured to address the central issues outlined in the problem statement and to provide a clear framework for empirical analysis.

This study will be conducted by coordinating these research objectives:

1. To identify factors impacting students' attitudes, interaction, and willingness in digital virtual reality.
2. To develop a model for factors influencing students' attitudes, interaction, and willingness in digital virtual reality.

3. To explore the mediating role of attitudes between factors influencing students' interaction and willingness in digital virtual reality.
4. To investigate gender as a moderating factor between influences on students' interaction and willingness in digital virtual reality.

1.5 Research Questions

Based on the TAM model and the characteristics of VR digital display, this study is going to construct the influencing factor model of students' interactive behaviour in virtual reality digital display from the perspective of the interactive behaviour and information acquisition process of virtual reality in digital display experience, and tries to answer the following research questions:

1. What are the key factors influencing students' attitudes, interaction behaviour, and willingness to engage with digital virtual reality in educational contexts in China?
2. How do these factors interplay to shape students' attitudes, interaction behaviour, and willingness in the digital display of virtual reality?
3. What is the mediating role of students' attitudes in the relationship between influencing factors and their interaction behaviour and willingness in digital virtual reality?
4. To what extent does gender moderate the relationship between influencing factors and students' interaction behaviour and willingness in digital virtual reality?

1.6 Research Hypotheses

This study constructs a conceptual model of influencing factors of virtual reality reading user interaction behaviour. This led to the hypothesis as follows:

Direct Effects – Main Hypotheses

H1: There is a significant relationship between attitudes and students' interaction behaviour and willingness in the digital display of virtual reality.

H2: There is a significant relationship between perceived ease of use and students' attitudes, interaction, and willingness in the digital display of virtual reality.

H3: There is a significant relationship between perceived entertainment and students' attitudes, interaction, and willingness in the digital display of virtual reality.

H4: There is a significant relationship between perceived usefulness and students' attitudes, interaction, and willingness in the digital display of virtual reality.

H5: There is a significant relationship between perceived reliability and students' attitudes, interaction, and willingness in the digital display of virtual reality.

H6: There is a significant relationship between gender and students' interaction behaviour and willingness in the digital display of virtual reality.

Moderation Effect – Main Hypothesis

H7: Gender moderates the relationship between attitudes and students' interaction behaviour and willingness in the digital display of virtual reality.

Mediation Effects – Main Hypothesis

H8: Attitudes mediate the relationship between predictor variables (perceived reliability, entertainment, usefulness, ease of use) and students' interaction behaviour and willingness in the digital display of virtual reality.

1.7 Research Significance

This study carries profound significance for various stakeholders within the domains of education, technology, and research. Educational practitioners stand to gain invaluable insights that can directly inform their instructional practices. By comprehending the factors influencing students' interaction behaviour and willingness in the digital virtual reality landscape, educators can tailor their approaches to foster optimal engagement and meaningful learning experiences.

Technology developers will find this study pivotal in refining their digital virtual reality offerings. Armed with an enriched understanding of the factors impacting user engagement, developers can fine-tune interactive elements and content, leading to enhanced user experiences and heightened adoption rates. Instructional designers will benefit from concrete insights that will guide the creation of digital virtual reality content. By aligning with student preferences and motivations, designers can craft immersive learning experiences that captivate and educate effectively.

Within the academic community, this study's contribution is two-fold. The comprehensive model and insights derived will extend scholarly discourse, enriching existing theories and frameworks in the realm of educational technology. Moreover, this research will inspire and shape future investigations, steering the trajectory of research within this burgeoning field.

This study's ramifications extend to pedagogical innovation. By uncovering the variables shaping interaction behaviour and willingness, the research paves the way for inventive teaching methods that maximize the potential of digital virtual reality for immersive and impactful learning experiences. Institutional decision-makers will find practical utility in the findings. This nuanced understanding can guide strategic decisions regarding technology integration, resource allocation, and curriculum development, fostering an environment conducive to effective digital virtual reality integration.

Ultimately, the study contributes to the broader educational landscape. Its insights ripple through educational practices, technological design, academic inquiry, pedagogical innovation, and institutional strategy, collectively enriching the quality of education in the era of digital virtual reality. The main research content is to apply virtual VR technology, combined with flash, Photoshop, 3D, and other technologies to the digital interactive experiment of display design, and make a set of teaching resources suitable for students' operation through the organic combination of a large number of interactive means such as text, picture, video, sound, animation and video, so as to solve the problem of students' low interest in learning Poor spatial imagination. From the perspective of human-computer interaction process, based on the relevant

research of scholars at home and abroad, this paper deeply analyses the process mechanism of virtual reality in digital display of middle school students' interactive behaviour.

