

**Learning Art Through Virtual Museums: A Qualitative Study of
Art Students in Higher Education in Saudi Arabia**

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higher education in Saudi Arabia

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Abstract

Immersive virtual reality technology is becoming a powerful tool for museums to promote learning. Adopting a qualitative approach, this study investigates how experiencing immersive virtual museums through a head-mounted display affects Saudi Arabian art learners' experiences, focusing on their sense of presence and flow. It also investigates the effect of that experience on their attitudes toward using immersive virtual museums for learning art and their intention to use such resources in the future.

Thematic analysis of data from 30 interviews, revealed the effective role of immersive virtual museum in art learning. Art learners experienced a sense of presence in an immersive virtual museum, enhancing their perceptivity and appreciation of both the museum and its content, surpassing traditional art sources. Additionally, it promoted a flow state, encouraging active engagement and connection. Appreciation and connection are aspects that have been insufficiently addressed in prior research on the effect of immersive virtual museum experiences. The findings demonstrated participants' positive attitudes toward the use of immersive virtual museums and their intention to use them in the future. This finding offers insights into the reasoning behind art learners' attitudes and intentions, enhancing understanding of their perspectives.

The findings provide unique insights into how the art learning experience can be improved through the use of virtual reality headsets, which allow users to actively explore the museum's content, enabling the construction of more meaningful learning experiences. The study advocates for universities to invest in virtual reality technology and collaborate with museums and technology developers to improve content quality. Integrating immersive virtual museums into university curricula and expanding access to these technologies can make art learning more effective. The COVID-19 pandemic has accelerated the shift

towards digital museum experiences, enhancing accessibility, improving art education opportunities for a wider range of learners and preparing learners for a digital future.

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Author's declaration

I declare that this thesis is my own work and has not been submitted in substantially the same form for the award of a higher degree elsewhere. I confirm that the word length of the thesis is within the permitted maximum.

Signature

Chapter 1: Introduction and Background

1.1 Introduction

Museums around the world are increasingly employing immersive virtual reality technology to make their content more accessible to the public as well as to facilitate education; this application of virtual reality technology has shown rapid growth over the last decade, fostering a more meaningful learning experience and helping learners develop a better understanding of the learning context (Xu et al., 2022). Numerous institutions have adopted this technology to digitise materials and make learning more interactive, with its implementation increasing as the technology becomes more sophisticated and affordable (Hutson & Olsen, 2022). Since the COVID-19 pandemic in 2020, educational institutions have rapidly adopted various digital technology tools to facilitate online learning (Yow, 2022). Higher education, in particular, has witnessed a growing interest in delivering academic materials in a digital format (Dumford & Miller, 2018; Yow, 2022). Universities are increasingly seeking to employ online as well as in-person learning (Roberts et al., 2024). In this “dual mode” of education, students are able to pursue their work entirely online, as an alternative to in-person educational experiences which are also available on campus. Dual mode delivery is defined by Robert's et al (2024) as "the delivery of an educational unit in a manner that can be undertaken equitably in both fully online and on-campus delivery modes" (p. 241) so that “all participation modes lead to equivalent learning” (p. 241). To this end, virtual museums can provide an alternative to museum visits for online learners however, they can also provide access to museums for learners that are geographically distant thus extending the reach of museums.

Following this trend, education and training have seen more active incorporation of virtual reality technologies across a variety of domains, which in turn has led to more research in this area (Radianti et al., 2020). In their study, Radianti et al. (2020) found that the most commonly discussed domains in the literature related to virtual reality in education from 2009 to 2018 have been medicine (78%), social science (15%), neurobiology (11%), and psychology (11%), while 18 publications were particularly relevant to the immersive elements of these environments.

Since the 1990s, immersive virtual reality has revolutionised how materials are delivered to learners in higher education (Biocca & Levy, 1995; Hutson & Olsen, 2022). The initial application of head-mounted simulation displays can be traced back to flight training during the 1960s and the 1970s (McLellan, 1996). Virtual reality head-mounted displays give users an immersive experience resulting in a sense of “being” within the virtual environment (Radianti et al., 2020). This technology has since become more and more widely available (and affordable) to universities, students, and the general public.

In one study, Chavez and Bayona (2018) investigated the various characteristics of virtual reality that appeared to contribute the most to its effective implementation in education and the positive effects it could have on students’ learning outcomes. Twenty-four characteristics of virtual reality were defined in their study, including interactivity, immersion interface, animation routine, movement, and the simulated environment. Additionally, they defined 17 positive potential consequences of virtual reality, some of the most prominent of which were better learning outcomes, valuable life experience, enhanced intrinsic motivation, increased interest in learning, and improved skill development among students. Such results have encouraged numerous researchers to study the different effects that this technology can have in a wide variety of disciplines.

Immersive virtual reality technology has been used for years in physical museums to enhance displays, engage modern audiences, and promote cultural awareness (Hutson & Olsen, 2022). According to Hutson and Olsen (2022), the digitisation of cultural heritage sites began in 2001, and virtual reality was implemented by several museums as an “edutainment” tool from 2001 to 2010, i.e., combining educational goals with an entertaining format. Roussou (2001) described how museums benefit from this technology by referring to the virtual environments developed by the Foundation of the Hellenic World (FHW), an Athens-based cultural heritage institution using CAVE technology to digitally reconstruct ancient cities. Later, 2011 witnessed the launch of more and more virtual museums, such as the Google Arts and Culture Museum Views, while an increasing number of sites were mapped between 2017 and 2020, facilitating full virtual visits of UNESCO World Heritage Sites and the digitisation of museum collections. This process has facilitated the study of often inaccessible works and

fostered more scholarly collaboration by increasing the availability of historical art resources to more people around the world.

As a result of the developments mentioned above, virtual museums have played a significant role in fostering interactive and lifelong learning while increasing access to museum content (İşlek & Aşıksoy, 2019) all while letting people learn by doing and experiencing (Sookhanaphibarn & Thawonmas, 2009). Various previous studies have shown how immersive virtual reality can be especially useful in art history education, for example, by allowing students to examine paintings, interact with virtual 3D reconstructions of historical sites, and attend classes set within a virtual environment (Hutson & Olsen, 2022). Furthermore, virtual reality can help students see history in the context of relevant physical places.

Digital technology has had a particular influence on young learners who grew up in a world dominated by ubiquitous smartphones and personal computers (Hutson & Olsen, 2022). These devices influence every facet of their lives, including shopping, gaming, social interaction, and learning (Hutson & Olsen, 2022). This has given students the ability to obtain an incredible amount of information about essentially anything at any time (Brownridge, 2020; Hutson & Olsen, 2022). As a result, students are no longer confined to traditional classrooms; instead, this technology has enabled the development of more interactive learning environments in which students can progress at their own pace and are more motivated to concentrate on the subject matter at hand, as opposed to passively receiving ideas, insights, or a large quantity of information (Nanthanasit & Wongta, 2018).

The COVID-19 pandemic in 2020 accelerated the already rapid adoption of digital technology to support distance and online learning (Yow, 2022). It is expected that within the next decade, the immersive virtual reality technology that was originally implemented temporarily in educational institutions to cope with the demands of the pandemic will become widely used in higher education on a permanent basis (Hutson & Olsen, 2022). For example, due to the barriers to making physical visits to museums during the COVID-19 pandemic, Yow (2022) arranged for pharmacy students to take a virtual visit to an anatomy museum. This experience offered a real-world environment that facilitated a more self-

paced form of learning, which helped the participants understand their anatomy lectures more thoroughly.

By implementing immersive virtual reality to virtually transport students to different locations and cultures, it is becoming more and more possible to “level the playing field” for those who otherwise could not gain the direct, physical experience required to succeed in this and other fields (Hutson & Olsen, 2022). Despite this advantage, the majority of college courses, including architecture and the visual arts, continue to be taught in the traditional way, using lecturing with PowerPoint presentations of images and textbooks as visual aids (Alawad et al., 2015; Ben Ghida, 2020). Meanwhile, students frequently perceive the current pedagogical approaches that are employed in art history to be boring due to the large quantity of information that has to be memorised and the lack of contextualisation in different cultures (Hutson & Olsen, 2022). In contrast to this approach, virtual reality has shown the potential to engage students more actively by immersing them in a simulated environment, unlike earlier technologies that presented information and images that would be consumed passively (Alawad et al., 2015). Immersive virtual reality is strongly suitable for digital humanities and art history departments due to its ability to transport students to any location worldwide, including cultural sites and museums (Hutson & Olsen, 2022). Virtual museums can help students make their learning more productive, feel more immersed in the topic at hand, engage and interact more actively, develop their understanding of the topic, and generally better appreciate what they see in the museum (Alawad et al., 2015), all of which helps convert learning modules into a more enjoyable format (İşlek & Aşıksoy, 2019).

According to a study by Hutson and Olsen (2022), a number of universities and libraries have adopted virtual reality technology on their campuses. For example, undergraduate students in the University of Calgary typically visit labs in order to complement or fill gaps in classroom lectures, such as employing Google Earth VR to virtually examine locations of interest (e.g., the Parthenon in Greece or the Stonewall Riots in the United States), a strategy that avoids the funding requirements of a fieldtrip to the actual location. Another example is the library at the University of Oklahoma, which offers students head-mounted virtual reality displays. In addition, the library staff collaborate with faculty members to create various learning opportunities that take advantage of virtual reality. In

Australia and New Zealand, Dalgarno et al. (2011) noted that universities were increasingly using 3D immersive virtual environments through online, in-person, blended modes, with the latter two modes being more commonly found. In another example, at the University of the West of Scotland, Baxter and Hainey (2019) reported that the majority of students thought that using virtual reality could improve teaching and learning, although not all students were convinced of its merits.

The limited number of head-mounted displays typically available to students in undergraduate university classes imposes obvious restrictions on the use of virtual reality in class. However, developments in these displays that enable visual and auditory immersion at a lower price, have eliminated numerous barriers that previously hindered the widespread adoption of such displays in academia, making virtual reality easier to deliver to a larger and larger number of students (Bekele & Champion, 2019).

1.2 Study Context

Saudi Arabia, the second-largest Arab state by land mass, spans over two million square kilometres at the crossroads of Asia, Africa, and Europe (Central Department of Statistics and Information, 2024). The Directorate of Education, established in 1925, laid the foundation for the Saudi education system, which has evolved into a centralised and standardised curriculum under the Ministry of Education (Alhomaidi & Salleh, 2022; Alsaleh, 2017; Rugh, 2002). Education is free to the postgraduate level, with students receiving a monthly stipend (Rugh, 2002), reflecting the government's significant investment in promoting public education (Alhomaidi & Salleh, 2022).

Since its founding, and especially in recent years, Saudi Arabia has made substantial advancements within the public education sphere. As such, the government is seeking to further improve and modernise education, as well as other areas of society, through digital technology and e-learning, which are expected to offer higher-quality learning opportunities (Alsaleh, 2017; Central Department of Statistics and Information, 2024).

As part of Vision 2030, Saudi Arabia is seeking to revolutionise education through new technology (Alawad, 2013). The government has recently created new programmes in a wide variety of important disciplines, from medicine and

engineering to arts and history. Digital technology and services have been used to facilitate this transition to improve education and personal development. This transition is designed to cater to students living in a digital age where technology is pervasive, this includes people who have used devices such as mobile phones, tablets, and personal computers from an early age. The growth of higher education in Saudi Arabia began with the establishment of King Saud University in 1957 and the Ministry of Higher Education in 1975 (Alhomaiddi & Salleh, 2022; Alsaleh, 2017; Gazzaz, 2006). The number of universities increased rapidly from eight in 1998 to 67 in 2024. This current total consists of 29 public universities and 38 private universities, including a mix of comprehensive universities, colleges, and technical institutions that cater to a wide range of academic disciplines and professional fields (Ministry of Education, n.d.). This surge in the number of universities is a reflection of the country's growing investment in the area of higher education (Alhomaiddi & Salleh, 2022). These institutions offer Saudis a wider and wider variety of opportunities to study and conduct research and are thus expected to facilitate the country's advancement in terms of education and technology. For that reason, higher education is seen as central to the Vision 2030 national development plan, which seeks to diversify the economy away from a heavy dependence on fossil fuels through a stronger focus on innovation and human capital (Saudi Vision 2030, n.d.).

The Saudi Arabian government's growing focus on higher education is a reflection of the important role it plays in economic and social development (Alawad, 2013; Alsoud, 2022; Nolte-Yupari, 2017). King Saud University, where I worked and one of the universities that participated in the present study, offers a wide selection of programmes with an enrolment exceeding 60,000 students (King Saudi University, 2023). Furthermore, it places a great emphasis on research and international partnerships (King Saudi University, 2023).

Despite the considerable financial investments, the Saudi Arabian government has made in education and the progress that has been shown in recent years, various issues continue to challenge the education system in the sector's ongoing effort to modernise its methods and employ new technology (Alhomaiddi & Salleh, 2022). In this light, one of the goals of the Ministry of Education is to encourage a knowledge-based economy through the development of more critical thinking and problem-solving skills among learners

(Alhomaidi & Salleh, 2022). In this regard, the area of art education faces similar challenges to those of other disciplines due to institutions and teachers employing traditional methods of teaching that fail to encourage students to engage in creative activities or exercise their critical thinking skills, despite these skills being fundamental in art education (Alsaleh, 2017). For example, in these classes, educators frequently use few if any visual resources, such as videos or slides (Alawad, 2013). Additionally, there is a paucity of specialised art educators and resources dedicated to art programmes. Addressing these challenges requires innovative approaches, such as integrating immersive virtual museum experiences to enhance art learning. Such tools could help educators and learners get past these limitations by giving students broader exposure to art from around the world as well as by encouraging creativity (Alhomaidi & Salleh, 2022).

However, according to Alawad (2013), art teachers are often not enthusiastic about electronic media out of a concern that it could draw attention away from the actual content by focusing on presentational considerations, which they fear might take something away from the spirituality of art. In addition, computers and related technology are typically seen as being more relevant to areas such as science and mathematics as opposed to art appreciation.

Despite these concerns, there is a growing demand for digital technology in art classrooms because it enables students to have access to and share far more visual resources from a more diverse range of sources. Furthermore, it offers teachers with more flexible methods of teaching and evaluating a more diverse classroom. This technology can also be used to improve the relationship between the educator and their students, thus creating a learning environment full of dynamic interaction (Woolfolk et al., 2008).

As outlined above, based on the literature and my own professional experience, I have found several fundamental challenges facing the field of art education in Saudi Arabia. One of the biggest issues is an excessive focus on traditional ways of teaching and evaluating student learning, despite current efforts to modernise (Alsaleh, 2017). For instance, traditional methods of teaching tend to rely heavily on rote learning to the detriment of creativity, critical thinking, and related skills (Alhomaidi & Salleh, 2022). Alhomaidi and Salleh (2022) stated that geographical location norms restrict exposure to various art

forms, limiting students' artistic experiences. Furthermore, a lack of specialised educators and inadequate art education resources and technology exacerbate the problems above. While there is a push towards digitalising these resources, effectively integrating technology into art education remains a challenge. Within this context, online resources and digital technology are vital for students in Saudi Arabia seeking to access and share visual resources (Alawad, 2013). Nevertheless, such technology is still not typically used in Saudi Arabian higher education (Al Mulhim, 2014). Addressing these challenges requires innovative approaches, such as using immersive virtual museums to enhance the art learning experience.

Given the background outlined above, my motivation for researching the effect of immersive virtual museums on the art learning experience in Saudi Arabia arose from the need to address the existing challenges in art education and modernise the art learning experience. By leveraging virtual technology, this research aims to provide students with access to a wider range of global art, overcoming cultural, geographical and logistical limitations, which is essential for comprehensive art education. Furthermore, it seeks to use this technology to create interactive and engaging learning environments that cater to the diverse needs of art students and enhance the overall educational experience. The findings could inform educational policies and practices, potentially transforming art education in Saudi Arabia and similar contexts.

1.3 Significance of the Study

Virtual reality technology is becoming a powerful tool for learning, and numerous studies have investigated its effectiveness when used in formal education. Through a bibliometric analysis of 1,296 journal articles conducted between 1980 and 2019, González-Zama and Abad-Segura (2023) found that the most productive countries in this field were the United States, Spain, the United Kingdom, Canada, and Russia. Furthermore, those researchers found a growing global scientific trend that could represent an interesting area for future research: the development of virtual reality in arts education in the context of higher education. However, countries in the Middle East have made much more limited contributions to this area of study.

Furthermore, virtual museums emphasise the physical and visual aspects of history and art in a way that can make learning more productive (İşlek & Aşıksoy, 2019). However, university students typically learn about these topics through the use of less immersive visual materials, such as images of famous works in textbooks, PowerPoint presentations, and websites, which minimise the ability of these students to perceive dimensions, textures, and lighting that can be noticed when observing the original artwork in person. These limitations can at least partially be overcome through the application of virtual museums.

Virtual museums can serve as a powerful tool to increase students' access to and engagement with art from around the world, thereby facilitating history and art education (Kampouroupoulou et al., 2013). Such a tool could be a particularly attractive option in higher education in Middle Eastern countries, such as Saudi Arabia. This is because art students in this region typically do not have the opportunity to physically visit European museums, which contain the works of art of pioneers and some of the most famous artistic movements, depriving them of a direct visit experience to see the artworks and examine them closely. İşlek and Aşıksoy (2019) conducted a content analysis of research trends based on the studies conducted on the subject of virtual museums between 2014 and 2017 in the Taylor and Francis and Scopus databases. Of the 60 studies identified, only 13 were found to be related to art education. This indicates that the field would benefit from further investigation.

Despite the demonstrated effectiveness of using immersive virtual reality with undergraduate university students (e.g., Yow, 2022), the majority of research in an art learning context has addressed the effect of immersion on the learning experience without examining both presence and flow as factors in the same study. The concept of presence can be used to enhance an immersive virtual museum experience by making it more realistic; this can result in the user having a more positive attitude toward the experience and feeling as if they are actually inside that environment, thereby encouraging them to respond to virtual stimuli the way they would to physical stimuli in the real world (Hutson & Olsen, 2022). When people achieve a sense of presence in a virtual museum, this feeling makes them more likely to enjoy the museum and see it as a worthwhile use of their time. At the same time, the concept of flow can likewise be used to develop activities that are more fun, engaging, and immersive for the learner,

which can lead to learners thinking more profoundly about what they see in a virtual museum. As with presence, flow can also result in users having a more positive attitude toward the museum. Despite the value of both of these concepts, many studies have only examined presence, while others have been restricted to flow. In some art learning studies, flow was examined in different immersive environments, but not in an immersive virtual museum (e.g., Guerra-Tamez, 2023).

Most research into attitudes toward using digital technology have employed quantitative methods and tools, e.g. the technology acceptance model (Davis 1989) has been the main model in acceptance research (Vogelsang et al., 2013). This model focuses on how perceived usefulness and ease of use impacts on users' attitudes and their intention to adopt new technologies. However, few studies have qualitatively measured learner attitudes, or learner attitudes about virtual museums, despite such methods being encouraged over focusing entirely on quantitative methods (Hirschheim & Klein, 2012). Qualitative research methods could help to, more clearly and in detail, interpret students' attitudes and intentions from their perspectives. This gap in the literature suggests the need for further study in the field, especially in countries with comparatively less research of this type, such as Saudi Arabia.

With the above points in mind, a good option for Saudi Arabian art learners who are unable to visit museums hosting original artworks could be to visit an immersive virtual museum so that they can explore a recreation of the dimensions, textures, and lighting of the location. However, the interplay of art learning with the immersive virtual museum and educational context of people in Saudi Arabia has not been adequately examined in previous studies. Thus, investigating the sense of presence and the flow state within this population could help address this gap in the literature by revealing Saudi Arabian students' attitudes and intentions toward this type of museum.

1.4 Theoretical and Conceptual Underpinnings

The present study investigated an immersive virtual museum experience based on a combination of constructivist and humanist learning theories. Constructivism was chosen for this study due to its emphasis on the role of active participation in constructing knowledge through experiences and interactions with the world

(Piaget, 1972; Vygotsky, 1978). In this way, the theory was leveraged to help the researcher understand how effectively an immersive virtual museum could enhance the art learning experience. The key term in constructivism is active learning, which emphasises student engagement through activities that promote analysis, synthesis, and evaluation of class content (Bonwell & Eison, 1991). This theory is thus in alignment with the interactive nature of virtual museums. Research into museum-based learning has been deeply affected by Dewey, stemming from his work contributing to constructivist thinking, defining experience more broadly, focusing on how visitors experience museum exhibits, and the vital role played by inquiry as well as having a continuity of experience (Hein, 2004). The interactive nature of immersive virtual museums aligns with this theory, providing a platform for students to engage with content actively and offering interactive tasks that require students to engage deeply with the content in order to construct their knowledge.

Immersive virtual reality technology can create a feeling of presence in a visitor to a virtual museum, which plays a crucial role in the learning experience, similar to the sense of presence experienced in a physical museum (Yow, 2022). The concept of presence in this context refers to the sense of being in a virtual environment (Slater & Wilbur, 1995). It is crucial for immersive learning experiences (Carrozzino & Bergamasco, 2010) as it enhances the perceived realism of the virtual environment (Huang et al., 2010).