Through implementing the research methods, this study analyses the characteristics and influencing factors of students' interactive behaviour in digital display of virtual reality, and constructs the evaluation index system of interactive system on the basis of the above research results; Finally, based on the main research results of each core chapter, this paper puts forward innovative service strategies for the digital display of middle school students' interactive experience of virtual reality.

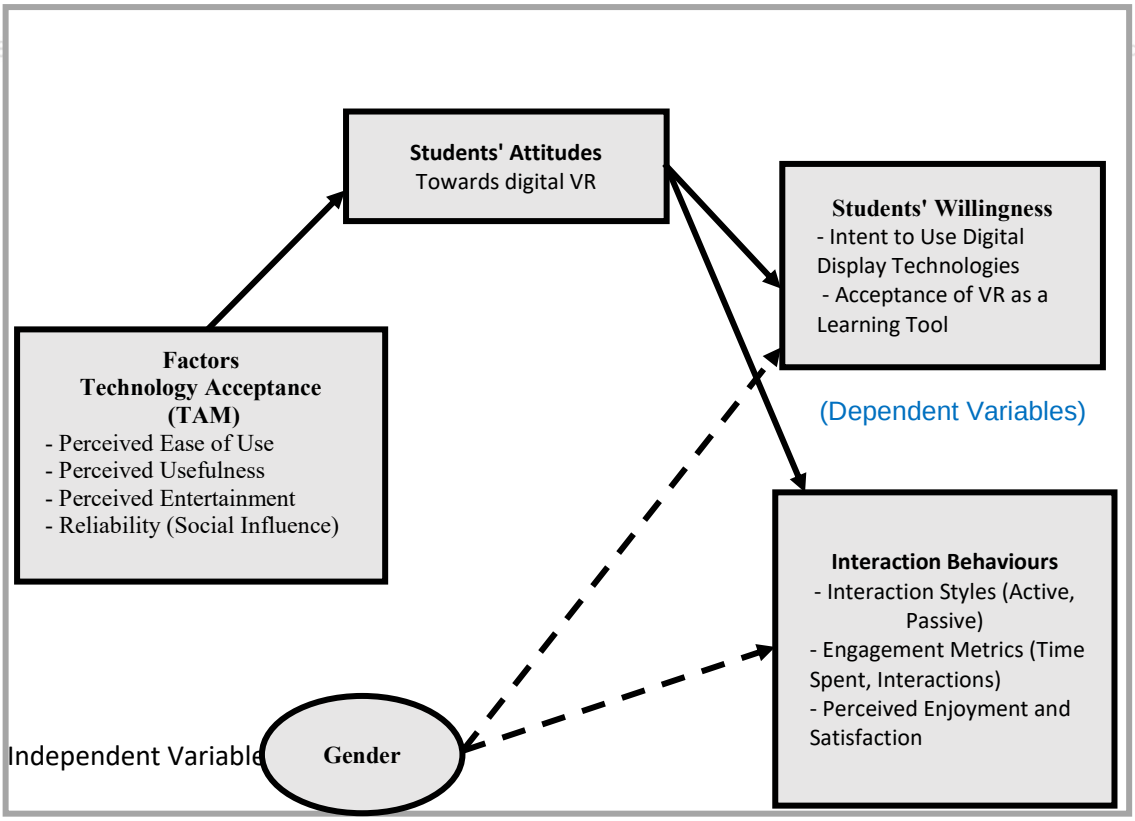
1.8 Conceptual Framework

The development of an influencing factors model (Figure 1.1) for virtual reality reading users' interaction behaviour involves an in-depth exploration of various dimensions. This model explores the intricate relationship between several key variables, encompassing perceived information, perceived interaction, perceived usefulness, perceived ease of use, perception and reading, use attitude, and interaction behaviour intention among virtual reality reading users (Davis, 1989; Davis et al., 1989; Venkatesh & Davis, 2000). It is crucial to emphasize that these variables are inherently intertwined, revealing a complex web of dependencies that influence user experiences within the virtual reality reading environment.