Additionally, this study incorporated flow theory, as defined by Csikszentmihalyi (1990), which describes a state of immersion and deep engagement in the learning experience. This aligns with the active learning role promoted by constructivism, enhancing student engagement and concentration during interactive learning activities. In the context of an immersive virtual museum, students can enter a flow state by engaging in tasks that capture their attention and enrich their learning experiences.

Furthermore, the study used the technology acceptance model (Davis, 1989) within a qualitative framework because the study aimed to provide a comprehensive understanding of the factors influencing university students' attitudes about using an immersive virtual museum for art learning. Qualitative methods such as interviews can provide richer, more detailed data about students' experiences and attitudes in this regard. Through qualitative analysis,

new themes can be identified, offering a more thorough understanding of the aspects influencing art learners' attitudes. The key concepts of this model include perceived usefulness, ease of use, and intention to use (see Section 2.2.3).

By integrating these theoretical and conceptual frameworks, the study provides a foundation for assessing the effect of immersive virtual museums on the learning experience and art learners' attitudes toward using them for art learning.

1.5 Purpose of the Study

The purpose of this study was to examine how an immersive virtual museum experience using head-mounted displays could affect Saudi Arabian art learners. More specifically, the study's emphasis was on these students' reported experience with presence and flow in such an environment. The study also sought to understand how this experience could affect Saudi Arabian art learners' attitudes toward and intention to take advantage of immersive virtual museum opportunities in the future.

This study used a qualitative approach to examine these areas of inquiry in order to understand the participating learners' experiences from their own points of view. The aim was to gain insight into the experiences of learners as they perceived those experiences; as a result, the findings could contribute to further collaboration between educational institutions and museums. Based on these findings, the study suggests ways of improving immersive virtual museum content, which could encourage museums to produce more effective immersive virtual content in the future. At an institutional level, the results are intended to help administrators, curriculum designers, and educators at art schools and universities make decisions about adopting immersive virtual museums. Additionally, the study addresses a gap in the literature through an in-depth examination of the effects of presence and flow in an immersive virtual museum on Saudi Arabian undergraduate university students, including their attitudes and intentions with regard to this experience.

1.6 Research Questions

Based on the aims outlined above, the present study sought to address the following research questions and sub-questions, with the first main research

question concerning students' experience and the second addressing their attitudes:

1. How do art students in higher education in Saudi Arabia experience learning in an immersive virtual museum?
 - 1.1 How do art students in higher education in Saudi Arabia experience presence when learning in an immersive virtual museum?
 - 1.2 How do art students in higher education in Saudi Arabia experience flow when learning in an immersive virtual museum?
2. How do art students in higher education in Saudi Arabia perceive learning through an immersive virtual museum?
 - 2.1 How do art students in higher education in Saudi Arabia perceive the ease of using an immersive virtual museum in their learning?
 - 2.2 How do art students in higher education in Saudi Arabia perceive the usefulness of immersive virtual museums in their learning?
 - 2.3 How do art students in higher education in Saudi Arabia intend to use immersive virtual museums in the future?

1.7 Research Approach

For the present study, the researcher adopted an interpretivist worldview, which asserts that meaning is based on social actors and is therefore subject to differing perceptions and interpretations (Guba & Lincoln, 1989). Interpretivist researchers focus on understanding the meaning that people construct through their own subjective experiences. In this way, the interpretivist paradigm attempts to understand human subjectivity. Interpretivists rely on qualitative data collection methods, such as semi-structured interviews and focus groups. Qualitative research involves gathering rich, detailed data in order to explore a topic that is often harder to understand through purely quantitative means (Creswell, 2014). This approach allowed the researcher in the present study to better understand art learners' experiences in an immersive virtual museum (see Yin, 2009).

Following the above approach, the researcher discussed participants' subjective meanings through face-to-face interviews after they had experienced an immersive virtual museum directly. Thematic analysis was employed to gain general insights into the effects that an immersive virtual museum could have on

the learning experiences of art learners and their attitudes toward using immersive virtual museums again in the future.

1.8 Thesis Outline

This thesis is divided into five chapters. Chapter 1 gives an overview of the topic, the context of the study, the problems that the study sought to address, its purpose and significance, the research questions it sought to answer, and the overall approach that was followed in collecting and analysing the data. Chapter 2 reviews the existing literature on immersive virtual reality museums, including an overview of virtual reality concepts, characteristics, devices, and effects on the user. The chapter includes a discussion of the relevant literature on the use of immersive virtual museums in art learning, learner attitudes toward immersive virtual museums, and the theoretical framework of the study. Chapter 3 describes the methodology, including the research paradigm and design, instruments, data collection and analysis procedures, and steps taken to ensure the trustworthiness of the findings. Chapter 4 presents the thematic analysis of the qualitative interview data with representative extracts from the interviews illustrating the findings. Chapter 5 discusses the findings in relation to the literature, considers the contribution of this research to the field, and discusses the implications for theory and practice. It concludes with limitations and recommendations for future research.

Chapter 2: Literature Review

2.1 Introduction

The purpose of this study is to understand the effect of using immersive virtual museums in art learners' experiences and how they can impact students' attitudes and intentions. This chapter discusses the relevant literature that informed the study. Section 2.2 presents the theoretical underpinnings that guided the study. It defines the key theories and concepts of the present research. Constructivism and active learning theory support teaching methods that engage students in activities. Flow theory describes deep immersion and optimal experience, impacting art learning. The technology acceptance model explains user acceptance and use of technology, focusing on perceived usefulness, ease of use, and intention to use. Lastly, presence refers to the sensation of being physically present in a virtual world, crucial for immersive experiences. Section 2.3 address immersive virtual reality characteristics (e.g., immersion, interaction), virtual reality devices, and the effect of virtual reality (presence and flow) on users. How museums are adapting to this technology is explored in Section 2.4, while Section 2.5 gives an overview of the potential applications of the immersive virtual museum in learning. Section 2.6 discuss constructivism, immersive virtual museums, and art learning. Section 2.7 discusses users' attitudes about immersive virtual reality in museums and their intention to use this technology, while Section 2.8 gives a summary of the chapter.

2.2 Theoretical Underpinnings

2.2.1 Constructivism and Active Learning Theory

To address the challenges of modern life, it is important to find innovative ways of engaging students, preparing them with the skills to deal with complex problems, absorb and adapt to new information, and come to their own understanding of that information; more traditional ways of teaching, in contrast, could fail to meet those needs (Basu, 2018). The last several decades have witnessed a major shift in epistemology from relying more on behaviourism to a greater focus on cognitivism. Cognitivist thinkers place a stronger focus on active learning, with students actively involved in acquiring knowledge; as such,

cognitivists take into account internal as well as external factors influencing the education process. In contrast, behaviourist thinkers place a heavy emphasis on external behaviour (Basu, 2018).

Educators and researchers have increasingly employed constructivist concepts in learning, leading to a growing emphasis on the learner. Instead of viewing knowledge as something to be acquired by a student, they examine the ways that a learner constructs their knowledge. Despite these scholars differing in terms of which factors they focus on in learning and cognition, their overall views and approaches can be considered under the umbrella of constructivism (Schunk, 2012).

As a theoretical framework, constructivism argues that people construct most of the knowledge they “acquire” (Bruning et al., 2004). This view thus holds all knowledge to be subjective, shaped by individuals’ unique cognitive processes (Efgivia et al., 2021). According to Schunk (2012), constructivists do not believe in the existence of scientific truths that are discovered and verified. Instead, they assert that learners create knowledge through personal methods of learning (Hein, 1998). According to Hein (1998), learners do not add new facts but rather reorganise, understand, and learn while they interact with the world. Donovan et al. (1999) added that constructivism focuses on how people learn by forging connections between previous experience and ideas they are familiar with on one hand and novel experiences and ideas on the other, which together help them achieve a deeper understanding.

Therefore, Schunk (2012) argued that people can view the world through a wide variety of prisms and that knowledge is constructed within the mind rather than being something that comes from entirely outside the individual. As a result, knowledge could be seen as “true” to a particular individual without needing to be true for any other person. This is because knowledge is shaped by personal experiences and beliefs, which necessarily vary from one individual to another (Cobb & Bowers, 1999).

The constructivist learning theory has three forms: radical constructivism, Vygotsky’s social constructivism, and Piaget’s cognitive constructivism (Basu, 2018). Piaget and Vygotsky’s theories are foundational to constructivism as a movement. Both of these thinkers asserted that learners should take an active role in constructing their knowledge, viewing learning as an internal cognitive

process rather being based on external influences (Nurhasnah & Kustati, 2024). The primary way their theories differ is in terms of information processing (Nurhasnah & Kustati, 2024). The primary factor shaping a person's learning, according to Piaget's theory, is the individual learner; in contrast, Vygotsky's theory asserts that the key factor here is a learner's social interaction with others, which is in turn shaped by society and tradition (Nurhasnah & Kustati, 2024). However, these theories can be seen as being in a complementary relationship, with each addressing the other's gaps or weak points (Utami, 2016).

Masgumelar (2021) and Nurhasnah and Kustati (2024) outlined the core components of constructivism as follows: (1) learners should be actively engaged in learning, (2) the learning activities should be based on real-life situations, (3) the activities should be both challenging and engaging, (4) learners should connect new and existing information via "bridging", (5) learners should be encouraged to reflect on what they learn in order to understand it better, (6) educators should act to help learners construct knowledge, and (7) teachers should engage in scaffolding, dividing learning into phases. In other words, constructivism asserts that learning should be driven by the learner through activities that are individualised to their needs, interests, and environment in order to construct knowledge and develop skills via dynamic learning (Basu, 2018).

Learning can occur within a constructivist framework through various approaches, including cooperative, problem-based, individualised, discovery, accelerated, and quantum learning (Mularsih, 2017). This involves activities that help learners create, understand, and organise information themselves (Supardan, 2016). In accordance with such principles, researchers have found active (student-centred) learning to be superior to passive (teacher-centred) learning. In this paradigm, the learner is responsible for reaching the learning objectives (Abualhaija, 2019).

From a constructivist perspective, Efgivia et al. (2021) stated that knowledge should be constructed by the learner rather than passively received from a teacher, as this is expected to help develop their thinking skills. Moreover, this framework claims that to be meaningful, learning should involve creativity (Newton, 2000). This means that while educators can assist students to some degree with connecting pieces of information, it is the learner who must forge

their own understanding through cognitive, intuitive, and other means (Tomljenovic & Vorkapic, 2020). Constructivism can be seen as a broad collection of approaches and strategies stemming from behaviourist and cognitive learning theories. Its goal is to help students learn through actively addressing problems (Kibsgaard & Chorkendorff, 2019).

As noted above, constructivist learning requires active engagement on the part of the student and individual knowledge construction (Geary, 1995; Nurhasnah & Kustati, 2024). The concept of active learning stems from Dewey's notion of learning by doing (Basu, 2018). Basu (2018) argued that combining constructivism with active learning should empower learners to find innovative solutions to difficult problems. Active learning can be further understood as being "hands on", in contrast to passively reading or observing a teacher (Mayrose, 2012). As such, it has become a broadly accepted idea in curricula that value learners as active participants in education (Reddy et al., 2021).

It should be noted that various terms are often associated or conflated with active learning. One is student-centred learning, in which students are active learners and teachers are facilitators (Teaching & Learning Team, Cambridge International, 2020). Inquiry-based, problem-based, or discovery learning involves answering a question, evaluating data, making connections between data and existing knowledge, reflection, and reaching conclusions. Experiential learning, in contrast, involves learning through one's direct experience with the world.

Constructivism in this regard means knowledge can be constructed through interaction with the real world in an active learning process (Hein, 1999). Under the above framework, the students are expected to engage actively in the learning process, while the teachers are expected to guide rather than direct their learning. Furthermore, the learning experience in constructivism, according to Moye (2021), involves learners taking an active role in engaging with the learning environment. This way of looking at learning experiences foregrounds the student as an active participant who reacts to certain aspects of the learning environment that interests them. Along these lines, Kippenberger (1997) stated that learners in this context can benefit from engaging in reflection and from encountering new experiences. According to Crombie (2006), these learning

experiences should focus on discovery learning, a form of content-based learning that is project-oriented.

With the above in mind, constructivism was selected partly because of how its concepts have been shown to influence museum education, especially regarding active learning, which are crucial for museums and educational programmes (Hein, 1991). Similarly, Chen (2010) noted the contribution of constructivist theory to education, as follows:

Constructivism as a learning theory emphasizes the combination of inputs from the senses, existing knowledge, and new information to develop new meaning and understanding through active, authentic, cooperative and reflective learning activities. (p. 73)

Museum educators have seen the importance of making learners active participants. For this to happen, students need to engage with artworks both physically and mentally. Thus, constructivist concepts can be applied to the process of learning in museums, especially in virtual museums as they pave the way for interaction, immersion, and presence to take place. Katz and Halpern (2015) argued that by taking on a more active role in learning environments such as virtual museums, users can improve their reasoning and become motivated to learn more about the exhibits.

Lee et al. (2010) discovered that realism and immediate control had a significant impact on the interaction and learning experience of people in virtual reality. Thus, learners actively construct knowledge through interaction with objects in a virtual world as they do in the real world. According to constructivist principles, Lee et al. (2010) explained that students are more engaged and gain a deeper understanding of material when given more opportunities to actively participate in the learning process in virtual environments. Dede et al. (1997) claimed that new perspectives and representations in virtual reality environments can help students improve their ability to correct misconceptions that are formed through traditional education and develop correct mental models. In addition to this, interaction has been shown to enhance the learner's motivation and guide their learning process. According to Kraus (1995), direct experience can enhance the accessibility of memory and guide the mental representation of the object

with which individuals interact. In this way, it helps individuals recall more details (Ajzen et al., 2018).

Bitgood (2013) discussed various theories, such as attention restoration theory and situated learning theory, in relation to the potential of immersive experiences to enhance museum visitor engagement and attention. These theories demonstrate that immersive experiences offer great potential for learning. Furthermore, virtual reality can be a powerful tool by enabling a more direct experience of objects since it is three-dimensional, allows experiences with multiple reference frames, enables multisensory communication and perspectives, and allows for greater physical immersion (Dede et al., 1997). Radianti et al. (2020) found that immersive head-mounted displays, for example, could encourage learners to more fully engage with objects that were being exhibited in virtual reality, to spend more time on learning tasks, and to acquire better cognitive, psychomotor, and affective skills.

Taking an active role during interactive lectures can enhance learners' ability to achieve immersion for longer periods of time while performing tasks. In one study, for instance, Spigner-Littles and Anderson (1999) found that around 10 to 15 minutes into a lecture, student concentration became weaker; in contrast to lectures lasting 50 minutes, active interactive lectures showed better learning outcomes. Such studies have suggested that active learning can help students enter a state of flow, better holding their attention.

2.2.2 Flow Theory

The kind of active learning championed by constructivism can be understood in relation to the flow state, based on Csikszentmihalyi's (1990) theory of flow. According to this theory, a flow state occurs when someone becomes completely immersed in what they are doing. This state, in turn, can result in higher engagement and active involvement in a learning activity. More specifically, students are expected to be more likely to enter this flow state when using interactive visual learning tools; this is especially the case when their skills are challenged to an appropriate degree (Rathunde & Csikszentmihalyi et al., 2005). Moreover, when learners can personalise online activities based on their ability, this can help them stay more focused on and engaged in what they are learning (Pandey, 2017). This can include letting learners choose what aspects of the

content best conform to their skill level, which can make learners feel as if they have more control over their learning and as a result make them more likely to actively participate in their learning (Ou et al., 2019). The theory of flow, as outlined above, suggests that educational tools can produce an environment that is more conducive to learning when they are more personalised and interactive.

Furthermore, the flow state has improved our understanding of deep engagement and the individual and contextual factors that may enhance it (Schmidt, 2010). Skadberg and Kimmel (2004) indicated that in online activities, the flow experience enhanced users' engagement, improved the attitude and behaviour of learners, and helped them develop their skills. This state induces a sense of being "in the zone" as the learner develops with minimal effort and interruption (Guerra-Tamez, 2023, p. 6). This can increase and optimise learner engagement, performance, and insight. Moreover, it can result in positive affect and an autotelic experience for the learner as well (Csikszentmihalyi, 1990; Kawabata & Mallett, 2012). Autotelic experience in virtual reality is a significant characteristic of flow where action and awareness merge and correlate positively with both the length of virtual reality use and the intention to continue using virtual reality (Hassan et al., 2020). In this regard, learning involves an adaptable, open-ended structure in which students actively explore the learning materials on their own terms (Wang & Chen, 2010). Then, an appropriate pathway is created in which learners may develop at their own pace while being presented with relevant content that matches their interests, abilities, and knowledge, among other factors (Erhel & Jamet, 2019).

Leung et al. (2018) and Chen (2010) asserted that the ability to experience, manipulate, understand, and interact with 3D virtual representations and visualise abstract concepts based on the dynamic relationships between several variables in the virtual environment could contribute to the learning process. Thus, the present study expected that immersive virtual museums could have a positive impact on the arts as they provide well-developed tools for learning. Based on Bandura's perspective (1977), experiences significantly influence people's attitudes. He emphasizes that attitudes and behaviours are shaped by experiences and observations. This means that how learners interact with and perceive their learning environment can directly impact their attitudes toward a particular subject.

2.2.3 Technology Acceptance Model

Researchers have developed several models to explain participants' attitudes toward technology as well as to identify and explain the factors that affect acceptance of e-learning (Abdullah et al., 2016). Prominent technology acceptance theories include the theory of reasoned action (TRA) (Ajzen, 1991), the theory of planned behaviour (TPB) (Ajzen, 1991), task technology fit (TTF) (Goodhue & Thompson, 1995), the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003), and the technology acceptance model (TAM) (Davis, 1989). Out of all of these theories, the last is the one that is most frequently found in the literature on e-learning acceptance (Abdullah et al., 2016).

The technology acceptance model was developed by Davis (1989) in order to explain the factors determining acceptance among various groups of users regarding a variety of technologies using methods that are as simple and theoretically justifiable as possible (Hu et al., 1999). According to Vogelsang et al. (2013), a central element of this model is the user's attitude toward using a given piece of technology. This attitude has a direct impact on their actual use of that technology, which serves as an indicator of their technology acceptance. It derives its constructs from the theory of reasoned action as well as from the theory of planned behaviour. Hence, it focuses on the behavioural intention to use technology. As such, it has been useful in research on university students' intention to use online-based education (Abdullah et al., 2016).

Two key constructs in this model are the perceived ease of use and perceived usefulness of technology (Hung et al., 2013). The centrality of these constructs in the model stems from them being the primary factors affecting whether someone accepts or rejects technology (Davis, 1989). The model thus claims that these constructs shape a user's decision about whether to make use of a new technology (Bagozzi, 1992; Davis, 1989; Hung et al., 2013). If users do not believe a new technology will be useful or user-friendly for a given task, the model assumes they will not view that technology in a positive light. Based on this assumption, the present study investigates whether increase in these two constructs could help users develop a more positive view about digital museums for art learning, leading to a stronger intention to use that technology.

To give a more detailed definition, perceived usefulness refers to “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989, p. 320). A device is thus more likely to be used if people think it will help them do their work more effectively (Abdullah et al., 2016). In terms of the construct, when a device or system has high perceived usefulness, this means the user sees a positive relationship between using the device and their performance. In other words, when someone thinks a device or system is useful, that person thinks that using it will improve their performance.

The other construct, perceived ease of use, can be defined as “the degree to which a person believes that using a particular system would be free of effort” (Davis, 1989, p. 320). While someone could see a device as useful, they could also think it will be too difficult to use, outweighing any potential benefits it might offer. Thus, this second construct is also thought to strongly determine whether a device or system ends up actually being used (Abdullah et al., 2016).

Both of these constructs are thought to be influenced by various external variables (Abdullah et al., 2016). As a result, if one wishes to explain a person’s behavioural intention to use a given piece of technology, one should examine any relevant external variables as well. For example, external variables influencing the adoption of high-quality virtual reality technology could include a user-friendly interface, responsive controls, and seamless navigation. Thus, incorporating such variables into the technology acceptance model can help make sense of why technology is adopted (Abdullah et al., 2016), for example, if users feel that a piece of technology will improve their learning outcomes, provide access to educational resources, and enhance their productivity and if they find it easy to use, with an easy interface and accessible learning applications. By the same token, doing this can also help determine why technology is not adopted (Abdullah et al., 2016).

Prior studies have shown the validity of the technology acceptance model to predict and interpret technology acceptance behaviour (Abdullah et al., 2016). For instance, in their study, King and He (2006) reported it “to be a valid and robust model” (p. 740). The model is widely used by acceptance researchers, who typically employ a quantitative approach (Vogelsang et al., 2013). Previous research has shown it to be reliable in this regard, possessing procedures and

ways of interpreting data that are well defined. It also has existing instruments that make it easier to use with a variety of technologies. Such simplicity and applicability have helped it become commonplace in information systems research. Using the technology acceptance model with a qualitative approach could provide more in-depth insights and a more detailed understanding of user experiences and attitudes, providing a clearer explanation of the reasons behind technology adoption.

2.3 Overview of Virtual Reality Concepts

2.3.1 Definition of Virtual Reality

The past several years have seen significant technological advancements in extended reality (XR) technology, an umbrella term encompassing virtual reality (VR), augmented reality (AR), and mixed reality (MR) technology (Lee, 2020). Users can employ a variety of methods to enter and interact with a virtual reality environment. For instance, a head-mounted display can be worn to enable a user to see and hear virtual reality elements while isolating the user from their actual surroundings. In augmented reality, the user interacts with virtual objects displayed onto the physical environment and viewed via headsets or the screen of a mobile device. Mixed reality combines the above experiences.

Virtual reality is one of the many components of information and communication technology. Virtual reality can be categorised into several different types based on how well it mimics reality and immerses the user (Ochs & Sonderegger, 2022; Yildirim et al., 2018). Immersive (or high immersion) virtual reality employs head-mounted displays to give a first-person view inside virtual reality, whereas non-immersive (or low immersion) virtual reality uses traditional desktop displays, where the virtual world is seen from the outside. Biocca and Delaney (1995) defined immersive virtual reality as “The sum of the hardware and software systems that seek to perfect an all-inclusive, immersive, sensory illusion of being present in another environment, another reality” (p. 63). This definition focuses on the psychological experience of virtual immersion. In contrast, others have focused more on the interactive experience, viewing immersive virtual reality as involving the senses of sight, hearing, and touch to give users the impression that they are immersed in the real world and let them

interact directly with the virtual reality system (Cecotti et al., 2020; Lin et al., 2020).

Overall, virtual reality generates a sense of being in the real world. Immersive virtual reality is a simulation of reality that combines the psychological sensation of being in a place with the ability to physically interact with that place. A core part of making virtual reality more immersive is giving users a sense of presence, meaning that users feel as if they are actually inside a virtual world, at least to some degree (Dengel & Mägdefrau, 2019). The degree of presence one feels is determined by the feeling of immersion and the interaction characteristics of the devices employed.

2.3.2 Characteristics of Immersive Virtual Reality

2.3.2.1 Immersion

One of the main features of virtual reality is immersion. According to Katz and Halpern (2015), virtual reality in museums has a unique characteristic as it helps the users to engage with the museum content and interact with concrete objects. There are many ways of describing the concept of immersion. Sherman and Craig (2003) classified it into mental immersion and physical (sensory) immersion. According to Du Vignaux et al. (2021), mental immersion is when someone becomes strongly engaged with a virtual reality simulation. In contrast, physical immersion is based on someone being able to use what they can hear, see, and touch to move around in the virtual world as well as manipulate things in it. Slater and Wilbur's (1997) definition of immersion in virtual reality focused on users developing a sense of presence that is facilitated through vivid simulations of a virtual space while at the same time they are able to ignore the real world around them. Along similar lines, McMahan (2003) stated that perceptual immersion is "accomplished by blocking as many of the senses as possible to the outside world and making it possible for the user to perceive only the artificial world, by the use of goggles, headphones, gloves, and so on" (p. 77). Meanwhile, Slater and Usoh (1994) stated that participants feel "immersed" through the display of sensory data surrounding them and the representation of the participant's body from the position and orientation defined by the participants' point of view within a given environment.

From a psychological perspective, Witmer and Singer (1998) defined immersion as a “psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences” (p. 227). More precisely, immersion could be seen as “a state of deep mental involvement in which [a user’s] cognitive processes cause a shift in their attentional state”, which can lead to a “dissociation from the awareness of the physical world” (Agrawal & Bech, 2022, p. 18) and giving the impression of being transported to another world entirely (Murray, 1997).

From a technological perspective, immersion in virtual reality is a quantifiable aspect of display technology, mainly determined by the extent to which displays are (a) inclusive (the degree to which the user is isolated from real-world stimuli), (b) extensive (the number of sensory modalities the system accommodates), (c) surrounding (panoramic displays), and (d) vivid (in terms of display resolution) (Slater & Wilbur, 1995). Therefore, Slater (2003) defined immersion as essentially whatever a device does to give the user a sense of being somewhere else. Slater (1999) connected the level of immersion with the level of technology: the more advanced the technology, the more immersive the experience. More specifically, immersion is an objective indicator that depends on hardware and software, such as display size and resolution, refresh rate, realism of lighting, type of position tracker, and quality of the visual, audio, and haptic feedback (Burdea & Coiffet, 1994).

This brings us to the concept of fidelity of spatial transformations, including the geometric field of view, display update rate, motion parallax, and depth cues, such as linear perspective, aerial perspective, and occlusion (Katz & Halpern, 2015). These factors determine how strongly a user is affected by what they see, hear, and feel in a virtual world and give users higher levels of realism and presence than they would have in a non-immersive virtual setting. This in turn allows users to interact with the virtual environment as if they were inside a physical place, deciding what to look at and from what distance and angle. Psotka (1995) stated that a museum visitor’s feeling of inclusiveness contributed to an emotional experience, which facilitated higher cognition and information retention. In this way, virtual reality can greatly contribute to the learning process. However, based on the literature cited above, describing immersion as a purely

psychological state means it will probably vary greatly from person to person, making it harder to control the degree of immersion between users. Therefore, it is important to consider objective indicators provided by technology.

For the purposes of the present study, and based on the literature above, the concept of immersion in a virtual reality could be understood in psychological and technological terms. In terms of psychology, immersion was expected to involve deep mental engagement and interaction with a virtual simulation to which one had a sense of being transported to, with this feeling being facilitated by a psychological separation from the real world. Virtual reality technology was expected to facilitate the psychological state of immersion described above by providing a virtual environment that separated users from sensory input from the world around them while serving them input through a high-resolution panoramic display, combined with realistic feedback. The resulting immersive experience was expected to keep users highly engaged in a way that mimicked how they usually interacted with the real world.

2.3.2.2 Interactivity

Interactivity is another important aspect of virtual reality. It involves real-time alteration of and interaction with the virtual reality environment (Chang & Wang, 2008). McLellan (2004) claimed that 3D visuals encouraged more interaction since the users can control their view of the contents of the virtual museum. Control is necessary for students because when they learn by making instructional decisions, they experience increased motivation to learn, which can lead to a higher level of performance (Kinzie et al., 1988). Immersive virtual reality can thus allow students to learn in an environment that is customised to their individual interests and skills, helps individuals to have a more personalised learning experience, and can boost motivation as they investigate things that are actually interesting to them (de Freitas & Neumann, 2009). In addition, learners have a stronger sense of their own competence and autonomy, as well as a greater desire to learn (Lepper, 1985).

Huang et al. (2010) referred to three types of interaction in virtual reality: learner-instructor interaction, learner-learner interaction, and learner-content interaction. In immersive virtual reality, users can gather and explore information through active multisensory interaction with the surrounding virtual environment.

Furthermore, virtual environment users can navigate and control objects that promote physical immersion (Huang et al., 2010). Through a 3D simulated world, which can reflect the real world or a fantasy world, people can experience and control objects using touch, voice command, and balance (Firat, 2010). In such an environment, learners can get immediate feedback on their actions. The interactive virtual environment that the present study employed was designed with these different forms of interaction in mind (Ha & Im, 2020).

In this context, virtual environments have a set of characteristics that can encourage users to interact more with content and to learn as they do so. One of the main benefits of this interaction is that users can approach objects from multiple points of view, which can stimulate their creativity (Dede, 1995). In turn, this can help individuals recall more details (Ajzen et al., 2018). Therefore, high interactivity in a virtual experience can trigger feelings of immersion in the virtual world.

2.3.3 Virtual Reality Devices

Virtual reality has received increasing interest among educational technology practitioners due to the widespread availability of affordable consumer-grade devices in recent years (Cecotti et al., 2020). An example of highly immersive equipment that generates a virtual environment is the cave automatic virtual environment (CAVE), featuring a room with projection displays on the walls, floor, and ceiling in which the user can freely navigate and interact (Nisiotis et al., 2019). However, this system is expensive and immobile. A more affordable (and mobile) technology is a head-mounted display, such as the Oculus Rift and HTC Vive, which offer accurate head tracking, high resolution, interactivity with the virtual environment, and a higher quality experience to users. However, this technology still requires a high-end computer connected to the head-mounted display in order to generate the virtual experience.

These head-mounted displays isolate the user from the external world, induce a strong sense of presence in them, and display the virtual environment in two main formats (Marín-Morales et al., 2018). These formats are 360-degree panoramas, which provide more realistic results in terms of users' psychological responses, and 3D virtual reality environments, which provide more realistic

results in terms of users' physiological responses, allowing the user to freely interact with the environment.

Virtual reality head-mounted displays are available in a variety of forms (see Figure 2.1), including PC-based systems, which require a powerful computer for use; standalone devices, which do not require a computer or console to operate and are wireless; console-based systems compatible with the PlayStation console; and mobile systems that use smartphones as display and processing devices (Guerra-Tamez, 2023) such as virtual reality glasses. A standalone headset, such as the Oculus Quest, is characterised by a cordless head-mounted display, and its design allows for considerably more freedom of movement. In several recent studies, Coyne et al. (2019), Wang et al. (2023), and Guerra-Tamez (2023) found that standalone virtual reality headsets resulted in higher immersion in a classroom setting. For these reasons, the Oculus Quest 2 was used in the present study.

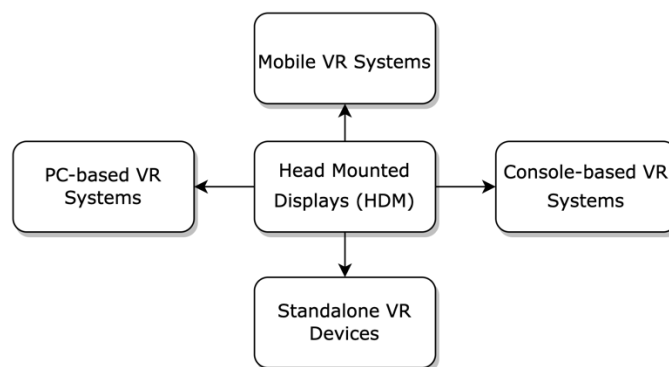


Figure 2.1 Categories of head-mounted displays for virtual reality.

2.3.4 The Effects of Virtual Reality (Presence and Flow)

2.3.4.1 Definition and Characteristics of Presence in Immersive Virtual Reality Environments

Presence is one of the main goals of immersion and interaction in a virtual reality experience (Carrozzino & Bergamasco, 2010). In this context, presence means that people experience a sense of existing within a virtual space (Deng et al., 2023; Sanchez-Vives & Slater, 2005). Sanchez-Vives and Slater (2005) described presence in virtual reality as a phenomenon that occurs when users respond realistically to virtual experiences in the same manner as they would react when they are exposed to reality. Their responses can be sensory motor contingencies that correspond to the actions and the idea that these users know

how to perform and act while they attempt to perceive their surroundings. This means that the users know how to turn their heads in order to change the direction of their gaze, take a step forward to get closer to something, and select or inspect virtual objects that they find around them (Slater, 2009), including through hand gestures and manipulations (Slater & Usoh, 1994).

These responses can be ascribed to the place and plausibility illusions combined with notions of immersion (Slater, 2009). According to Slater (2009), the place illusion occurs when the virtual reality user feels they are in a particular place despite knowing that this is not true. The plausibility illusion is when events seem to be happening in spite of the knowledge that they are not. Based on these illusions, a strong sense of presence is created by an immersive environment, which motivates the learner to cognitively process the learning material more deeply (Huang et al., 2010).

In a virtual reality system, the user can interact with and manipulate the virtual environment; this includes moving through the environment and controlling objects within it (Lee et al., 2010; Seibert & Shafer, 2018). Consequently, the degree of similarity between the spatial, auditory, and haptic transformations of objects in a virtual environment and the real world can generate a sense of presence (Barfield et al., 1997; Bystrom et al., 1999). Although distinct, immersion and presence are closely connected, which usually means that the higher (or more sophisticated) the immersion, the higher the sense of presence, and vice versa (Bowman & McMahan, 2007; Ochs & Sonderegger, 2022; Slater, 2003; Slater & Wilbur, 1997).

Presence in an immersive virtual reality experience, as defined by Slater and Wilbur (1995), is “a state of consciousness, the [psychological] sensation of being in the virtual environment” (p. 14), while Brown and Cairns (2004) suggested that presence is a state of full immersion (as an experience) that may be reached by becoming engaged and engrossed in an activity. Put differently, presence could be defined as “the subjective experience of being in one place when one is physically in another” (Witmer & Singer, 1998, p. 1). Jensen and Konradsen (2018) noted that many factors can facilitate or hinder immersion and presence, such as graphical quality and awareness; the graphical quality of virtual reality and the awareness when using virtual reality might reduce the

sense of presence, while personality characteristics may be related to limited skill gains from using virtual reality technologies.

Ochs and Sonderegger (2022) investigated how participants wearing head-mounted displays experienced being in a virtual world. They compared two learning devices: a highly immersive virtual reality headset and a less immersive system (i.e., desktop screen) in both noisy and quiet learning environments. There were 63 participants aged 18 to 26 from the University of Fribourg. Of these, 19 had used a virtual reality headset before, but none of them had used such technology more than four times. The majority of the participants reported higher levels of presence when using a virtual reality headset, which they reported was more immersive, interactive, and interesting.

While some researchers have sought to distinguish presence and immersion as separate concepts (e.g., Agrawal & Bech, 2022), presence and immersion are often used as synonyms (e.g., McMahan, 2003). Furthermore, scholars conducting presence-related research often consider immersion a lower-level concept or a determinant of presence, whereas others such as Zhang et al. (2017) regard immersion as a higher-level concept. Sanchez-Vives and Slater (2005) described immersion as simply a description of overall fidelity in relation to physical reality provided by the display and interaction systems. In this view, presence research involves carrying out experiments that manipulate the variables that make up immersion.

In accordance with the literature, the concept of presence in the present study referred to the manner in which participants engaged with and reacted within an immersive virtual reality environment in a way that reflected their experiences with physical reality. Therefore, a user's sense of presence was determined by the degree of immersion, and immersion was determined by the degree to which the display and interaction systems of virtual reality accurately represented physical reality. The interdependence between these concepts can make it challenging to determine which is a higher-level concept. However, I posited that the absence of a high degree of vividness in representing physical reality and interaction systems may hinder one's ability to experience a sense of presence in a virtual reality environment.

2.3.4.2 Definition and Characteristics of Flow in Immersive Virtual Reality Environments

Csikszentmihalyi (1990) found that total immersion in an activity and the feeling of complete engagement was associated with a subjective experience called flow. Csikszentmihalyi developed the concept of flow as an optimal experience of happiness. This concept shares some characteristics with immersion (Csikszentmihalyi, 2014). Flow is immersion in the present moment that enhances, energises, and fulfils (Guerra-Tamez, 2023). It entails extreme attention, a lack of self-consciousness, a sense of control, complete focus on the task at hand, a performance breakthrough (Csikszentmihalyi & Larson, 2014; Guerra-Tamez, 2023; Guerra-Tamez et al., 2021), clear goals, clear and immediate feedback, and time distortion (Csikszentmihalyi, 1990). Flow occurs when someone is completely absorbed in their interests, for example, when someone seemingly reads a book for a few minutes but realises an hour has passed (Hassan et al., 2020).

According to Schmidt (2010), Csikszentmihalyi described his observation of students at a U.S. art school to see what inspired them to create their artworks. He noticed that students were so focused on their work that they ignored outside distractions, lost track of time, missed meetings and mealtimes, and worked late into the night, apparently maintaining profound focus and enjoyment. However, once the painting or sculpture was finished, it seemed to lose its value to the student, indicating that art's value was in the process, not the product. He suggested eight conditions are required to reach a flow state: tasks with an achievable chance of completion, clear goals, immediate feedback, profound involvement, a sense of control, loss of self-awareness, time distortion, and most importantly enjoyment. Csikszentmihalyi described these experiences as autotelic, in which the purpose (telos) resides in participation (auto). Afterwards, Csikszentmihalyi and his colleagues investigated flow in numerous contexts, such as education, psychology, psychiatry, anthropology, and business, and noticed that participants frequently revealed optimal states of total absorption, concentration, and enjoyment (Hassan et al., 2020). A state of flow with high levels of enjoyment and sense of control in virtual environments has been correlated with higher online experimentation and exploration (Ghani & Deshpande, 1994).

Virtual museums combine a variety of flow stimuli, from contemplation of the aesthetics of artwork practised by artists in general to the characteristics of immersive and stimulating virtual reality to experience flow. In Csikszentmihalyi and Robinson's (1990) study conducted with museum specialists, participant responses provided support for the notion that flow can be experienced when viewing art. In addition, Chalkroom (or *La Camera Insabbiata*) was selected as "Best Virtual Reality Experience" in the first competition related to virtual reality to take place at the Venice International Film Festival (Anderson, 2017). Laurie Anderson mentioned in her creative concept that while most virtual reality artworks create attractive spaces, viewers can only experience spontaneous flow and immersion in a quiet space (Huang & Tsau, 2018). Thus, immersive virtual museums combine the observation of artists' aesthetics with virtual reality to create a flowing experience in attractive, quiet spaces that can enhance spontaneous flow and immersion. Csikszentmihalyi designated flow experience as the name for aesthetic experience in the context of art. Csikszentmihalyi and Robinson (1990) argued that it is probable that "Philosophers describing the aesthetic experience and psychologists describing flow are talking about essentially the same state of mind" (p. 8). They elaborated on this issue in the following quote:

When this heightened state of consciousness occurs in response to music, painting, and so on, we call it an aesthetic experience. In other contexts, such as sports, hobbies, challenging work, and social interactions, the heightened state of consciousness is called a flow experience. But it may be that the quality of the subjective states is the same in both contexts, that the aesthetic and the flow experiences are in reality indistinguishable from one another. (p. 9)

Virtual reality is a technology that transports users to immersive realities, which can facilitate the flow state (Hassan et al., 2020). In immersive virtual reality, wearing a headset directs the user's senses, such as sight and hearing, into an individual context, which might encourage a higher level of concentration on a task and provide a foundation for autotelic experiences and immersion; this enables users to have a sense of control, such as when browsing a website or

using a new device. In addition, this kind of overlap between flow and presence supports studies that have found presence to be a prerequisite of flow (Novak et al., 2000). When an attempt is made to integrate the user's senses, such as sight and hearing, into the virtual environment and provide a sense of control to interact with, the goal is to create a sense of being in the place, thereby enhancing the user's sense of flow. Ha and Im (2020) suggested that interaction between a user and a virtual environment was closely related to telepresence and the flow experience. Moreover, Hoffman and Novak's (1996) review of 12 empirical studies using flow theory indicated that interactivity directly and indirectly affected the flow experience. Thus, when users interact actively within a virtual environment, they are more likely to experience flow where individuals are fully immersed and focused on the task at hand, experiencing a greater sense of control over and enjoyment in what they are doing.

Technology has made astounding leaps in the quality of immersive, interactive virtual reality that is currently available. In turn, more researchers in various areas have reported on the ways this technology can affect users. The ways that flow and presence are connected or intersect indicates that an immersive virtual environment has the ability to produce a flow state in the user. In the present study, based on the relevant literature, the virtual museum was expected to facilitate a flow state among users by engaging their senses and allowing them to feel some degree of control when interacting with an immersive virtual museum.

2.4 Definition and Overview of Immersive Virtual Museums

Numerous fields have responded to the recent advances in virtual reality technology and the changing needs of their stakeholders, from healthcare and medicine to education and video games. Museums—which play an important role in conserving history and culture as well as in the education of arts, history, and science—are no exception in this regard and have changed considerably over time. Throughout history, museums have played a variety of roles, ranging from private collections of the wealthy to modern institutions for the public with primarily educational purposes (Simmons, 2010). A rough overview of this evolution of the museum, taken from Simmons (2010), is presented in Figure 2.2.

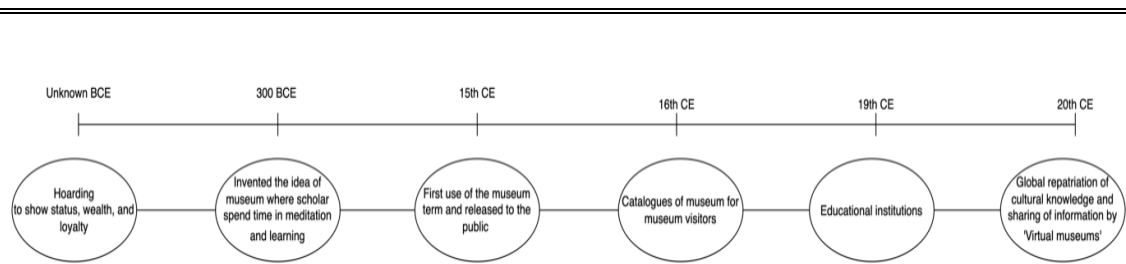


Figure 2.2 Overview of the evolution of the museum.

Before museums existed in a formal sense, people collected artefacts as a symbol of wealth and status (Simmons, 2010). A notable early museum was the Museum of Alexandria in the third century BCE. The term “museum” was first used to describe Lorenzo’s collection in the fifteenth century. He collected books, intaglios, precious stones, medals, tapestries, Byzantine icons, sculptures, natural history specimens, and paintings, and in 1582, his vast collections were released to the public. In the sixteenth century, visitors were provided with catalogues of museum contents with drawings, histories of important pieces, and collection appraisals. In the late nineteenth century, museums became primarily educational institutions that allowed everyone to access their contents and learn about historical events (Nisiotis et al., 2019). Museums also began to become more specialised. For instance, historic house museums preserve buildings because of their architecture or affiliation with an important person or historical event, open air museums or living museums contain period architecture, and mobile museums serve schools. In the twentieth century, the growth of museums around the world resulted in the founding of the International Council of Museums (2022), which has given the following definition for the modern museum on its website:

A museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibits tangible and intangible heritage. Open to the public, accessible and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection and knowledge sharing.