Underpinning this model is the assumption that each of these influencing factors positively contributes to the user's sense of pleasure while engaging with the virtual reality reading environment (Alzahrani et al., 2020; Kim et al., 2017). Moreover, it is posited that each factor has a constructive impact on enhancing perceived usefulness, thereby augmenting the overall sense of pleasure experienced by the user (Venkatesh et al., 2003). Empirical validation of these relationships was sought through a comprehensive questionnaire-based survey, which yielded valuable insights into the users' interactions with virtual reality reading environments (Venkatesh et al., 2003; Venkatesh & Davis, 2000).

Figure 1.2

The Conceptual Framework



The conceptual framework illustrates the relationships among key constructs in this study, aligned with the Technology Acceptance Model (TAM). The independent variables include perceived usefulness, perceived ease of use, entertainment, and reliability. These factors influence students' attitudes towards digital virtual reality, which in turn mediate their interaction behaviour and willingness to use DVR. Gender acts as a moderating variable, affecting the strength or direction of the relationship between attitudes and the dependent variables. This structure resolves the earlier misclassification of variables and ensures alignment with the research objectives and hypotheses.

Illustrated by the visual representation in Figure 1.2, the intricate interplay between virtual reality and user behaviour comes to the fore (Alzahrani et al., 2020; Davis, 1989). The intricate network of connections delineated in the figure underscores the intricate synergy between each component, signifying their mutual influence on one another (Kim et al., 2017). The comprehensive scope of this model underscores the multifaceted nature of virtual reality reading experiences, where each facet bears significance in shaping users' willingness to interact with the virtual reality environment (Davis et al., 1989; Venkatesh & Davis, 2000).

The conceptual framework illustrates the interplay between various factors influencing students' interaction behaviour and willingness in the context of digital virtual reality. The framework incorporates both direct relationships and moderating influences, highlighting the role of attitudes as a mediator in this complex dynamic.

Independent Variables:

1. **Perceived Usefulness (PU):** Students' perception of the value and benefits of digital virtual reality.
2. **Perceived Ease of Use (PEOU):** Students' perception of the ease with which they can interact with digital virtual reality.
3. **Content Engagement:** Students' level of engagement with the content presented in digital virtual reality.
4. **Interactivity Design:** The quality and design of interactive elements within the digital virtual reality.

Mediating Variable:

5. **Attitudes towards Digital Virtual Reality:** Students' overall attitudes and sentiments toward using digital virtual reality for learning and engagement.

Dependent Variables:

6. **Interaction Behaviour:** Students' actual behaviour and engagement patterns while interacting with digital virtual reality.
7. **Willingness to Use:** Students' readiness and intention to actively and consistently use digital virtual reality.

Moderating Variables:

8. **Gender:** The moderating influence of a student's gender on the relationships between the mediating variable and the dependent variables.

The framework demonstrates how perceived usefulness, perceived ease of use, content engagement, and interactivity design directly impact students' interaction behaviour and willingness. Additionally, attitudes towards digital virtual reality mediate these relationships, helping explain how the independent variables collectively influence the dependent variables. Gender serves as moderator, influencing the strengths and directions of these relationships based on the students' demographic and cognitive attributes.

By incorporating these variables and their interconnections, the conceptual framework provides a comprehensive depiction of the intricate dynamics shaping students' interaction behaviour and willingness in the digital virtual reality context.

1.9 Scope and Limitations

This study will involve first-year students officially enrolled in Gansu province from 2021 to 2022. It is estimated that about 1621 college students in Grade 1 will be participating in the experiment as subjects, involving 325 males and 1296 females. The respondents will answer the questionnaire and later will be randomly selected for an interview session by researchers. The involvement of both genders is to justify the research objective and hypothesis of this study.

This research focuses on investigating the factors influencing students' interaction behaviour and willingness in the context of digital virtual reality displays. The study aims to provide a comprehensive understanding of how variables such as

perceived usefulness, perceived ease of use, content engagement, and interactivity design collectively shape students' attitudes, interaction behaviour, and willingness. The investigation encompasses a diverse student population and various educational settings, aiming to capture a holistic view of the phenomenon.

1.10 Delimitations

This study on students' interactive behaviour and attitudes in the virtual reality digital display environment acknowledges specific delimitations that frame its scope and parameters.

1.10.1 Population and Sample

The study focuses exclusively on first-year students officially enrolled in Gansu Province during the academic years 2021-2022. Consequently, findings may not generalize to students from other academic levels or institutions, potentially limiting the broader applicability of results.