According to Meinecke et al. (2022), the basic notion of a virtual museum originated with André Malraux's Imaginary Museum, which he referred to as a museum without walls, consisting of images taken at different times across the globe. A more recent development is what we would today recognise as a virtual museum, which, as its name implies, exists online, although many are based on tangible collections (Schweibenz, 2019). Lewis (1996) defined a virtual museum as an electronically accessible display of pictures, sound recordings, documents, and information that represents culture, science, and history-related content. According to Meinecke et al. (2022), physical museums can be complemented by virtual museums in several ways, as the virtual museum lacks the limited space that physical museums must contend with when designing exhibits and can be used to display fragile material without the risk of damaging it. Because of their ease of access, virtual museums thus hold great promise for the global repatriation of cultural knowledge and the sharing of information.

Museums have to respond to advancements in technology and the changing needs of visitors. There is a need to provide a more interactive, immersive, and stimulating experience than what is currently provided by traditional museology, i.e., displaying objects in specific and restricted patterns with limited information (Nisiotis et al., 2019) and locations. In response to this need, new museology seeks more profound visitor engagement with the exhibits on display (Vergo, 1997). This means that instead of seeing artwork in a simple static 2D form, whether online or in printed format, virtual museum visitors will be able to engage and interact with art and explore the museum and its details as they would in a physical museum.

The immersive museum is a historical concept; throughout history, wealthy Greeks surrounded themselves with panoramic views depicted on the walls of their rooms. The artists did work to make these panoramas as realistic as they could so that the viewers could experience an alternate reality (Ochs & Sonderegger, 2022). Many of these palaces and halls have since been converted into museums and exhibition spaces that present the works of artists from that era. For example, the Painted Hall of Old Royal Naval College in Royal Greenwich Museum was designed by Sir James Thornhill in the early eighteenth century. In the beginning, the hall served the Greenwich pensioners who lived at the Royal Hospital, but it was soon turned into a tourist attraction. It encompasses

40,000 square feet and its surfaces are covered in paintings depicting 200 figures of kings, queens, and mythological creatures. Therefore, the idea of surrounding the viewer with an alternative reality in which the individual feels like they are in a different environment has existed for a long time in art. In immersive virtual reality learning environments today, users can wear a headset that displays panoramic and artistic scenes of those museums and exhibitions while blocking their view of the outside world.

Virtual museums not only conserve information through items, photographs, images, files, and scripts but also help users explore museum content with audio-visual technology and understand a historical event through paintings, videos, and dioramas in a museum without having to visit that museum in person (Syarifuddin, 2017). A virtual museum “reconstructs a real place and/or acts as a knowledge of a metaphor, and in which visitors can communicate, explore and modify spaces and digital or digitalized objects” (Pujol & Lorente, 2012, p. 46). Sylaiou et al. (2017) divided virtual museums into five basic categories based on the primary visual method that they employed: 360-degree panoramic images, scalable images with text, searchable databases, 3D environments, and videos. The 360-degree panoramic image, for example, is a reality capturing technique that displays an unbroken view of the surrounding area (Bourke, 2014). Using a different approach, Carrozzino and Bergamasco (2010) divided virtual museums into three groups according to the level of immersion they sought to provide: high-immersion virtual museums, which use high-immersion systems, such as a CAVE; low-immersion virtual museums, which use low-immersion systems, such as an immersive workbench; and non-immersive virtual museums, which use non-immersive technology, such as a regular desktop computer. Paliokas and Kekkeris (2008) and Soroko (2022) divided virtual museums into several categories as well using different considerations. One was the virtual museum as an art collection containing digitalised pictures, videos, and context for artwork. Video tours, in contrast, give visitors a panoramic display of real-life museums. Virtual reality museums present architecture and other content in 3D virtual reality experiences. Other virtual museums focus on encouraging visitors to interact socially. Finally, some virtual museums are essentially an artist blog that presents an artist’s body of work.

Virtual museums are no longer considered simple digital versions of real museums. They have become more complex communication systems linked to narratives, interaction, and immersion in three-dimensional reconstructed scenarios (Pescarin, 2014). In a virtual museum, a visitor can examine, explore, learn about, and interact with a digital collection of artefacts within a single- or multi-user environment without restrictions related to time and space (Sylaiou et al., 2009). For example, the website v-must.net offers selective shows that are interactive but not static as they are controlled by the spectator (Antonaci & Ott, 2014). This website combines various levels of immersion experiences with the virtual world, characterised by immediate response options, flexibility, originality, and liveliness (Antonaci & Ott, 2014). The Museum of Pure Form (MPF) provides interaction with 3D models of sculptures using the senses of touch and sight. It has digital copies of original works that are used for research and studies, mainly when real objects would be difficult to access and store (Carrozzino & Bergamasco, 2010). Another example is the Old Royal Naval College in Royal Greenwich Museum (Old Royal Naval College, 2020), which provides free 360-degree immersive virtual tours of the Painted Hall through a virtual reality headset (see Figure 2.3). The tours allow visitors to interact with, pan around, and zoom in on the exhibitions and have up-close explorations of Baroque masterpieces from home to marvel at the details in ultrahigh resolution and discover the stories behind the art. This experience includes a series of texts, images, and vocal narrations on styles and authors. Another example is the Beyond the Walls virtual reality experience hosted by the Smithsonian American Art Museum (2020), featuring librarians who will answer questions and interact with researchers and visitors from all over the U.S. through an online chat platform, message boards with entertaining content, suggestion boxes, and digital reference services (Carrozzino & Bergamasco, 2010).

As part of its Vision 2030 national development project, Saudi Arabia seeks to modernise technology in all government sectors, including in the education sector (Al Mulhim, 2014) while preserving its historical cultural heritage (Moshashai et al., 2020). With the above goal in mind, Saudi Arabian museums are seeking to launch virtual tours that showcase some of the major heritage sites that can be found in the country, such as sites built in the ancient Kingdom of Dadan and Lihyān (900 to 200 BCE) (AIUla, 2020). These changes come as a

response to the limited use of digital technology in Saudi Arabian museums (Aleqtisadiah, 2020). However, most Saudi Arabian museums still focus on collecting and preserving valuable objects instead of incorporating them into art education.



Figure 2.3 Painted Hall of the Old Royal Naval College.

Museums that are typically included in educational programmes do not meet Saudi Arabian art students' needs. Similar to many countries around the world, Saudi Arabia does not have enough original artworks from major artists and movements that are necessary resources to understand the history of art. In contrast, European museums have an enormous number of original pieces of art, which is why some museums have launched virtual museum experiences to increase access to their collections around the world.

2.5 Review of the Literature Related to Immersive Virtual Museums

2.5.1 Effectiveness of Immersive Virtual Museums

Museums are traditionally considered a type of learning environment (Hulusic et al., 2023) because of their significant role in preserving, exhibiting, and interpreting cultural, historical, artistic, and scientific objects. Multisensory learning is embraced by museums, with sensory-based learning constituting an essential element (Weiglhofer et al., 2023). This type of learning engages multiple senses (e.g., tactile elements, auditory devices, and visual displays) that

enable visitors to move around, understand, and explore the various objects on display. Petridis et al. (2005) suggested that when students visit a museum, they are able to interact with both tangible and intangible cultural artefacts, which can enhance their understanding of concepts related to those artefacts. Thus, students not only see artwork passively, as they do with images, but also physically interact with historical and cultural artefacts. However, traditional exhibitions in museums offer restricted possibilities for interaction between visitors and the objects on display. Petridis et al. (2005) pointed out a limitation in traditional museum exhibitions, noting that the opportunities for interaction between visitors and displayed objects are often limited to reading labels that provide few details about the exhibitions, browsing through shop brochures, and following audio guided tours that offer minimal information and fail to respond to a visitor's personal information preferences.

Meinecke et al. (2022) asserted that traditional museums face limitations in terms of the number of artworks they can display, their fixed arrangement, and the level of visitor access within a finite physical space. Further limitations include factors like the fragility of objects, the exhaustion of visitors, and the accessibility of artworks, that is, whether they are part of existing collections or are on temporary loan from other institutions. Institutions are frequently unable to present the most suitable content for illustrating a particular theme due to these constraints. Therefore, visiting a museum goes beyond passive observation of images. Museum visitors physically engage and interact with artworks rather than only see static artworks with few details. This highlights the potential drawbacks of the traditional museum, while emphasising the significance of physical interactive experiences for a more efficient learning experience.

In general, the adoption of immersive virtual technology has been considered beneficial, contributing positively not only to the learning outcomes but also to the overall experience of learners (Du Vignaux et al., 2021). This technology can be used as an effective tool to foster students' engagement and understanding of course content (Barab et al., 2000) and can be used to help learners engage in more meaningful learning experiences (Jonassen, 1994). Through systematic and comparative analysis of pedagogical, psychological, philosophical, sociological, methodological, and specialised literature; analysing the pedagogical experience of using virtual museums in general secondary

education institutions; and questioning teachers about their experience using virtual museums, Soroko (2022) concluded that virtual museums enhanced learning, increased cognitive interests, and individualised learning. They emphasised that the use of a virtual museum provided significant enhancement, expansion, and deepening of the subject matter addressed in the curriculum. Virtual museums appeared to facilitate the transfer of educational content in a relatively simple, clear, and emotional way, and they significantly enhanced students' cognitive engagement, expanded their perspective on the world, and aroused their interest in specific fields of knowledge. Despite their positive findings on virtual museums' effects on learners' experience and despite employing a variety of methodologies, including systematic and comparative analysis and surveys, Soroko's survey relied on teachers' perspectives. This approach has a potential limitation, as findings may be influenced by teachers' unique points of view (given their role as knowledge transmitters) rather than learners' perspectives as knowledge seekers. The results were also limited to secondary educational institutions; as such, the findings could be quite different for art students at a university, the target population of the present study.

The exploration of virtual reality in education has garnered significant attention in recent research. Researchers have conducted comparative studies between virtual reality and other learning tools to evaluate its potential to enhance the learning experience. In one such study, Parong and Mayer (2018), for instance, explored how immersive virtual reality influenced college students' interest, motivation, and performance. Their research compared the efficiency of delivering scientific content through immersive virtual technology versus a desktop slideshow. The findings indicated that students exposed to the slideshow experienced lower levels of motivation, interest, and engagement compared to those who interacted with the immersive version of the content.

In another study, Allcoat and Mühlénen (2018) had 99 participants experience one of three learning conditions: conventional (textbook style), virtual reality, or video (passive control). The materials used the same text and 3D model for all conditions. It was discovered that participants in the virtual reality condition reported higher levels of engagement compared to those in the other conditions. As a result, they corroborated previous studies that found that using virtual reality to examine museum content increased participants' engagement

with it. They noted the potential for virtual reality technology to act as an alternative to the traditional kind of learning that is usually focused more on reading a textbook. The fact that students using virtual reality maintained comparable levels of performance while showing a more positive mood and higher engagement suggested that virtual reality has the capacity to provide a more immersive and enjoyable learning experience. Allcoat and Mühlener highlighted the potential capabilities of immersive virtual technologies to draw in as well as maintain learners' interest and engagement compared to other means, suggesting that the way in which content is conveyed can have a major impact on the learning experience. Thus, students using these technologies are likely to encounter a richer and more immersive educational experience, potentially involving heightened engagement, interactivity, and a deeper comprehension of the subject matter.

Various studies have consistently shown that immersive virtual reality had a positive outcome with regard to different aspects of learning and in different fields, such as history, art history, and medicine. In art education, it provides new potential opportunities to update and enrich the art learning experience in museums. In one study, Hutson and Olsen (2022) examined art history students and teachers' expectations of using virtual reality headsets as part of the coursework. They offered a course aiming to explore the perceived educational advantages as well as the technical and pedagogical challenges associated with the use of virtual reality technology, considering perspectives from both students and faculty members. Subsequently, they sought to determine the best strategies for how and when to incorporate virtual reality technology into the postsecondary curriculum. Their study initially surveyed students to determine how familiar they were with virtual reality technology and the perceived advantages of integrating such technology into the curriculum. Following that, they surveyed students' experiences with virtual reality assignments in face-to-face and online coursework. The exam results in the study showed that immersive virtual reality technology was associated with better learning outcomes in terms of excitement, motivation, depth of learning, and long-term retention. However, these findings did not predominantly involve art learners; instead, the majority were from other diverse disciplines. These included six participants each from Art History and Visual Culture, Gaming and Design; three from Business Administration and/or

Sports Management; two from Healthcare Management; two from Accounting; and four from miscellaneous majors, such as Criminology, Social Work, Cybersecurity, and Marketing. In the present study, it was expected that responses from learners enrolled in an art college would likely differ from those of other majors. The expectation was that their responses would provide a more art-focused point of view, providing a clearer understanding of the experience of university students studying art.

Immersive virtual reality technologies, highlighted for their unique characteristics of immersion and interaction, have emerged as a promising tool to enhance the learning experience, outperforming traditional methods. Such tools can offer many positive outcomes in the learning process (Hutson & Olsen, 2022). As a result of these characteristics, museums have extensively employed virtual reality technologies to present museums and their collections in a more attractive manner, thereby enriching the learning experience and aligning with museums' educational goals. Moreover, Sylaiou et al. (2017) stated that the incorporation of features like 3D reconstructions of museum architectural spaces and panoramic videos and images with associated information contributed to a more enriching learning experience. Such an approach may encourage users to engage more deeply with the virtual museum content, thereby improving their reasoning and desire to learn more about the exhibitions, as well as their cognitive capacity to integrate and understand the information presented to them (Katz & Halpern, 2015).

Access to vivid and high-resolution displays is a major factor that can help create a more immersive experience for learners in virtual reality. In one study, Reymond et al. (2020) suggested that advances in digital technology had enabled a larger number of people to be able to access high-resolution artwork regardless of their location or the time of day. An example of this type of technology is ArtRift, a virtual reality tool developed for art history students and educators (Casu et al., 2015). The primary function of ArtRift is to enable the creation of virtual museum rooms that present artworks with multimodal annotations, such as audio or text descriptions, to highlight and explain various aspects of the artworks. This tool facilitates the comparison of two or more artworks by placing them in the same virtual space together. It also allows

students to use head-mounted displays or shared displays to examine the artworks.

Casu et al. (2015) evaluated the impact of immersive virtual reality on students attending Filippo Figari High School in Sassari. In their study, the researchers used ArtRift to show a selection of artworks physically located in different spaces—such as Michelangelo’s David and Moses—in one virtual environment, which participants were allowed to explore through two visualisation options. The first option used a monocular view of the 3D scene with control of the point of view using a keyboard or multitouch gestures. The second option allowed participants to investigate artworks through a virtual reality head-mounted display, specifically the Oculus Rift. In this option, users controlled their location within the room using a keyboard and could freely move and rotate their head to change the viewpoint direction. The researchers used an instructional material motivation survey to evaluate the perceived effectiveness of the virtual experience. The results indicated that through virtual reality, students were able to make direct comparisons between the physical elements of the artworks, such as texture, scale, size, and orientation. Furthermore, students reported experiencing feelings similar to those of an actual museum visit and better appreciated the details of the artworks as a result of the stereoscopic visualisation of sculptures provided by the Oculus Rift. This aligned with the findings of Shahab et al.’s (2023) study, which stated that virtual reality offered vivid and stimulating content that users could perceive and actively engage with.

Furthermore, Casu et al.’s (2015) study reported that using the Oculus Rift had a positive effect on students’ interest in the subject of the lesson, increased student satisfaction with the lesson, increased the feeling that the lesson content aligned with the students’ needs, and increased students’ motivation to learn. Despite the positive outcomes of this experiment for high school students and the presentation of a selection of artworks in the classroom that were physically located in different places, the works and elements within were limited in this approach by what the educators chose, unlike museums, which contain a more diverse collection of artworks. In addition, despite providing students with the opportunity to move around to explore the details of the artwork, the interaction using the Oculus Rift was limited to users controlling their location within the room using a keyboard and moving freely and rotating their head to change the

viewpoint direction. Additional unique characteristics of virtual reality, such as zooming in (a major focus of the present study), were not used in that study.

Using virtual reality to display artwork can enhance the viewer's appreciation for that art and its details. According to a study by Reymond et al. (2020), art students have become acclimated to seeing digital reproductions of artworks on computer screens rather than physically seeing the originals in museums or exhibitions. Nowadays, art learners can access high-resolution artwork at any time and from any place due to advancements in digital communication technology. Furthermore, it is generally presumed that these reproductions are aesthetically comparable to the original artwork. Compared to the originals, however, they differ in the representation of colour, in addition to image quality, resolution, and format. For example, the reproduction could have a higher colour saturation than the original work.

Based on the findings of Casu et al. (2015) and Reymond et al. (2020), one could expect that an aesthetic appreciation of art could be facilitated by the use of immersive virtual reality environments designed by specialists seeking to highlight elements such as texture, scale, size, and colour using devices that reproduce the museum environment and its artistic details more closely. Thus, in an immersive virtual museum, the ability to zoom in to see distant works and the clarity of their details could provide an experience better than that of a real museum.

2.5.2 The Effect of Presence on Learning Experience

Dengel and Mägdefrau (2019) and Casu et al. (2015) stated that interactivity and vividness can contribute to enhancing a sense of immersion as well as a sense of presence within a virtual museum. This would support the claim by Lau and Lee (2015) that well-developed virtual reality content has the capacity to inspire learners, enabling them to delve more deeply into a topic and explore it in greater detail. Casu et al.'s (2015) study combined two important elements in this experience (interaction and vividness) that can help produce well-developed virtual reality content. Dengel and Mägdefrau (2019) suggested that the more interactive virtual content is, the greater the immersive experience participants are likely to have. In addition, the more vivid and clear the content is, the more

realistic the virtual experience is likely to be and the more likely participants will feel present in a lifelike environment.

Virtual museums that employ three-dimensional reconstructions of physical objects and spaces usually seek to mimic a regular museum visit as realistically and authentically as possible through the incorporation of multimedia information, hypertext/spatial navigation, and the possibility to zoom in on and rotate individual virtual objects (Paliokas & Kekkeris, 2008; Sylaiou et al., 2017). In a study by Bindman et al. (2018), participants who engaged with three-dimensional virtual content using a virtual reality headset reported experiencing a deep sense of presence as well as immersion within the virtual environment due to feeling involved in and connected with the environment as well as a sense of empathy. Immersive virtual technology, in addition to supporting interaction and providing features like image fidelity, can contribute to a sense of presence or immersion (Bower, 2008). In general, the observations mentioned above highlight that recent progress in virtual reality technology not only improves user interactions but also substantially contributes to the development of a psychologically compelling and immersive virtual environment.

In another study, Chrysanthopoulos et al. (2021) stated that using immersive virtual reality technology helps engage various senses, and interaction in an immersive virtual environment can enhance the perception of visual realism and evoke a stronger sense of presence, thus enhancing the learning experience in a museum. A study conducted by Ochs and Sonderegger (2022) gave valuable insights into the relationship between immersive virtual reality headsets and learning outcomes. In that study, participants evaluated the virtual reality headset as a better tool for learning.

Navigating within a virtual museum can have a positive emotional effect on the learner. Furthermore, studies have shown that emotional response and the sense of presence have an effect on each other; for example, if someone is feeling positive while they are inside an immersive virtual environment, this emotional state can lead to a stronger sense of presence for the user when interacting in that environment (Dengel & Mägdefrau, 2019). Presence, in turn, could lead to a more positive emotional response from the user (Pekrun et al., 2000), which can help make virtual reality more immersive. Mamur et al. (2020) conducted a case study on primary and secondary school visual arts teachers'

cultural and critical readings of their virtual museum experience. The researchers found that this experience facilitated a closer examination of works of art. In turn, examining and understanding artworks in greater detail evoked appreciation and interest among the participants. The researchers claimed that museums sought to achieve many goals, including facilitating the creation of intellectual and emotional experiences that stimulate curiosity, excitement, and empathy. Attention and memory are stimulated by emotions, which are essential for learning. Consequently, as art education through immersive virtual museums continues to grow, it is important to refer to the emotional aspects of this experience.

Commenting on the emotional effect of this experience, Westwood (1999) stated that a sense of presence within a space is not something that people typically consider in their everyday lives, outside of virtual reality; instead of something they consciously think about, this sense of presence within the real world is something that they simply feel. Westwood added that not paying attention to emotional responses could lead to a failure to report important biases. These biases could be related to the desire that someone might have to please the person conducting a given study, the ways in which someone might view the positive attributes of a given piece of technology, and the fears that someone might have about how common digital technology has become. For these reasons, and because such feelings are a fundamental part of being human, it is important to examine the ways that individuals subjectively perceive or feel about virtual reality.

The feeling of presence in immersive virtual reality plays a crucial role in learning. Just like presence in traditional museums, the sense of presence in virtual reality is particularly valuable for topics and modules that rely on visit-based learning (Yow, 2022), as it significantly improves the learning experience.

The need to adopt virtual reality accelerated during the COVID-19 pandemic (Meinecke et al., 2022), as this technology could help meet the need for more efficient remote and online education while at the same time providing the advantage of self-paced learning opportunities (Yow, 2022). Virtual reality technology can allow museum visitors to transcend the limitations of location and time (Hutson & Olsen, 2022). Furthermore, using virtual reality technology in museum exhibitions can help overcome other drawbacks of physical museums,

including the static nature of traditional display modes (e.g., images), obstacles to meticulous investigation and observation, and a lack of interest (Li & Chang, 2017). It can enable visitors to navigate more freely and interactively in real time to discover and select information within a 3D environment, simulating the experience of navigating a physical museum with varying degrees of realism (Sylaiou et al., 2017). Furthermore, it can efficiently meet the needs of courses that involve visit-based learning by providing more immersive and interactive experiences that mimic real-world environments. Therefore, since its increasing adoption during the pandemic, virtual reality has been attracting attention as a potential instructional medium in museums. In addition, since the rapid deployment of online learning during the COVID-19 pandemic, universities have been preparing for another pandemic by offering courses in both offline and online formats, including virtual reality technology to replace traditional experiences (Roberts et al., 2024).

As an example of the trend noted above, Yow (2022) used Gather,¹ an online proximity-based video-conferencing platform that allows for interaction and self-paced learning, to develop a virtual anatomy museum and presented it to first-year pharmacy students enrolled in the Human Anatomy and Physiology module at Taylor's University in Malaysia. Visiting a human anatomy museum was one of the activities for that course, but due to the lockdown during the COVID-19 pandemic, it was not possible to physically visit the museum. As a result, the visit had to be conducted virtually. The aim of the study was to evaluate the learning experiences and perspectives of the students during their virtual anatomy museum visit. A self-administered questionnaire and universal sampling were used to collect 61 pharmacy students experiences and feedback. The majority of the students reported that they enjoyed the virtual visit and felt motivated by it. They discovered that the virtual museum offered a real-world environment with a self-paced learning mode, which reportedly helped them comprehend anatomy lectures more thoroughly. This experience enhanced the students' engagement with self-paced learning during their visit. In addition, students could use the virtual anatomy museum as an alternative platform for visit-based learning.

¹ This platform can be found through the following website: <https://www.gather.town/>.

As another example of the growing interest in virtual museum research, Jones and Alba (2019) conducted a comparative descriptive mixed-methods pilot study as a joint research project between the University of North Texas (UNT) and the Autonomous University of the State of Mexico (UAEM). Effectiveness, usability, and knowledge acquisition data in the Leopoldo Flores Museum in Mexico and its online three-dimensional replica were collected and analysed. The main findings of this study indicated that (a) students who visited the museum after first using the virtual environment gained more knowledge about the museum and engaged in more substantive discussion during the guided tour and that (b) the solely virtual museum experience, when used alone without visiting the actual museum, was similar to the in-person guided tour in terms of visitor satisfaction and knowledge gained. In a similar study, Cecotti et al. (2020) designed a virtual museum for paintings, in which 25 participants had their experiences assessed using questionnaires. According to the results, students reportedly felt as if they had been transported to an environment that presented material in a way that was similar to how it was displayed in a physical museum.

In another study on this topic, Tatli et al. (2021) compared virtual and real museum visits in terms of perceived presence and knowledge retention. The sample consisted of 28 students divided into two groups; one visited a virtual museum, while the other visited a physical museum. The researchers gathered data through semi-structured interviews with students, as well as drawings made by those students. In virtual museum visits, participants reported a sense of presence similar or higher to that of participants who took a physical museum tour. Thus, based on the literature cited above, the virtual museum represents a realistic alternative to a real museum, simulating an authentic experience while supporting self-learning for visit-based education.

In light of the positive findings on virtual museums' capacity to provide an authentic museum experience, there are differing opinions among scholars about how well they can replace a physical museum. Utkan Özden (2019), for example, suggested that an immersive virtual museum appears to be a powerful means of exploring a museum without limitations or constraints; however, they argued that it cannot fully replace a physical museum, although the virtual museum experience does offer the advantage of being able to view and explore any artwork or artefact simply by sitting in front of a computer. Shehade and

Stylianou-Lambert (2020) noted that a significant limitation in virtual reality is the impact on social interaction during the museum visits. Virtual reality tends to immerse users in a virtual environment and isolate them from their physical surroundings, which can hinder social interaction. This may result in users feeling isolated from others and disconnected from the wider social context; however, this is not the case if the virtual museum is multi-user and allowing several visitors can enter and interact with each other.

On the other hand, Lepouras et al. (2001) suggested that virtual reality can provide museums with a number of benefits, including the ability to solve common issues. First, virtual museums are not bound by the same limited space of physical museums or the requirement for visitors to interact with the exhibits. Second, virtual reality enables the display of objects that cannot be exhibited, such as those that are too vulnerable or valuable or cannot be displayed due to space constraints. Third, exhibits may be observed from various perspectives that could not be achieved in a physical museum, e.g., looking to the side or behind the exhibit, to explore details and aspects that visitors would not normally see. Fourth, virtual reality provides users with the opportunity to explore environments that may no longer exist, are inaccessible due to their remote location, or are in a state that prevents interior navigation. For example, virtual reality could be used to create immersive experiences of archaeological sites that have been excavated and then covered over to preserve them (e.g., see McKie, 2024). Liu et al. (2021) added that learners might fail to gain a comprehensive understanding of the exhibits during traditional physical museum visits due to exhibits being crowded, the museum giving them an overload of information, and the time restrictions of a physical visit. Schofield et al. (2018) made similar points about the advantages of virtual reality as a powerful tool that can enable museum visitors to experience locations or objects that cannot be exhibited, reconstructed, or re-enacted physically due to limitations in terms of available space, funding, or number of workers. As demonstrated by the literature cited above, there remains a conflict of scholarly opinion regarding the extent to which virtual museums could serve as a viable alternative to physical museums.

Ochs and Sonderegger (2022) mentioned that although more and more studies have examined immersive virtual reality, only a comparatively small number of these have analysed how the sense of presence could influence

learning in this context. More specifically, despite the apparent learning benefits of using immersive virtual reality in art education and museums, few studies have measured the effect of presence in virtual museums on the art learning experience, as the majority of previous research have focused on the benefits of immersion and its effects on the learning experience. Therefore, additional research is needed that addresses the link between presence in immersive virtual museums and the quality of the art learning experience. Since so few studies have examined presence in virtual museums (Zhou, 2019), the present study looked at presence as a theoretical consideration in the effect of an immersive virtual museum on art learning.

2.5.3 The Effect of the Flow State on the Learning Experience

Many researchers have claimed that visiting a physical museum generally induces a state of flow in visitors. A number of studies have examined this phenomenon, but one of the most noteworthy is Latham (2016). Latham (2016) compared the numinous experience of visiting a physical museum with the psychological concept of flow, highlighting both their structural similarities and distinctive characteristics. A numinous experience refers to a connection to a deeper, more profound dimension beyond an ordinary visit to a museum. Some individuals seek a more profound and meaningful connection with a historical place or period that evokes an emotional response. The study's results revealed that flow was a significant part of the museum visitor experience and that it should be integrated more directly into the general understanding of the potential results of museum visits. Accordingly, the researcher identified four themes in a visitor's "numinous" experience with museum objects, as outlined in the quote below:

Object Link: The object initiates an experience that links the experiencer to the past through both tangible and symbolic meanings; Being Transported: The experience is felt as if being transported to another time and place; it affects the experiencer temporally, spatially, and bodily; Connections Bigger than Self: Deeply felt epiphanic connections are made with the past, self, and spirit; Unity of the Moment: The numinous experience with museum objects is holistic,

a uniting of emotions, feelings, intellect, experience, and object. (Latham, 2016; p. 6)

Csikszentmihalyi and Robinson (1990) examined whether museums might represent a barrier to the people visiting them being able to have a deeper experience. They gave some practical suggestions to solve this issue by making changes to the museum in ways that could encourage a flow state. These recommendations included providing benches or other places to relax, better lighting arrangements, fewer distractions, better noise and crowd management, and employing didactic methods that make visitors feel more confident and help them with establishing realistic goals when visiting the museum.

The literature cited above has illustrated the value of more directly integrating the concept of flow into the understanding of how museum visits affect individuals, in particular art learners. From my personal experience, during a visit to a museum, art learners always try to gain a deeper understanding of art concepts, connect more profoundly with the artwork, and develop their appreciation for art. For that reason, the present study sought to ascertain whether the flow state and art learning experience may be affected by the interactive and immersive characteristics of a virtual museum. Interactive and immersive characteristics are essential to learning through this type of technology.

Prior research has pointed out the significance of interactivity in enhancing the effectiveness of learning. Ha and Im (2020), for instance, highlighted the positive impact of interactive and visual learning tools on the flow state and the learning experience. Interaction when using learning tools can enhance concentration (Esteban-Millat et al., 2014; Ha & Im, 2020; Kiili, 2005), curiosity, and hedonic motivation (Oudeyer et al., 2016), thereby promoting learners' active role in knowledge construction (Evans & Gibbons, 2007). Kucuk and Richardson (2019) suggested that interactivity encourages cognitive and emotional engagement while preventing distractions. Ha and Im (2020) stated that interactivity in online learning tools resulted in a state of concentration and absorption comparable to the flow state. Such research has shown how interactive and visual learning tools can induce a state of flow, enhancing the overall learning experience.

In another study, Ha and Im (2020) claimed that interaction plays a crucial role in fostering a flow state and influencing the learning experience. Colour theory principles were employed in two distinct versions of a website they developed. They conducted two studies to examine how learners were affected by an online learning tool offering interactive content that could be personalised. One version of the website featured non-interactive visual content, while the other used an interactive visual learning tool that enabled dynamic manipulation of visual content. The second study delved into the personalisation of difficulty levels within the interactive online activity. The key findings of their study indicated that interactive learning could promote active engagement by capturing students' attention, addressing their interests, and reducing distractions in their surroundings. This appeared to increase students' enjoyment and their perception of its hedonic value, which were both enhanced by offering personalised difficulty options, increasing the positive effects of the tool and ultimately contributing to an improved flow experience for learners. Their study showed the significance of interactive and personalised elements in the online learning and flow experience of college students. Nevertheless, it was conducted using a website focusing on the principles of colour theory rather than the immersive virtual environment targeted in the present study.

Various studies have claimed that interaction within a 3D environment can enrich the learning experience. For example, McLellan (2004) suggested that characteristics of virtual environments—such as 3D images and interactive displays, where users have control over the content viewed or visited—could encourage users to learn more about a given subject. In another study, Sylaiou et al. (2017) evaluated the efficacy of virtual museums with interactive 3D reconstructions according to 164 learners, the majority of whom were postgraduate and undergraduate students at Aristotle University. Five representative museum websites were selected (featuring panoramic images, scalable images with text, searchable databases, 3D environments, and videos) in accordance with predetermined criteria. These criteria were imageability, interactivity, navigability, personalisation, and communication. After exploring these websites, participants were required to complete a questionnaire that addressed a variety of generic learning outcomes, including knowledge, skills, values, emotions, and behaviour. The findings of the research, contrary to

expectations, revealed no apparent effect on learning outcomes. Positive aspects of the virtual museum that were acknowledged by participants who were familiar with gaming included it being “realistic”, “interactive”, “appealing”, and “exciting”. In particular, the participants expressed appreciation for the chance to visit a virtual museum, praising the ability to examine details of Van Gogh’s paintings. Interactive features enabled them to explore and appreciate the 3D museum’s content. This aligned with Casu et al.’s (2015) finding that virtual reality enabled students to explore the basic elements of artwork, such as texture, scale, and size, and appreciate its details. The study also closely aligned with the typical practices of art learners when examining artwork in museums, as well as with Katz and Halpern’s (2015) assertion that an online virtual museum can encourage students to become more enthusiastic about exhibitions and more deeply engaged with their content.

Another core feature of the virtual museum is the ability to let students freely access and interact with museum content from around the world (Kampourpoulou et al., 2013). Moreover, virtual museums can gather artworks physically located in different places so that they can be compared in one place (Casu et al., 2015). They allow learners to choose what they want to study, encouraging a student-centred constructivist learning environment. In this way, virtual museums can help bridge the gap between formal and informal education and enhance active learning through interaction with museum collections (Liu, 2006). The interaction tools for exploring images (e.g., options for manipulating images) in online museums enhance interactivity and enable visitors to freely access exhibit details that might not be visible to the naked eye due to size or spatial restrictions in physical museums; for example, visitors could use the zoom feature to see distant locations inside the museum, such as the ceiling, thereby enhancing the overall museum experience (Sylaiou et al., 2009; Sylaiou et al., 2017). Mundy and Burton (2013) added that the integration of digital and 3D interactive content in museums has the potential to trigger aesthetic sensitivity in people. Since not all elements of a painting or museum are easily accessible or easy to see with the naked eye, offering more interaction in virtual museums could facilitate access to these details.

A sense of control can play a crucial role in a user reaching a state of flow and becoming immersed in an interactive experience (Ha & Im, 2020). Being

given the freedom to move, make choices, and control their interactions can help learners focus on the present moment and ignore distractions. A head-mounted display can facilitate this immersion and concentration in virtual reality by isolating users from outside distractions. Considering the negative effects that distractions can have in education, including visual, physical, and auditory interruptions, the isolation from external influences provided by a head-mounted display offers a significant advantage over a traditional learning environment (Ochs & Sonderegger, 2022).

In support of the above argument, Guerra-Tamez (2023) presented a theoretical model for virtual reality learning by surveying undergraduate art and design students. An analysis of 200 surveys suggested that immersive virtual reality using a head-mounted display improved flow, which affected the learning experience via motivation, curiosity, cognitive benefits, reflective thinking, and value perception. Similarly, Perry et al. (2017) claimed that immersive virtual reality increased students' interest and engagement and helped them better understand the content. According to Rogers (1957), students cannot learn without motivation, while Kampouroupoulou et al. (2013) noted that the needs and interests of students need to be taken into account. Based on the literature, virtual reality may align with university students' interests and needs. However, flow and immersive virtual museums have only been examined together in a very small number of studies within the context of art learning, the focus of the present study.

Research has shown that one of the most significant benefits of virtual reality is that it allows users to approach objects and settings from various perspectives (Dede, 1995). In one study, Lin et al. (2020) noted that the proper projected size of artwork should be considered for better reading and viewing, and there is a need to improve the design of object size and interaction for a virtual exhibition to be as impressive as a physical one. In another study, Guerra-Tamez (2023) stated that introducing students to a virtual 3D environment could help them develop a deeper appreciation for the creative process as well as a better understanding of complex concepts. This is because, with virtual environments, learners interact and explore in new ways, using different tools and experiences to reach their creative potential. Moreover, it could simulate historic works of art and design, allowing students to view them in higher

resolution and obtain a deeper comprehension of their context. Moreover, 3D interactive content in digital museums can increase visitors' motivation, stimulate aesthetic sensibilities and creativity, and provide new approaches that engage visitors in new individualised interactive experiences (Mundy & Burton, 2013).

Diverse opinions and points of view appear among researchers concerning whether using a head-mounted display in an immersive virtual museum will contribute to an improved aesthetic experience for users. Taking a sample of 78 university students, Lin et al. (2020) compared the experience of art appreciation through desktop and head-mounted display virtual reality to appreciating a physical painting. The evaluation of paintings and the emotions expressed during their appreciation did not differ significantly across conditions, indicating that the participants believed that the paintings were comparable regardless of whether they were viewed in virtual reality. Due to technological limitations, the participants viewed head-mounted displays as hindering the free appreciation of artwork. While such displays allowed users to look in any direction, the painting scale was fixed without the ability to manipulate it. Therefore, viewers were unable to see fine details on the paintings. Consequently, the absence of some interactive features such as zoom can negatively impact the virtual reality experience.

Although using head-mounted displays to explore virtual museums can promote a state of flow by reducing distractions and increasing the focus on museum content, some critics have raised concerns about their use and impact. Yow (2022) expressed a concern that students engaging in online learning faced greater social isolation. This barrier may negatively impact students' academic performance, learning experience, and overall success during their university years.

Furthermore, several studies have addressed potential negative physical side effects of virtual reality use, particularly in immersive environments (Davis et al., 2014). The most common is cybersickness, a type of motion sickness involving symptoms of discomfort and illness caused by immersion in virtual reality (Mazloui Gavvani et al., 2018; Davis et al., 2014). Ochs and Sonderegger (2022) listed motion sickness, simulation sickness, and rift sickness. People using a virtual reality headset might suffer from nausea, sweating, dizziness, and loss of balance. McMahan (2003) suggested that these

symptoms were likely caused by poor design or overlong use of the hardware, while McCauley and Sharkey (1992) asserted that the sense of motion in virtual reality contributed to both simulator sickness and presence. The mismatch between visual stimuli and the appropriate vestibular or proprioceptive feedback is the most likely cause of these symptoms (Mazloumi Gavvani et al., 2018). This means that when the brain receives conflicting signals from the eyes (which detect motion) and the vestibular system (which helps with balance and sensing motion), it can cause confusion. The vestibular system helps the brain understand the body's position, keeping people balanced while walking, standing, or turning their head. Mousavi et al. (2013) noted that other factors were known to increase the likelihood of experiencing cybersickness. Some of these were related to technical issues such as flickers, lags, and position tracking errors. Others were related to individual differences, such as gender, age, and illness. Children from the age of 2–12, women, and individuals experiencing some forms of illness are more likely to be affected by cybersickness.

In their study, Kucuk and Richardson (2019) found that having a good interface could promote higher emotional and cognitive engagement in online learning. In addition, prior research has suggested a relationship between learning and learner emotions (Sylaiou et al., 2017). Chng (2019) asserted that emotions are a complex state of feeling that leads to physical and psychological changes, impacting both thought and behaviour. In learning, emotion refers to the feelings that learners express when the learning process takes place (Shuck et al., 2013). Emotions are thus an important variable in the learning process (Rager, 2009). Chng (2019) found that both positive and negative emotions—such as excitement, enthusiasm, confidence, frustration, enjoyment, hope, anger, anxiety, and fear—could affect learning progress. Negative emotions among students made it more difficult for them to continue their studies, while positive emotions helped them with absorbing information.

Many of the studies examining immersion in virtual reality have agreed that positive emotions associated with the experience contributed to increased interest. For instance, Guerra-Tamez (2023) stated that virtual reality offered an engaging and immersive experience that could help keep learners interested in what they were doing. The state of flow (Csikszentmihalyi, 1990) and the feeling of presence (Slater, 2003) resulting from the immersive virtual experience could

also increase interest in activities and enjoyment from being transported to the virtual environment. In a recent exploratory investigation, Marín-Morales et al. (2019) examined the psycho-physiological responses evoked during the free exploration of an art museum and its virtual rendition within a 3D immersive virtual environment. Using wearable technology, the researchers recorded electroencephalographic and electrocardiographic data from 60 participants. Their analysis revealed a deep involvement of brain synchronisation in the processing of emotional stimulation within a virtual reality setting.

Such findings align with the tendency of visual artworks to evoke deep emotional responses in viewers. For example, the monochromatic prints of Käthe Kollwitz may evoke a feeling of sadness or even depression (Arnold et al., 2014). Each student finds a personal set of emotions in each piece of art, and it is this ability to feel empathy for the tone of the work and then to have a dialogue about those feelings that aids in understanding artistic content. When one interacts with a painting or sculpture, there are instances where one may feel a connection or empathy, as if sharing one's own experiences with the work (Brinck, 2018). The act of finding meaning in, understanding, or otherwise appreciating art has long been seen as connected to pleasurable psychological reactions (Funch, 2022). Since this pleasurable feeling is an outcome of appreciating art, it is called aesthetic pleasure. Vischer (1873) emphasised the importance of emotion and empathy in understanding art. He argued that aesthetic experience comes from a concept known as *Einfühlung*, which translates to "feeling into" or "in-feeling". According to him, when we interact with works of art, we do not just observe them passively but emotionally connect with them by imagining ourselves as part of them, interacting with content on a cognitive and emotional level that resonates with the thoughts, feelings, and expressions conveyed by the artwork. Chng (2019) argued that the roles of individual emotions in online learning settings have been discussed separately (e.g., enjoyment in one study and awe in another) but not typically within the same study, and there may be many other types of emotion present throughout the learning process. Therefore, during the current study, these emotions were discussed in light of the experiences of presence and flow.

2.6 Constructivist and Immersive Virtual Museums and Art Education

According to Kealy and Subramaniam (2006), sensory immersion in education has been shown to raise students' interest, knowledge, and creative learning. Museums offer students the opportunity to learn new things and build on what they have already learned, look for things to learn that interest them, engage in learning by doing, assess how they learn, gain valuable navigation skills, have new experiences, and become more confident in themselves (Sylaiou et al., 2017). Such opportunities are also available in the direct, first-person experiences offered by virtual museums, which enable students to immerse themselves and participate more actively in their studies (Alawad et al., 2015) as well as acquire strategies for learning by doing (Said & Suboh, 2014).