1.10.2 Time Frame

Data collection for this study is confined to the academic years 2021-2022, reflecting the time constraints of the research period. The short-term scope may not capture long-

term trends, developments, or changes in students' interactive behaviour and attitudes beyond this timeframe.

1.10.3 Data Collection Methods

This study employs a structured questionnaire as its primary data collection method. While questionnaires offer valuable insights into participants' perspectives, the reliance on self-reported data may introduce response bias and social desirability effects, potentially affecting the accuracy and objectivity of findings.

In essence, these delimitations delineate the study's boundaries, emphasizing the specific context, time frame, and methodologies embraced. While the study contributes valuable insights within these confines, these delimitations underscore the importance of interpreting findings within the specified parameters.

1.11 Operational Definition

1. **User Behaviour:**

   User behaviour refers to the observable actions and engagement patterns exhibited by students when using digital virtual reality (DVR) systems for educational purposes (Ouellette & Wood, 1998). It captures how students navigate, respond, and engage with the learning material presented in immersive environments. In this study, user behaviour is measured through system-generated logs, capturing metrics

such as session duration, frequency of interactions (e.g., clicks, navigations), and specific activity sequences within the DVR environment. This operationalisation is particularly suitable because it provides objective, real-time data on how students actually behave during DVR sessions, rather than relying solely on self-reported perceptions. It is widely used in educational technology research where behavioural engagement is a key outcome. For first-year college students in Gansu Province many of whom may have varying degrees of digital proficiency—this method ensures an unbiased measure of their interaction patterns, accommodating differences in self-reporting ability. Furthermore, since the study focuses on exploring the links between behaviour, attitudes, and willingness to adopt DVR, having a behaviourally grounded, system-based measurement aligns directly with the research questions aimed at understanding actual usage and engagement in practice.

2. **Interactive Experiences:**

Interactive experiences denote the degree to which students actively engage and respond within DVR environments, including their sense of immersion, agency, and responsiveness (Freina & Ott, 2015). This construct is measured using a Likert-scale questionnaire assessing perceived control, immersion, enjoyment, and interactivity during the DVR session. This operationalisation is appropriate for capturing subjective user experiences, especially in a learning environment where emotional and psychological immersion significantly influence educational outcomes. For this study's population of novice university students, self-reported perceived interactivity provides insight into how DVR affects motivation and active learning.

3. **Virtual Interaction:**

Virtual interaction refers to the dynamic, computer-mediated communication and engagement between users and simulated entities or environments (Li et al., 2019; Cao et al., 2005). In this study, virtual interaction is assessed through structured observation and self-reported ratings on a scale evaluating realism, responsiveness, and depth of interaction with virtual elements. This method enables the triangulation of observed behaviour with users' own perceptions, providing a nuanced view of how natural and effective the virtual interactions are. This is particularly useful in an educational setting where perceived realism may affect a student's willingness to participate.

4. **Virtual Reality:**

Virtual reality refers to an immersive digital environment that simulates real-world experiences using sensory cues, often facilitated by head-mounted displays (HMDs) (Beck, Rainoldi, & Egger, 2019; Sutherland et al., 2018). For this study, students' exposure to VR is measured by asking participants to indicate their familiarity, frequency of use, and comfort level with VR hardware and software. This operationalisation helps contextualise participants' prior experience with the technology, which could influence both their learning behaviour and perception of usefulness. It is especially relevant for a diverse student sample with varying exposure to advanced digital technologies.

5. **Virtual Interaction Technology:**

This construct encompasses the tools and devices that enable interaction in VR environments, including headsets, controllers, and haptic systems (Li et al., 2019).

Students evaluate the effectiveness of these technologies via a usability scale assessing ease of use, responsiveness, comfort, and system reliability. Evaluating the technology itself provides insight into usability factors that may act as enablers or barriers to student interaction. It is appropriate for this research as it identifies potential external factors that affect user engagement and acceptance.

6. **Digital Display:**

Digital display refers to the electronic presentation of multimedia content through screens or projectors (Weisschadel, 2022). In the context of this study, it is measured by students' feedback on visual clarity, information richness, display responsiveness, and engagement via a self-administered questionnaire. This construct is crucial for understanding how the visual quality of DVR content affects learning and user engagement. The self-report format captures subjective impressions that may influence attitudes and willingness to use DVR.