Although there is no single approach that can satisfy all visitors' interests, a constructivist museum seeks to provide learners with opportunities to construct their own narratives and reach their own conclusions about the meaning of the exhibition's content (Hein, 1999). Such museums let students make their own connections with the material, encouraging diverse ways of learning. As mentioned in Section 2.2.1, constructivist educational theory posits that learners construct knowledge in their minds by interacting with the world rather than by passively adding new facts (Hein, 1998). Similarly, Katz and Halpern (2015) stated that using virtual reality lets users interact with museums as if they were visiting a physical location, deciding what to look at and from what distance and angle; in this way, it can be anticipated that users will become much more immersed in the environment presented by the museum, thereby perceiving their experience as less mediated and more real. Immersive virtual reality can thus help students gain a deeper understanding of the culture and context of the material they are learning about, ultimately leading to a more meaningful learning experience (Xu et al., 2022). Moreover, Chiang et al. (2014) suggested that students can develop a deeper understanding of a topic and become more engaged in learning by participating in activities such as field trips and interactive exhibitions through virtual reality.

With the above literature in mind, there are clear overlaps between learning in virtual reality and the goals of constructivism (Hein, 1991; Mulcahy, 2016). People who visit virtual museums have the autonomy to freely explore information in context, in line with a constructivist learning approach. In this way,

visitors engage in actively constructing knowledge about the content on display as well as themselves (Sylaiou et al., 2009).

Although constructivist theory has gained relatively wide acceptance in education due to its emphasis on active learning, direct experience, learner engagement, and learner-constructed knowledge, it also has certain noteworthy limitations (Kirschner et al., 2006). The main drawback is that constructivist pedagogy involves minimal instructor guidance due to its emphasis on approaches such as discovery, problem-based, inquiry, and experiential learning. In such a minimally guided approach, students are placed in inquiry-based learning contexts and tasked with independently discovering the foundational and well-known principles of science by imitating the investigative practices of expert researchers (Janssen et al., 2010; Kirschner et al., 2006; van Joolingen et al., 2005).

Compared to instructional approaches that place more emphasis on guiding the learning process, minimally guided instruction can be less effective and less efficient (Kirschner et al., 2006). For example, in science education, when students acquire knowledge through pure discovery methods with minimal guidance, they often feel “lost and frustrated” in the classroom (Kirschner et al., 2006, p. 6), which can lead to misconceptions and incomplete or disorganised knowledge as a result (Brown & Campione, 1994; Hardiman et al., 1986; Kirschner et al., 2006). Others have asked why constructivists advocate for learners to independently construct basic scientific concepts, such as potential energy and valency (Matthews, 2002, Taber, 2019). Driver (1983), a key figure in constructivist science education, noted that students are highly unlikely to independently develop scientific concepts without significant guidance from teachers.

Moreover, minimal guidance can lead to unequal learning outcomes (Sylaiou et al., 2017). According to Piaget, the knowledge people interact with is added to schemas of prior knowledge, wherein learners construct knowledge (Taber, 2012). Taber (2012) noted that constructivist learning heavily depends on the prior knowledge, experiences, and intrinsic motivation of the learner to direct their own learning process, so the lesson will be understood and interpreted in many different ways. This is because prior experiences impact on how students understand and perceive concepts (Jonassen, 1991; Alanazi,

2016). As a result, detractors contend that constructivism might not be equally beneficial for all learners (Alanazi, 2016). While unguided learning can aid comprehension, cognitive load theory suggests that free exploration in complex environments can increase working memory load and undermine learning, particularly for novice learners who lack the schemas to integrate new and past knowledge (Kirschner, 2006). Moreover, some psychologists have criticised it for letting dominant students control the classroom while average students are ignored (Gupta, 2011). Thus, there are a wide range of learning outcomes because students have diverse levels of ability and so require varying degrees of instruction and organisation in the classroom.

Despite the concerns outlined above, most of the research criticising constructivism has been conducted in the sciences and is not necessarily applicable to art learners, whose task is to describe and interpret artwork rather than to acquire facts about it. In the present study, students participated in learning experiences within a virtual museum using a free exploration approach. This created the potential for gaining knowledge from direct observation rather than relying on perspectives provided by others. The museum represented an authentic learning environment, following an instructional approach that places students in environments in which they can explore, discuss, and meaningfully construct concepts about issues directly relevant to the real world (Donovan et al., 1999). Thus, museums support first-person experiences and attract students' attention, motivating them to study and thereby enhancing their reflection (Winn, 1993). In addition, the learning that occurs in museums could be seen as unconventional and largely democratic (Tripathi, 2020). In museums, art students are encouraged to freely explore, ask questions, and seek answers. With the absence of texts in the museum and a planned route for visitors to follow, different visitors could construct their own meanings, and they may choose different artefacts to examine and reflect upon. For instance, one museum visitor that Tripathi (2020) interviewed tried to understand and engage with the artworks and constructed her own meanings. The role of museums is thus shifting from being primarily authoritative knowledge sources to providing individuals with opportunities to learn in their own ways and allowing visitors to engage in independent learning (Tripathi, 2020). This is aligned with art learning; students' appreciation of art is a subjective and individual interpretation of the content they

have learned and experienced (Tripathi, 2020). This means that a virtual museum, when incorporated into a university course, could benefit from both guided and individual exploration being made available. Guided exploration offers structured goals and insights from experts, making it easier for students to understand the background and value of the material on display. In contrast, individual exploration enables a more personal engagement with the displayed material, encouraging students to come to their own conclusions about it and develop a deeper emotional connection to it.

A large number of studies have discussed the role of constructivism in schools, but only a few of them have examined this issue among undergraduate university students. In one of these studies, for example, Alt (2015) measured academic self-efficacy in 167 undergraduates, comparing problem-based learning to lecture-based learning. Students in problem-based learning saw the learning environment as more constructivist and had higher academic self-efficacy than those in lecture-based learning. The most significant positive predictor of academic self-efficacy in the study was the extent to which higher-order meta-cognitive learning processes towards knowledge were engaged. Despite the positive results among undergraduates, they only participated in a few studies, particularly in art. The present study will therefore enrich this area of research by taking a constructivist approach to art learning among undergraduate university students in an immersive virtual museum.

2.7 Learner Attitudes Toward Immersive Virtual Museums

The second research question of this study sought to understand the impact of the immersive virtual museum experience on art learners' attitudes toward using this technology. Bandura (1977) highlights that people's experiences and observations significantly shape their attitudes and behaviours. Supporting this, research indicates that engaging virtual environments also positively influence learners' attitudes (Konečni, 2015; Li et al., 2002; Shim, 2003). In their study, Taylor and Todd (1995) claimed that positive attitudes toward learning in a virtual environment could lead to better participation and learning. This claim has been supported by a number of recent research.

Deng et al. (2023) argued that having experience of visiting virtual museums influenced visitors' willingness to visit museums in the future. The

researchers distributed questionnaires to 429 participants. The participants were 55% women and 45% men, and most of them were 18–35 years old, generally with a higher education level (a bachelor's degree or above). Over 66% of the sample reported having prior experience with a digital museum. The results revealed that the more positive the cognitive experience was during a virtual museum, the more positive emotional evaluations were found, which in turn increased participants' willingness to visit physical museums in person. Furthermore, the researchers found that cognitive immersion, interactive experience, hedonic experience, and available experience all had a positive effect on the participants' intention to visit physical museums in the future.

For their study, Liu et al. (2021) designed a virtual museum called Tujia instruments museum (Vtujia). The design of the museum was based on seven principles of multimedia design. These principles were coherence, signalling, redundancy, spatial contiguity, temporal contiguity, multimedia, and personalisation principle. The experiment involved 56 college students who volunteered to participate in the study. Among them, there were 21 men and 35 women. The age range of the participants was between 20 and 22. The participants received instructions to experience Vtujia and complete a questionnaire. The findings revealed that the students held a positive attitude toward the virtual museum. This positive attitude suggested that virtual museums can be a valuable tool in education, potentially increasing interest in learning and engagement and paving the way for further research and applications in diverse educational contexts.

Kampouropoulou et al. (2013) investigated the construction and use of art heritage virtual museums in education. After 100 students were taught using this method and answered a questionnaire, most participants reported positive attitudes, based on the idea that virtual museums enriched the traditional methods of learning. In contrast, Antonaci et al.'s (2013) study assessed 29 Italian school teachers and 372 students' awareness, perception, and actual use of virtual museums and found a low use of virtual museums. This was despite participants considering them powerful tools.

In a study conducted in Saudi Arabia, Ismaeel and Al-Abdullatif (2016) examined the potential that virtual museums had as an effective educational tool. They investigated the views of sixth-grade students regarding the interactive

Virtual Museum of Al Hassa Cultural Heritage. At the end of the course, 118 students answered a questionnaire. The results revealed positive attitudes toward using an interactive virtual museum in cultural heritage education. This finding confirmed the importance of virtual museums as a means of enriching and complementing the curriculum. On the other hand, Saudi Arabian universities rarely use digital technology in education (Al Mulhim, 2014). Moreover, few studies have addressed the attitudes of art students toward immersive virtual museums in art education or considered these museums as powerful learning tools. This gap in the literature motivated the present study.

In their study, Baxter and Hainey (2019) used a mixed-methods approach to assess the perspectives of 100 undergraduate students in the creative industries on the use of virtual reality. Their goal was to determine whether virtual reality had the potential to support and provide novel pedagogical avenues in higher education. The majority of the findings were positive, with students indicating that virtual reality could be used in education. Due to the small sample size and the fact that the research was conducted at only one academic institution, generalisations could not be made from the results; however, some of the findings may be transferable to other settings and similar situations.

Cecotti et al. (2020) proposed a new fully immersive virtual reality museum for paintings. It was designed for art history lecturers in which users could explore a series of paintings in their original size. The originality of the application was that anyone could easily modify its content, including the paintings and questions linked to each painting, without prior programming experience. Through a NASA-Task Load Index test (NASA-TLX) and system usability scale (SUS), 25 participants assessed the workload and system usability. The results indicated that the system was highly usable, suggesting it could be implemented in art history courses to increase engagement among students. Regardless of the limitations of the virtual reality technology, participant feedback indicated that the immersive aspect was successful and that the learning benefits could be extended beyond art history students to various individuals interested in art. On the other hand, Cecotti et al. (2020) noted that although the resolution of current virtual reality headsets is sufficient for appreciating visual art, users still recognise that they are staring at a computer screen. Therefore, compared to an actual museum, the virtual reality experience could be seen as more restrictive.

Many studies have employed quantitative tools to measure learner attitudes toward using digital technology, typically using the technology acceptance model (developed by Fred D. Davis in 1989), the main model used in acceptance research (Vogelsang et al., 2013). The main component of the model is the user's attitude toward technology use. Perceived usefulness and perceived ease of use shape this attitude and the intention to use a given piece of technology.

In a study employing the technology acceptance model, Hung et al. (2013) surveyed 441 users of three virtual weather museums in Taiwan. Their aim was to offer insight into digital museum adoption from user and system perspectives. The findings indicated that many of the participants intended to use digital museums and held a positive opinion of them.

Based on the same model, Awang et al. (2009) likewise surveyed the intention to use virtual reality among museum visitors. Perceived usefulness, perceived ease of use, and perceived enjoyment were the independent variables. This study was conducted based on a prototype of the ViSeum virtual museum. The results showed that ease of use, usefulness, and enjoyment predicted the use of ViSeum.

In an empirical study, Huang et al. (2015) surveyed 167 university students' views on learning via virtual reality applications. Their answers indicated an intention to use virtual reality. This intention was encouraged by the factors of interaction, immersion, and imagination, which had a positive impact on virtual reality's perceived ease of use and perceived usefulness, which in turn influenced their behavioural intention to use that technology. Thus, positive beliefs and attitudes would appear to support learners' intention to learn in a virtual environment (Huang et al., 2010). In this context, Huang et al. (2015) explained the importance of evaluating user acceptance of virtual reality learning environments in order to ensure effective use of immersive virtual reality technology.

Flow is generally defined by a positive state of mind that can make individuals more likely to want to enter that state again in the future (Katz & Halpern, 2015). The learner's ability to control the flow of information when they are in the process of interacting with something can increase the cognitive ability to understand, retain, and then incorporate new information. For these reasons,

flow in virtual reality has been associated with people using virtual reality more often and for longer periods of time (Hassan et al., 2020). In addition, when virtual reality users feel a sense of presence in a physical museum, they are more likely to hold a positive view of the virtual museum and the material it has on display. In their study, Katz and Halpern (2015) showed that when an online museum was more similar to a physical museum, visitors were more likely to view the museum content in a positive and accurate light. In that study, the researchers exposed a total of 565 participants to four virtual museums: these included 2D art and aircraft museum collections and comparable 3D collections. The study revealed that the relationship between a 3D environment and the visitors' intention to visit the physical museum in the future was moderated by the feeling of presence and cognitive participation that they experienced in the virtual museum. As a result, the researchers recommended that teachers offer 3D museum tours in order to engage their students in a more realistic learning environment. The study also indicated that offering multimodal feedback and richer perceptual cues—such as the ability to view 3D objects from various perspectives and being able to zoom in on such objects—could improve reasoning and increase interest in cultural content. Therefore, based on these and other studies, when users perceive virtual reality as more realistic, they are more likely to keep engaging in it and avoid getting discouraged (Hassan et al., 2020).

Few studies have qualitatively measured learner attitudes about virtual museums, despite such methods being encouraged. At the end of the 1990s, researchers in information systems were encouraged to use more qualitative methods instead of focusing entirely on quantitative methods (Hirschheim & Klein, 2012). Palvia et al. (2003) found that qualitative research methods were ideally suited for examining complex organisational contexts that are usually used in the information systems field. With this in mind, qualitative research could help promote a better understanding of art students' attitudes about using the immersive virtual museum in learning. Vogelsang et al. (2013) argued that qualitative research could overcome the limitations of purely quantitative methods in this area, since all categories and factors in a study can be described effectually, unlike quantitative research, as three or four quantitative items cannot measure an implementation process. Despite the valuable results of the above research, this type of study has not often been applied to university art students,

and self-reported student attitudes toward an immersive virtual museum experience are likewise limited. Such a gap in the literature calls for more research in this area, particularly in places like Saudi Arabia where relatively few of these studies have been conducted.

This literature review has combined dimensions of the technology acceptance model (see Figure 2.4), highlighting key concepts such as external factors (vivid content, cognitive immersion, interaction, and imagination) that influence users' perception of technology's usefulness and ease of use. Students find virtual reality user-friendly, facilitating effortless interaction and engagement, and consider it highly useful for learning by enhancing their cognitive ability to understand, retain, and incorporate new information. Consequently, students express positive attitudes toward immersive virtual museums and intend to use them in the future due to the positive experiences, usefulness, and ease of use they provide. This aligns with the technology acceptance model upon which the second research question was based.

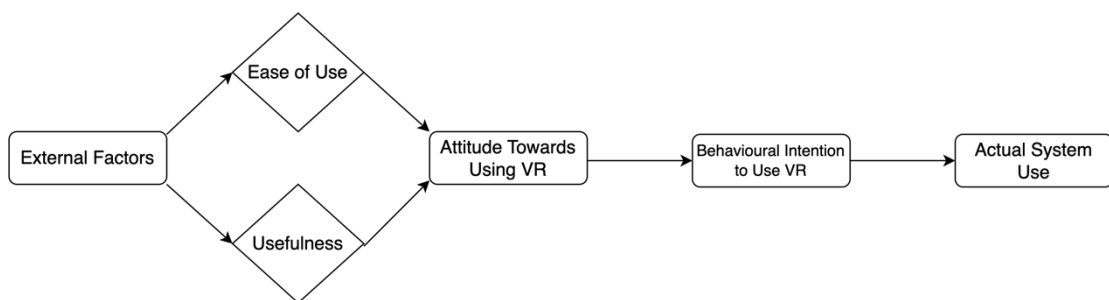


Figure 2.4 Dimensions of the technology acceptance model (Davis, 1989).

This technology acceptance model was adopted because its goal is to understand the personal experiences related to the factors of perceived usefulness, ease of use, and intention to use. However, these factors of the technology acceptance model may not sufficiently capture the details of subjective experiences through the commonly used quantitative approach in technology acceptance studies. Therefore, the focus shifted to qualitative investigation, which allows for richer and deeper insights into how immersive virtual museums affected subjective experiences related to perceived usefulness, ease of use, and intention to use, rather than just focusing on measuring variables as in quantitative studies.

2.8 Chapter Summary

This chapter defined the main components of an immersive virtual museum, including the concept of immersive virtual reality, virtual reality devices, immersive virtual reality characteristics, the effects of such devices on users, and how museums are adapting to this evolving technology. The theories and concepts adopted to guide the study (i.e., constructivism, active learning, flow theory, presence, and the technology acceptance model) were explained in relation to virtual reality. The chapter then explained the potential of the immersive virtual museum in the context of education, including the concepts of presence and flow, followed by a discussion of users' attitudes about immersive virtual reality in museums and their intention to use this technology. In doing so, the chapter highlighted a gap in the literature that the present study seeks to address.

Chapter 3: Research Design

3.1 Introduction

The purpose of this study is to understand the effect that an immersive virtual museum can have on art students' self-reported learning experiences as well as how this experience affects their attitude toward experiencing more such experiences in the future. The first research question and its two sub-questions targeted students' learning experience with an immersive virtual museum through their sense of presence and flow:

1. How do art students in higher education in Saudi Arabia experience learning in an immersive virtual museum?
 - 1.1 How do art students in higher education in Saudi Arabia experience presence when learning in an immersive virtual museum?
 - 1.2 How do art students in higher education in Saudi Arabia experience flow when learning in an immersive virtual museum?

The second research question and its related sub-questions targeted the same students' attitudes toward the immersive virtual museum used in this study:

2. How do art students in higher education in Saudi Arabia perceive learning through an immersive virtual museum?
 - 2.1 How do art students in higher education in Saudi Arabia perceive the ease of using an immersive virtual museum in their learning?
 - 2.2 How do art students in higher education in Saudi Arabia perceive the usefulness of immersive virtual museums in their learning?
 - 2.3 How do art students in higher education in Saudi Arabia intend to use immersive virtual museums in the future?

This chapter provides an overall discussion of the methodology of the study. It begins with the research approach, including how an interpretivist paradigm and qualitative approach guided the study. It then states the researcher's stance on the philosophical worldview that framed the study. This is followed by a description of the procedures that were adopted in this study to understand the participants' experiences in the immersive virtual museum and their attitudes toward learning through such museums and intention to use them again in the future. The participants as well as the data collection and analysis techniques employed in the study are described in detail. The chapter then

discusses the researcher's role in the study, the steps that were taken to increase the trustworthiness of the findings, and some of the main ethical considerations that were taken into account.

3.2 Research Approach

All research involves taking a particular philosophical worldview and research paradigm to collect, analyse, and present findings. Although usually implicit, a study's paradigm significantly influences the thinking and practices involved in carrying out the study (Wahyuni, 2012). Research paradigms assist researchers in defining the nature of an enquiry along specific philosophical dimensions (Guba & Lincoln, 1994; Blanche et al., 2006), guiding them to select methods that align ontologically and epistemologically with their fundamental beliefs (Guba & Lincoln, 1994), and justifying their choice of particular methods (Crotty, 1998).

Research paradigms can be distinguished by two main philosophical dimensions: ontology and epistemology (Kalof et al., 2008; Laughlin, 1995; Saunders et al., 2009; Wahyuni, 2012). Ontology can be defined as "an area of philosophy that deals with the nature of being, or what exists; the area of philosophy that asks what really is and the fundamental categories of reality" (Neuman, 2011, p. 92). It focuses on the existence of reality, which can be perceived as either dependent or independent of social actors and their interpretations, depending on the theoretical framework followed (Saunders et al., 2009; Wahyuni, 2012). Epistemology, in contrast, refers to "an area of philosophy concerned with the creation of knowledge; it focuses on how we know what we know or what are the most valid ways to reach truth" (Neuman, 2011, p. 93). Epistemology emphasises ways to generate, understand, and use knowledge that are considered acceptable and valid within the given framework (Wahyuni, 2012). Furthermore, a research methodology can be quantitative, qualitative, or mixed, depending on the specific needs and objectives of the study (Bryman, 2012).

The purpose of the present study was to understand how individuals interpreted their learning experiences, their attitudes and intention to use this technology in the future. Specifically, it explored how participants constructed their understanding of the world through their interactions with their environment.

Consequently, this research was based on an interpretivist worldview, which emphasises the subjective interpretation of social phenomena.

The interpretivist paradigm seeks to understand individuals' views about their own experiences (Guba & Lincoln, 1989). Interpretivists believe that reality is based on social actors and their subjective perceptions and interpretations of it. Because of the diversity in individuals' backgrounds, assumptions, and experiences, social reality can be understood through the lens of multiple perspectives (Hennink et al., 2011). Thus, to understand participants' experiences and subjective meanings, interpretivist researchers tend to engage in a dialogue with participants (Wahyuni, 2012) in order to get specific details about a particular social reality being studied and to display them in a narrative form of analysis (Neuman, 2011). Axiologically, interpretivist researchers study reality from social actors' personal perspectives; thus, participants and researchers' values significantly influence the collection and analysis of data in this type of research. The interpretivist researcher is viewed as the "primary interpreter and filter" of data (Goodwin & Goodwin, 1996, p. 111). According to Drisko (2013), this type of "researcher serves as a witness and also as a translator of experiences and understandings across different social groups" (p. 85). As a result, the researcher should try to be as objective as possible in gathering and analysing the data.

A qualitative approach to research focuses on exploring and understanding the individual meaning of a phenomenon by collecting detailed, in-depth data (Creswell, 2014). Such data are often gathered to answer questions about what is happening or how something came about (Suter, 2012). For these reasons, qualitative research findings typically focus on words rather than on numbers (Bryman, 2012). This type of research is widely used in the field of education due to its ability to investigate topics within their natural contexts and to interpret phenomena based on the subjective interpretations given by individuals (Denzin & Lincoln, 2011). Qualitative research is frequently described as inductive in nature, focusing on identifying themes from the data without forcing a specific theoretical model. According to Braun and Clarke (2019), this type of analysis involves the interpretation and construction of meaning by the researcher. Themes are developed through a process of interpretation that incorporates the researcher's conceptual influences and understanding. This

process is not purely inductive but rather integrative, combining both inductive and deductive elements. This methodology involves exploring a variety of possible interpretations of the data in order to show how the researcher came to a particular conclusion, thus making it easier for readers to assess how valid the stated results are.

To gather the data, the researcher in the present study employed semi-structured interviews. The main benefit of this data collection method is that it enables the interviewer to communicate directly with the participants in a way that can ultimately produce more detailed information, such as through elaboration and clarification (Shneiderman & Plaisant, 2006). It provides an opportunity for participants to share their perspectives, beliefs, and emotions, offering a deeper understanding of the meanings they assign to events and situations. In this context, the interviewer should seek to establish a rapport with participants, listen actively, and engage in a process of data analysis to identify themes within the responses of the participants. A semi-structured interview consists of a set of pre-planned main questions that are used as a guide to cover the same topics with each person who is interviewed, who is then given the opportunity to clarify or provide further details, if needed, to reach a deeper understanding (Sönmez, 2013).

Moreover, semi-structured interviews allow for flexibility in the data collection process. While the pre-planned questions ensure that certain topics are addressed uniformly across all interviews, the interviewer can adapt the conversation based on the participant's responses, pursuing interesting or unexpected lines of inquiry as they arise. This adaptability can lead to richer, more nuanced data, capturing the complexity of participants' experiences and perspectives. The open-ended nature of semi-structured interviews facilitates a conversational style, encouraging participants to express themselves more freely and openly than they might in a more structured or rigid interview format. As participants articulate their thoughts and feelings in their own words, the interviewer can probe deeper into their responses, seeking to understand the underlying reasons and motivations behind their statements. This method aligns well with the interpretivist paradigm's emphasis on understanding the subjective meanings and interpretations individuals attach to their experiences.

In addition, the interactive nature of semi-structured interviews helps build a rapport between the interviewer and the participants, which can enhance the quality and depth of the data collected. When participants feel comfortable and trust the interviewer, they are more likely to share candid and detailed information, leading to a richer and more comprehensive understanding of the research topic. The process of conducting semi-structured interviews also allows the researcher to observe non-verbal cues, such as body language and facial expressions, which can provide additional context and insight into the participants' responses and motivate the researcher to delve deeper into the reactions and try to understand them. These observations can be valuable in interpreting the data and understanding the full scope of participants' experiences and perspectives. Thus, semi-structured interviews are a powerful tool for qualitative research within the interpretivist paradigm, enabling researchers to gather in-depth, nuanced data that reflect the complex and varied realities of the participants' lived experiences.

3.3 The Researcher's Stance on the Research Paradigm

I expected that introducing an immersive virtual learning experience to art students would most likely produce an effect on their learning or attitudes. Therefore, I wanted to understand what these effects might be. To answer the research questions, I adopted an interpretivist research paradigm, as it was the most relevant to the present study. This research examined the shared meaning and understanding of the participants' experiences. As such, the participants were asked to describe their individual experiences, with the researcher documenting the subtleties of these experiences through face-to-face individual interviews and then producing interpretations of what participants said and felt in this context. I decided to use a qualitative approach for two main reasons. First, such an approach would be more appropriate to provide an in-depth understanding and interpretation of the participants' responses to the experience. Second, the nature of the required data relied on the words that participants used to express their experience. This would entail constructing the meaning and impact of the immersive learning experience.

Additionally, the interpretivist paradigm aligns well with the aim of exploring the subjective realities and personal meanings that participants attach

to their experiences. This paradigm acknowledges that each participant's perspective is unique and valuable, thereby enabling a richer and more nuanced understanding of how immersive virtual learning influences art students. By using qualitative methods, I could delve deeply into the participants' narratives, capturing the complexities and intricacies of their experiences.

This approach not only facilitated a thorough exploration of individual responses but also allowed for the identification of patterns and themes that might not have been evident through quantitative methods. Consequently, this methodology was instrumental in shedding light on the multifaceted impacts of immersive learning environments on students' educational journeys.

3.4 Participants

This study targeted undergraduate students from Saudi higher education art departments who met the following criteria. Participants had to have been enrolled in academic art courses; have studied the foundation modules, i.e., art history and art criticism; have completed at least two years of full-time study; and be at least 19 years of age. These selection criteria were necessary to ensure that the students had the requisite art knowledge to participate.

After receiving ethics approval, the researcher requested a list of all students enrolled in the art programs of two of the most prominent universities in Saudi Arabia in the 2021-2022 academic year. The lists that the respective art programmes gave the researcher contained 63 potential participants. All the participants were volunteers. Additionally, all the participants in the study were women due to the location of the study. Gathering qualitative data is complicated in Saudi Arabia by gender norms that can hinder interaction between men and women. Since the researcher in this study is a woman, this meant that gathering data from male students through individual (one-to-one) interviews would have been difficult.

One way to get around this issue would have been to have a man interview male participants, with the main researcher interviewing female participants. Moreover, another relevant issue is that there were no male students enrolled in the art school programmes of either university where the study took place during the period in which the study was conducted. As a result of these issues, all the

interviews were limited to female students who were enrolled in the two target art school programmes.

The researcher acknowledges that this in turn may impact the scope and generalisability of the research findings. The exclusive focus on female students might limit the ability to generalise the findings to all art students in Saudi Arabia or in other cultural contexts where gender dynamics differ. Nonetheless, this approach provided valuable insights into the experiences of female art students in Saudi Arabia, a group that has historically faced unique educational and social challenges. Additionally, the focus on this demographic allowed for a more in-depth exploration of their specific perspectives and experiences, which might have been diluted if the sample had included both genders. The researcher also notes that future studies could expand the sample to include male students or conduct comparative studies across different cultural settings to enhance the generalizability and applicability of the findings. Despite the limitations, the convenience sampling method used was appropriate for the study's aims and context, allowing for effective and efficient data collection during a challenging time.

After identifying a list of 47 students who qualified to participate, an invitation was sent via email in late September 2021. The email included a brief summary of the topic and purpose of the study, detailing what the interview would entail, and the use of a virtual reality headset and touring a virtual museum. Invitation recipients were asked to reply to the email if they wished to participate. They were given six weeks to respond to the invitation and give an interview, although this period was later extended due to a weak response rate. This study took place during the COVID-19 pandemic, when most universities were closed, and most courses were being taught remotely. As a result, I allowed for an extended period to receive their consent to participate in order to reach a sufficient number of participants.

Written consent was obtained from participants after they responded to the invitation email. The written consent form explained the aims of the study, what the interview would include, how their data would be used, and that pseudonyms would be used to ensure, as far as possible, their anonymity. Of the 47 participants who met the requirements of the study, 31 replied to the email and were willing to participate in a face-to-face interview, although one of them

apologised for not attending after the appointment was set, leading to a final sample of 30. This sample size was deemed sufficient to provide clarity, insight, and understanding (see Neuman, 2011) about the role of immersive virtual museums in art students' experiences and attitudes.

Interviewees were asked to choose a time that would be convenient for them at one of two available locations to conduct the interviews. This study was conducted on the campus of two universities in the capital of Saudi Arabia that awarded bachelor's, master's, and doctoral degrees in Fine Arts. Before the study, I had worked at a Saudi university (unaffiliated with the present study) as a lecturer, teaching theoretical and practical art subjects before moving to the Department of Curriculum and Teaching Methods of Art Education at one of the Saudi universities that participated in this study and worked at it for six years. Despite the fact that I had worked at one of the universities involved in the study, I was not the participating students' teacher and had no power over them. This led to a more equal relationship with the participants.

Therefore, this context was familiar to me and eased access to potential participants. Art students usually study the foundational modules relevant to art history, museum and exhibition studies, and art criticism in the first two years of their programme and apply the content of these foundational modules during the rest of the programme. Since art resources are essentially limitless, institutions give students the freedom to search for resources through the Internet, books, or museums and exhibitions to complement their learning. Often, these resources are visual, with images based on a particular photographer's perspective. This diversity in learning materials encourages students to explore a wide range of artistic expressions and historical contexts, enriching their educational experience.

The familiarity with the academic environment and the art curriculum at these universities provided an advantage in understanding the students' educational background and their potential engagement with the immersive virtual museum experience. My previous teaching experience and my role in the Department of Curriculum and Teaching Methods of Art Education helped in designing the study in a way that was relevant and accessible to the participants. This connection to the educational context ensured that the interviews were

conducted in a supportive and understanding atmosphere, facilitating open and honest communication.

In conclusion, the study's design, participant selection, and data collection methods were carefully chosen to align with the research objectives and the unique context of Saudi Arabian higher education. The use of the sample and familiarity with the academic environment all contributed to the study's ability to gather meaningful and in-depth data on the impact of using immersive virtual museum on art learners' experiences, attitudes and their intention to use the immersive museums.

3.5 Semi-Structured Interviews

The nature of the questions that this study sought to address required oral answers so that the participants could more fully describe their perspective, experience, and feelings during their visit to the immersive virtual reality museum and so that they could provide further explanation and details if necessary. This need prompted the researcher to choose to gather the study's data through open-ended semi-structured interviews. The goal of an interview is to encourage a conversation between the interviewer and the participant based on the participant's reflections on and discussion of their experiences for the purpose of constructing a mutual understanding about those experiences (Ornek, 2008). In addition, the interviewer can ask for more details or clarifications after asking predetermined questions to ensure a better understanding of their responses, e.g., "Could you please explain?" (Barnard et al., 1999). This strategy enables researchers to better understand the subjective interpretations and perspectives of the participants.

During one-on-one interviews, participants in the present study were encouraged to express their feelings, interpretations, and opinions regarding their personal experience in their own words. This allowed for the collection of much richer and more detailed feedback than would have been possible otherwise. The richness of qualitative data is vital in capturing the complexities of participants' experiences, which quantitative data might not fully convey. The open-ended nature of the questions permitted participants to delve deeply into their personal narratives, thereby providing comprehensive insights into their engagement with the immersive virtual reality museum.

All the participants in this study were asked the same set of pre-planned questions during the interviews to cover the same topics with each participant. The questions were used as a starting point to begin a dialogue, with follow-up questions asked based on their individual responses. This approach ensured consistency across interviews while allowing flexibility to explore unique aspects of each participant's experience. In this way, the semi-structured interviews encouraged the interviewees to express themselves freely within the limits of the study's area of interest. The flexibility of semi-structured interviews is particularly beneficial where the goal is to understand new insights and understandings that may not have been anticipated by the researcher.

Based on the literature, the conceptual framework (see Chapter 2 for further details), and the research questions, I formulated the main and guiding interview questions. By reviewing previous qualitative and quantitative literature, a set of interview questions was derived from which the required information could be obtained. The interview questions were formulated in accordance with the research objectives and the conceptual framework. Identifying them helped to set the main themes that would be explored during the interviews and helped to design questions that would focus on capturing data relevant to the research context through a broad exploratory question followed by more specific questions. The main themes included participants' perceptions of the immersive virtual museum experience, its effect on their learning, attitude and intention to use the immersive museum.

To verify the quality of these questions, a pilot study was conducted with three colleagues, two of which had graduated and were employed as art teachers at the time of the study, while the third was a doctoral student who would go on to graduate and become a teacher after the data were collected. Their answers obtained during the pilot study were not included in the main study. The purpose of the pilot study was to identify any potential weaknesses or flaws in the interview design before proceeding with the main study (see Turner et al., 2010). Pilot testing is a critical step in qualitative research as it helps refine the data collection process, ensuring that the questions are clear and capable of eliciting the desired information. Thus, after the pilot study was completed and analysed, I made changes to some of the interview questions. These changes were minor refinements to remove duplication and to rephrase questions to make them

easier to understand (see Section 3.8 for further details). These adjustments were aimed at enhancing the clarity and effectiveness of the questions to facilitate better communication during the interviews.

To answer the first research question, which focused on the learning experience, I designed indirect open-ended questions, with follow-up questions asked throughout the interview to gain a better understanding of the participants' responses. Indirect questions are useful in encouraging participants to reflect deeply and provide more nuanced answers. For example, instead of directly asking about their learning outcomes, I might ask, "Did the virtual museum help you examine the content, construct meaningful knowledge, and understand the elements of the topic? " This type of question prompts participants to think critically and share detailed reflections, which are invaluable for qualitative analysis. Follow-up questions such as, " Why do you think that?" further helped in delving into specific details and enhancing the depth of the data collected. This comprehensive approach ensured that the interviews provided rich, detailed data that could be thoroughly analysed to answer the research questions and achieve the study's objectives.

The final interview protocol consisted of the following questions:

1. How was your experience learning in the virtual museum?
 - 1.1. If applicable, please give reasons or justifications for your answer (Why do you think that?).
2. Does the immersive experience help you actively engage and become involved in new explorations of the art content (topics and features)?
 - 2.1 If so, can you explain how?
3. Did the virtual museum help you examine the content, construct meaningful knowledge, and understand the elements of the topic?
 - 3.1 If so, what made you notice that it helped?
 - 3.2 Can you give examples?
4. Describe the extent to which you shut down your sense of the outside world.
 - 4.1 Can you explain how you felt?

5. How did this disconnect help you perceive the virtual museum content (i.e., the topics of the paintings)?

5.1 Can you provide an example?

6. Did you feel like you were in a real museum?

6.1 Can you provide three examples of the things that made you feel like you were in a real museum?

7. To what extent did a sense of presence help you deeply explore the virtual museum artworks?

7.1 Can you provide three examples?

8. To what extent did the ability to directly control movement, navigate, zoom in, and change viewpoints of the content facilitate your learning experience?

8.1 Can you provide an example?

9. What are the strengths of using virtual museums in terms of helping you construct new knowledge and understanding of artworks? (For example, aesthetic value.)

10. What are the weaknesses of using virtual museums in terms of helping you construct new knowledge and understanding of artworks? (For example, aesthetic value.)

11. Would you like to provide any further notes or comments?

The second main research question asked about learners' views on learning through an immersive virtual museum. To answer this and follow up questions, such as why participants adopted these views, I used direct qualitative questions. The interview questions in this study were formulated based on the main concepts of the technology acceptance model that have been used in several quantitative studies (see Chapter 2), including perceptions of ease of use, usefulness, and intention to use. I did not use common models but rather relied on asking participants directly about ease of use, usefulness, and intention to use. This was done to give the participants the freedom to express what they thought without restricting them to previous models that were not related to art learning in an immersive virtual museum. This type of question provided better access to participants' thoughts, feelings, and interpretations of the meaning and justification of their attitudes (Sutton & Austin, 2015). The goal was to explain

how individuals' experience of immersive virtual museum, including feelings and thoughts, influence art learners' attitudes and intention to use it.

The final interview protocol was based on the three sub-questions of the second research question:

1. How do art students in higher education in Saudi Arabia perceive the ease of using an immersive virtual museum in their learning?
2. How do art students in higher education in Saudi Arabia perceive the usefulness of immersive virtual museums in their learning?
3. How do art students in higher education in Saudi Arabia intend to use immersive virtual museums in the future?

3.6 Materials

3.6.1 Oculus Virtual Reality Headset

The Oculus virtual reality headset is one of the best options to use in immersive virtual environments, especially for art students (Coyne et al., 2019; Guerra-Tamez, 2023; Wang et al., 2023). In addition to the common features of virtual reality headsets, such as free exploration and 360-degree views, the Oculus Meta Quest 2 provides a 1832x1920 resolution that contributes to the feeling of being in a real environment (Meta, n.d.). As a result, it can display a high level of detail. For artists and learners, exploring paintings and other museum content in a virtual environment requires high-resolution imagery and precise control over the environment. For these reasons, the Oculus Meta Quest 2 was the virtual reality headset chosen for this study.

The Oculus headset effectively isolates the wearer from their physical surroundings, ensuring an immersive virtual experience. Recognising the potential hazards of moving around blind to the real world, the headset incorporates a vital safety feature: guardian boundaries. Prior to entering the virtual environment, users can define these boundaries using hand-held controllers, as depicted in Figure 3.1 (sourced from Adeola, n.d.-a). This proactive measure serves to confine users within a predetermined area, alerting them if they approach the boundaries during exploration.

The guardian boundaries act as virtual guardrails, providing visual and auditory cues to warn users when they near the limits of their designated space. Should a user venture beyond these boundaries, the virtual environment

seamlessly transitions to a view of their actual surroundings, effectively grounding them back to reality. This feature facilitates a safe and intuitive navigation experience, empowering users to move naturally within the virtual environment without fear of colliding with physical obstacles.

By leveraging this system, users can freely engage with virtual objects and surroundings, employing familiar body movements to interact and explore. This seamless integration of virtual and physical spaces enhances the overall sense of presence and immersion, enabling users to fluidly transition between the two realms. Whether interacting with virtual exhibits or admiring panoramic vistas, users can navigate with confidence, knowing that the guardian boundaries provide a safeguard against potential hazards in the physical environment.

In essence, the Oculus headset's implementation of guardian boundaries fosters a harmonious blend of safety and freedom within the virtual environment. By allowing users to move naturally while maintaining awareness of their physical surroundings, this feature enhances the user experience, promoting immersive exploration and interaction. Thus, users can confidently embrace the virtual realm, unencumbered by concerns of accidental collisions or disruptions, and fully immerse themselves in the rich and dynamic world of virtual art and experiences.

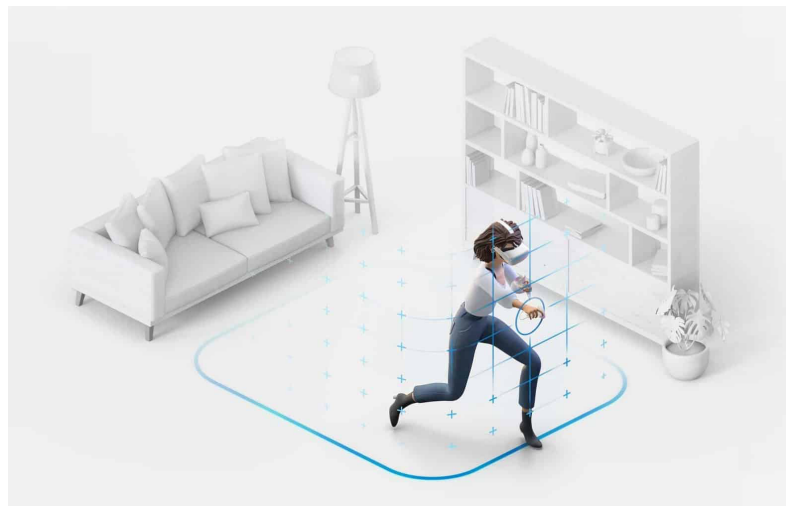


Figure 3.1 Setting boundaries with the Oculus headset.

The device used in this study consisted of a wireless headset and controllers with a simple setup and no need for a PC or console (see Figure 3.2, taken from Adeola, n.d.-b). The pair of touch controllers had buttons and joysticks for interacting with the virtual environment. The controllers were wireless and

connected to the headset via Bluetooth. In addition, this device included a direct touch feature that would allow users to interact with the virtual environment using their bare hands by tapping on buttons to read descriptions, arrows to move forward, and zooming in or out on details. The resulting immersive experience with the 3D environment and hand tracking was expected to make the virtual museum feel more real.



Figure 3.2 Oculus headset and controllers.

3.6.2 The Virtual Museum

The virtual museum chosen for this study serves as an extension of the esteemed Painted Hall at the Old Royal Naval College, renowned as one of England's most distinguished historical decorative painted buildings, with origins dating back to 1707-1726.² Revered as a “Baroque masterpiece known as Britain’s ‘Sistine Chapel’” by the Old Royal Naval College (n.d.), the Painted Hall stands as a testament to the grandeur and artistic prowess of its time. To provide access to this cultural gem, the museum offers free virtual tours accessible via an HTC Vive headset, enabling participants to immerse themselves in a captivating 3D environment.

In selecting this museum, consideration was given to the quality dimensions outlined by Sylaiou et al. (2017), which encompass various aspects essential for an enriching virtual experience. These dimensions include imageability, highlighting the importance of a strong panoramic image characterised by shape, colour, and arrangement. Vivid, high-resolution images

² The virtual Painted Hall can be found on the following website: <https://virtualltour.ornc.org/>.

of objects and elements, particularly in panoramic views, are emphasised to ensure an immersive and visually captivating experience for users. Moreover, the virtual museum allows participants to examine museum content and its details through zooming features, a capability often absent in physical museums. Navigability is also prioritised, enabling users to seamlessly explore the virtual museum, navigate between 3D representations of art, and access relevant information about the displays. Additionally, narration about museum content enhances users' understanding by providing context and insights into the artworks showcased.

Furthermore, the selection of this virtual museum was informed by its alignment with participants' coursework objectives in art education. The theoretical modules in art education aim to cultivate a sense of beauty and art appreciation by delving into the aesthetic values inherent in renowned artworks. The focus on the Baroque period within the Painted Hall's exhibits aligns with one of the main artistic movements studied in art schools, offering students a contextualised learning experience rich in historical and cultural significance.