7. **Perceived Usefulness (PU):**

PU captures students' beliefs that using DVR will enhance their learning performance. This is operationalised using a Likert-scale survey with items adapted from validated TAM instruments (Davis, 1989; Venkatesh et al., 2003).This approach aligns directly with the TAM framework, making it appropriate for understanding motivational factors behind technology acceptance. It reflects the core of the research aim whether students find DVR educationally beneficial. Operationally, Perceived Usefulness (PU) will be measured using a Likert-scale questionnaire assessing students' agreement with statements related to the benefits and value they perceive in using digital virtual reality for learning.

8. Perceived Ease of Use (PEOU):

PEOU pertains to students' assessment of the simplicity and user-friendliness of their interactions with digital virtual reality systems for educational purposes (Davis, 1989; Venkatesh et al., 2003). It will be assessed through a survey where students rate their agreement with statements that evaluate the ease of interacting with digital virtual reality platforms. This measure is vital for understanding whether technical barriers influence students' willingness and attitudes. Given the target population of new university students, assessing ease of use helps determine the accessibility of DVR tools.

9. Content Engagement:

Content engagement gauges the level of students' active participation and immersion in educational content presented via digital virtual reality displays (Bakker et al., 2014; Doyle & Chen, 2013). For this study, it will be quantified by analysing students' duration of interaction, frequency of interactions, and depth of engagement with specific educational content within digital virtual reality environments. This dual-method approach is appropriate as it blends objective behavioural data with subjective insights, offering a fuller picture of student engagement. It directly informs the research questions on interaction and willingness.

10. Interactivity Design:

Interactivity design assesses the perceived quality and functionality of interactive features embedded in DVR content. It is evaluated via expert reviews and student ratings focusing on responsiveness, intuitiveness, and user control (Chen & Pu, 2018; Hsiao et al., 2019). This operationalisation allows researchers to assess the

impact of content design quality on learning and user satisfaction. In the context of this study, it identifies how design influences students' decisions to engage with DVR systems.

11. Attitudes towards Digital Virtual Reality:

This refers to students' overall disposition, emotional responses, and sentiments regarding the adoption of digital virtual reality for educational engagement and learning (Ajzen, 1991; Venkatesh & Davis, 2000). Attitudes towards Digital Virtual Reality will be captured using a scale that measures students' emotional disposition, beliefs, and sentiments toward the integration of digital virtual reality in education. This operationalisation is critical for capturing the mediating role of attitudes in the study model. It supports exploration of how students' evaluations influence their interaction and willingness to adopt DVR.

12. Interaction Behaviour:

Interaction behaviour encompasses observable actions, responses, and engagement patterns displayed by students while interacting with educational content via digital virtual reality displays (Ouellette & Wood, 1998; Venkatesh & Davis, 2000). For this study, it will be captured through video recordings and tracking of students' actions, gestures, and engagement patterns while interacting with digital virtual reality content. This approach ensures that engagement is measured in real-time, minimising bias and capturing authentic behaviours. It complements survey data and supports a behaviourally focused interpretation of student interaction.

13. Willingness to use:

Willingness to use captures students' readiness and intention to actively and consistently interact with digital virtual reality systems for educational purposes (Fishbein & Ajzen, 1975; Venkatesh & Davis, 2000). Willingness to use reflects students' readiness and intent to consistently adopt DVR in their learning. It is operationalised through a questionnaire measuring behavioural intention, perceived value, and likelihood of future use (Fishbein & Ajzen, 1975; Venkatesh & Davis, 2000). As a dependent variable, this construct is central to the study's goal of predicting technology adoption. The self-report format is suitable for gauging internal intention, especially among students who are exploring DVR for the first time.

1.12 Chapter Summery

Chapter one introduces the research focus on factors shaping students' interaction behaviour and willingness within the digital virtual reality landscape. It establishes the significance of the study, highlighting gaps in existing literature and the need for comprehensive insights into the complex interplay between perceived usefulness, perceived ease of use, content engagement, interactivity design, attitudes, and gender. Research questions are formulated to unravel these relationships, considering the mediating role of attitudes and the moderating influence of. The chapter outlines the practical implications for educators, technology developers, and researchers, while acknowledging limitations inherent in the research design. The conceptual framework

provides a visual guide to the intricate dynamics under investigation, paving the way for the subsequent exploration into students' engagement in digital virtual reality.