The chosen virtual museum offers a highly immersive tour, presenting a meticulous 3D reconstruction of the Painted Hall that strives to authentically replicate the experience of a physical museum visit. Through intuitive navigation controls, participants can explore the 3D space and interact with content in real-time, gaining deeper insights into the aesthetic, social, cultural, and historical dimensions of the artworks on display. By providing access to this virtual environment, the museum facilitates a seamless exploration of art and fosters a greater understanding and appreciation among participants.

This virtual museum offers users two distinct immersive modes, providing flexibility and enhancing the overall user experience. In both modes, users utilise a virtual reality headset to move around the museum, immersing themselves in high-resolution imagery that brings the Painted Hall to life. Commencing from the central hub of the main entrance hall, users embark freely and easily on a seamless journey through three expansive spaces representing the Painted Hall. The museum also provides users with a written and audio introduction and explanation of its sections before they begin (see Figure 3.3). After that, participants can choose whether to continue with the first mode experience or switch to the second mode.

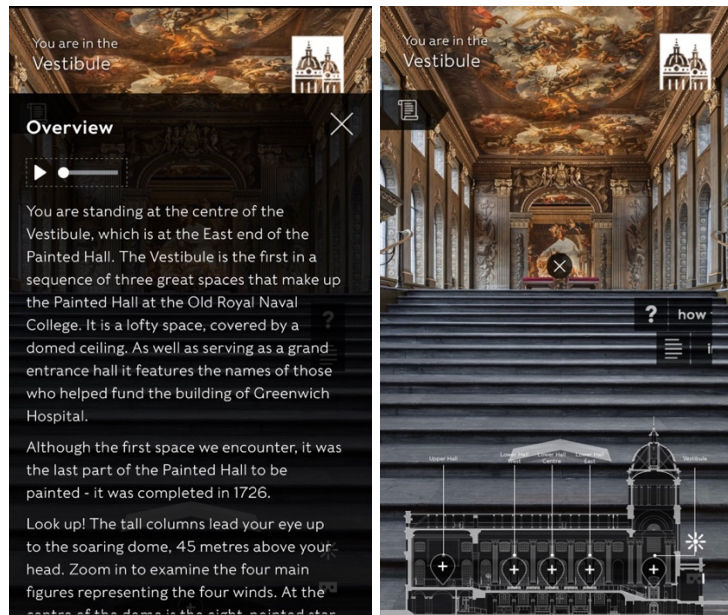


Figure 3.3 Introduction and explanation of its sections.

In the first mode (see Figure 3.4), users find themselves within the virtual confines of the museum, enveloped by its architectural elements and ambiance. Navigation is intuitive, facilitated by a simple click on a designated circle that materialises in front of the user. This interactive feature enables users to traverse the museum effortlessly, progressing forward or navigating into specific halls with ease. Furthermore, users have the freedom to manipulate the camera's position and adjust the viewing direction by natural head movements, enhancing the sense of immersion.

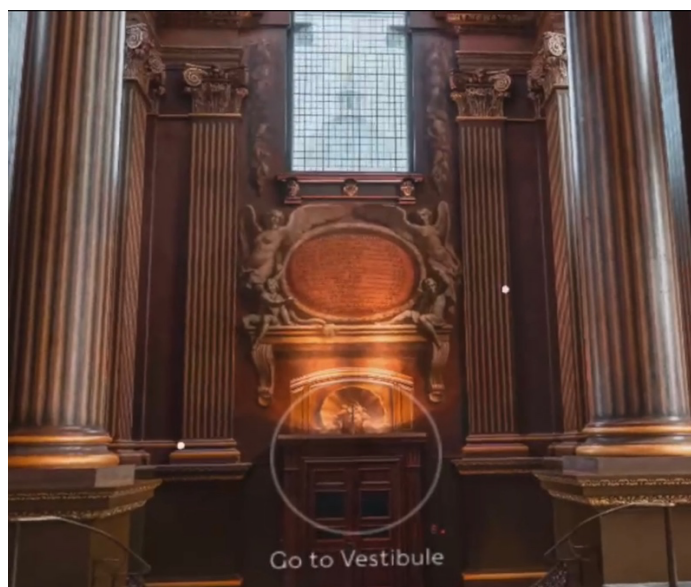


Figure 3.4 User experience in the first mode.

Additionally, users can tailor their viewing experience by adjusting the resolution of images, allowing for optimal visualisation of details (see Figure 3.5).



Figure 3.5 Adjusting the resolution of images.

Transitioning to the second mode (see Figure 3.6), users are presented with a fully immersive experience where the museum website window occupies their entire visual field. This mode effectively blocks out external distractions, enabling users to focus solely on the virtual environment.

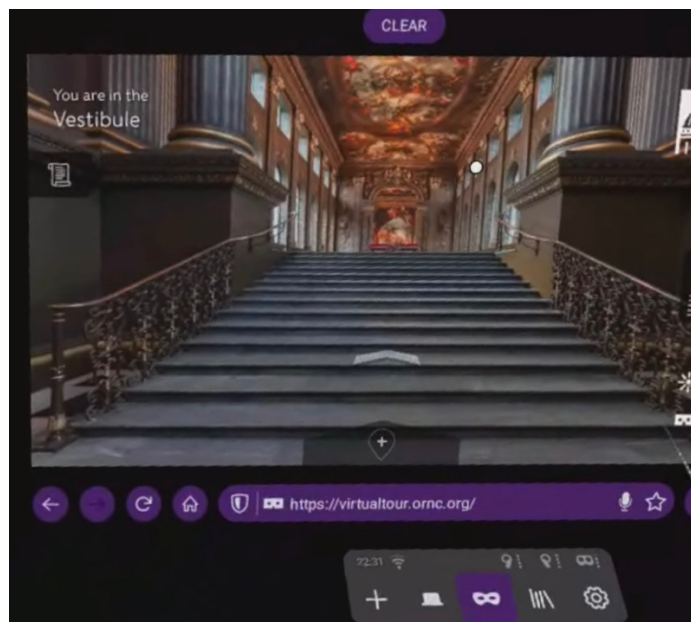


Figure 3.6 User experience in the second mode.

Here, users can engage in a detailed exploration of the ceiling, utilising zoom functionality to uncover fine nuances in ultra-high resolution (see Figure 3.7).

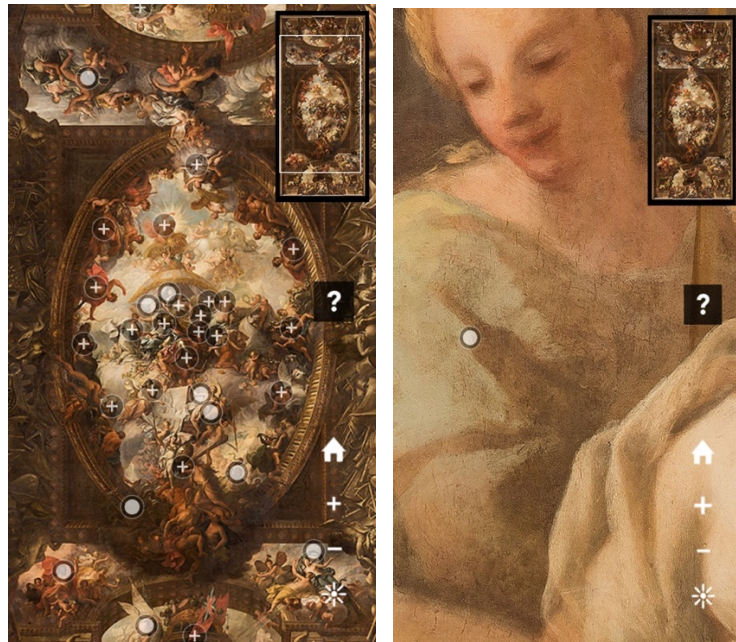


Figure 3.7 In-depth view of the ceiling details.

Educational descriptions accompany specific points of interest, enriching users' understanding of the painted ceiling's elements and historical significance (see Figure 3.8). Navigation within the virtual space remains intuitive, with users able to move through halls via floor-displayed arrows, complemented by keyboard and mouse controls for adjusting the camera's position and viewing direction.

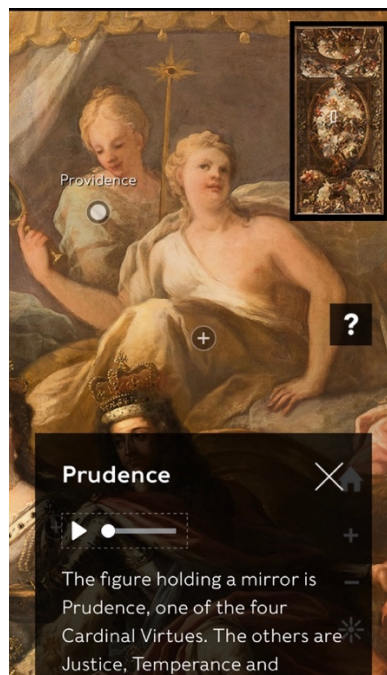


Figure 3.8 Detailed descriptions of key points of interest.

Overall, these two immersive modes offer users distinct perspectives and functionalities, catering to varied preferences and enhancing the overall immersive experience. Whether exploring the museum's architectural details or delving into the intricate artwork adorning the ceiling, users are afforded a seamless and engaging journey through the virtual rendition of the Painted Hall. Through intuitive navigation controls and interactive features, users can immerse themselves in the cultural richness and historical significance of the Painted Hall, fostering a deeper appreciation for its artistic and architectural splendour.

3.7 Procedure

At the beginning of each interview session, sincere gratitude was extended to the interviewee for their valuable commitment to participation, acknowledging the significance of their contribution to the research endeavour. Following this expression of appreciation, participants were promptly briefed on the interview structure, assuring them of ample time and autonomy to expressive their experiences within the immersive virtual museum environment. It was emphasised that their insights and reflections would be given due consideration without any impact on their academic standings or grades in university courses.

Furthermore, participants were explicitly informed of their right to discontinue their involvement at any stage of the interview or study, without facing any repercussions. They were assured that in such cases, all provided information would be promptly omitted from the research and deleted from the researcher's records, ensuring their confidentiality and privacy.

A brief script was then presented to each interviewee, explaining the overarching purpose and objectives of the study. This script served to provide clarity and transparency regarding the research goals, facilitating participants' understanding of the significance of their involvement. Additionally, explicit permission was sought to record the interview proceedings, with participants reassured that only the researcher would have access to the audio recordings. They were further assured that these recordings would be transcribed verbatim and subjected to pseudonymisation to safeguard their anonymity and confidentiality.

Three steps were taken with each participant (see Figure 3.8). In the first step, they were informed about how to use the virtual reality headset, moving

through and interacting in the immersive virtual museum, and the task that they would be asked to carry out. In the second step, the user started the virtual reality experience, switching between the two immersive virtual museum modes during the same session. In both immersive modes, the user wore a virtual reality headset, moved around the virtual museum, and interacted with the system in order to accomplish their assigned tasks. The tasks included a free exploration of the immersive virtual museum and examining the content on display to explore the aesthetic characteristics of the Baroque period.

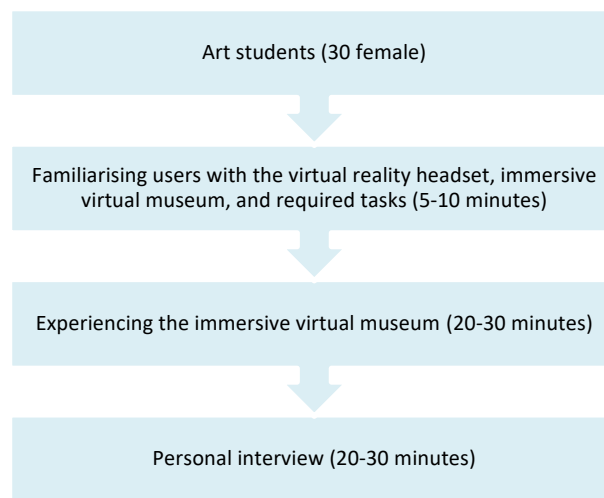


Figure 3.9 Procedure: Introduction, experience, and interview.

Once the second step was completed, the user was invited to a one-on-one personal interview (the third step). Prepared interview questions were used to prompt interviewees to talk about their virtual museum experience and how it had affected their learning and attitude. The combined duration of the virtual museum visit and the subsequent interview was around 40–60 minutes for each participant.

During the interviews, the participants were asked predetermined questions and given the opportunity to explain their immersive virtual museum experience and comprehension of it. They were also asked to provide additional details and to clarify certain points.

Finally, participants were invited to sign an interview consent form, signifying their voluntary agreement to continue participating in the study. This step underscored the ethical considerations surrounding informed consent and ensured that participants were fully aware of their rights and responsibilities. The interviews were conducted between September 2021 and February 2022 at

designated sites chosen for their convenience and suitability for the interviewees, further prioritising participant comfort and accessibility.

3.8 Pilot Study

Before the main study, I conducted a pilot study with three participants, two of which had graduated from the two Saudi universities used in the main study, while the third had graduated and worked at one of the two universities as a lecturer. They had some knowledge about the technology used but far more knowledge related to art. The pilot study was needed to test the immersive virtual museum website and virtual reality headset used, the duration and instructions for the visit, the interview protocol, and the process of thematic analysis. The pilot study revealed no need for any major changes, and the pilot data were not combined with the main study's data. The changes that were made after the pilot study were limited to refining the interview questions to remove duplication, improve phrasing, and extend the duration of the interview and virtual museum experience.

As with the main study, the pilot study examined how art students experienced an immersive virtual museum, their attitudes about using such an immersive virtual museum for art learning, and their intention to use such museums again in the future. The pilot interview transcripts were compared based on students' comments on immersive virtual museums, and their comments were analysed thematically. To reach more accurate findings and to preserve the meaning of the participants' expressions, the analysis of the data was made in Arabic at the beginning, and then at the end, all significant themes and quotations were translated into English. To carry out the qualitative analysis, the interview transcripts were processed in Atlas.ti, the software program that was used to code the entire dataset.

The pilot study data were organised and analysed according to Braun and Clarke's (2006) recommended method. This process starts with reading the transcripts several times to identify codes, focusing on information related directly to the research questions, which helps identify a list of codes. At this stage, relevant codes are combined into potential themes. After the themes are reviewed and given names, a report is produced like the following preliminary report.

The three participants were asked to explain their learning experience regarding the immersive virtual museum. The initial theme was deep engagement with the virtual material, as two of them reported that this experience enhanced their engagement. First, two of the three participants reported feeling “present” in the virtual environment, which reportedly enhanced their curiosity and encouraged them to make more explorations, as shown in the quotes from the interviews below:

I felt that I was really inside the museum and looking at paintings, and this helped me deeply focus on art pieces instead of looking at their 2D copies. (Sama)

This immersive experience helped me learn better compared to when I’m present in the real museum because the museum could be crowded, and the information might not be clear. (Shahad)

In addition, two of the three participants showed attention focus, i.e., paying attention and moving around to investigate all of the details about the museum materials:

These paintings are full of feelings and life. Their colours are bright and attractive, mainly the colour of the skin, hair, details of the body drawing, and the metal pieces on the painting. I enjoyed looking at the paintings. (Shahad)

A second theme that was identified from the pilot study participants’ statements was the perceived positive impact of this immersive virtual experience on their art learning, particularly through a state of flow that they achieved in the virtual museum. The first benefit of the virtual museum was that it reportedly enhanced the participants’ self-regulation:

The perspective, hue, and the shadows are important to me in drawing. Thus, the immersive experience enabled me to deeply examine depth and know how famous artists use shadows, depth, and light. (Sama)

A second benefit was that the virtual museum promoted understanding and helped participants acquire knowledge with less cognitive effort:

The experience helped me to understand Baroque art quickly and easily as I navigated comfortably without making any effort to gather information. (Majida)

A third stated benefit was the use of various methods and senses to gather information and examine the museum content, which helped participants actively construct their subjective perception of that content:

I learned deeply and easily thanks to the buttons that provide descriptions and information on the painting and its parts. These features allowed me to learn all the details in the museum. (Majida)

It gives the opportunity to examine the details and zoom in or out on the parts that are not clear. It shows how it looks from different viewpoints. (Sama)

It allowed me to actively live the experience and draw conclusions through individual experiences. (Shahad)

A fourth benefit was that participants thought more deeply and critically about the learning material:

This immersive experience helped me to focus on and understand the underlying meanings of the artworks. (Shahad)

I felt involved and connected with the paintings' content because I felt the feelings that the artist wanted to convey about the characters and the environment that they put me in. (Sama)

I felt the elements, objects in the painting, and the ideas drawn. Characters from novels, stories, and famous personalities are displayed in high resolution. (Majida)

A third theme was the positive attitude about learning in virtual museums. First, two participants reported that the immersive virtual museum facilitated learning as it worked through handheld devices and could give access to a large amount of information:

All related information exists in one place. I mean, by using the computer and mobile phone, I access the information I

want. I feel these museums can teach me useful information. (Sama)

I learned easier and better without restrictions, difficulties, or complex tools. (Majida)

Second, the immersive virtual museum reportedly gave the participants access to reliable sources of information:

It improved my learning experience. I was having trouble getting reliable information like this. It was taking time and effort, but the immersive virtual museum allowed me to get information easily. (Majida)

I got information I wanted. If I need more details, I click on the points and see all the details. (Shahad)

Third, the virtual museum reportedly provided an enriching experience by giving users the ability to make more frequent visits and by offering an unlimited duration for each visit:

In the virtual museum, everything was clear, and I could clearly see the objects and return frequently. (Majida)

Fourth was participants' apparent enjoyment from the overall experience. Csikszentmihalyi (1990) indicated that the feelings of enjoyment, focus, immersion, and involvement are often accompanied by a sense of pleasure. This mental state of enjoyment is associated with "flow" or "optimal experience" (Csikszentmihalyi, 1990). Participants referred to this state in the following quotes:

It was an enjoyable experience. Time flew by without feeling [like much time had passed] while I was still searching, looking, and reading. (Majida)

It is interesting, not traditional information. I felt that I went there and saw the museum. I was able to live the experience calmly and enjoy it. It was wonderful. (Sama)

Participants' positive attitudes toward learning in the immersive virtual museum reflected an intention to visit more virtual museums in the future:

I expect that the virtual reality experience will help me to visit museums that I could not actually visit [in person]. (Sama)

I am going to use virtual museums to understand difficult concepts. (Shahad)

Despite these advantages, participants also brought up some negative considerations. One was the lack of sufficient content:

The immersive virtual museum's content is weak. (Majida)

Another was the low quality of existing virtual museums:

I can find museums, but they are random without depth and accurate details, such as the museum that I saw in the experience. (Shahad)

The process of data analysis revealed numerous themes essential for addressing the research inquiries within the framework of active learning and flow (Csikszentmihalyi, 1990), as well as the technology acceptance model (Abdullah et al., 2016; Davis, 1989), and the intention to utilise virtual museums more extensively in the future. Furthermore, conducting the pilot study proved invaluable in identifying weaknesses, overlap and redundancies within some interview questions, leading to necessary amendments.

The pilot study was instrumental in refining the research methodology and provided the researcher with valuable practice in interviewing and data collection. Specifically, it helped in fine-tuning the interview procedure, ensuring that it was effective and efficient. By recording the interviews, the researcher could assess the quality of their performance in conducting the interviews, as well as evaluate the effectiveness of the interview questions. This evaluation process was crucial in determining the quality of data that could be obtained within a specific timeframe. The pilot study allowed the researcher to estimate the expected duration of the interview and virtual museum experience, ultimately extending the combined total time to approximately 40–60 minutes. This extension was necessary to ensure that enough data could be collected for a comprehensive analysis.

Furthermore, this process facilitated an assessment of the efficiency of data collection methods, leading to refinement by eliminating redundancy and improving the overall interview protocol. Notably, refinement efforts included revising or removing questions that inadvertently elicited duplicate responses due to ambiguous wording. For instance, some questions were found to elicit the same responses as others, indicating a problem with their wording that made

them appear redundant. To address this issue, the researcher refined certain questions and eliminated others entirely. This process ensured that each question was unique and capable of eliciting distinct and valuable information. This refinement enhanced the clarity and effectiveness of the interview process and minimising potential confusion for participants.

The pilot study also highlighted potential problems that could arise while using the virtual reality headset and exploring the immersive virtual museum. By identifying these issues early, the researcher was able to plan the main study more effectively. This included allocating sufficient time for both the immersive virtual museum experience and the subsequent interviews. By doing so, the researcher ensured that participants had ample opportunity to engage with the virtual museum and provide detailed feedback during the interviews. Furthermore, the pilot study provided insights into the practical aspects of conducting research with virtual reality technology. It helped the researcher understand the potential technical difficulties and user experience challenges that participant might face. This understanding allowed the researcher to make necessary adjustments to the setup and instructions, ensuring a smoother experience for participants in the main study.

In summary, the pilot study was a crucial step in refining the research design and methodology. It helped identify and address weaknesses in the interview questions, improve the researcher's interviewing skills, and ensure the quality and efficiency of the data collection process. Additionally, it provided valuable insights into the practical challenges of using virtual reality technology in research, enabling the researcher to plan and execute the main study more effectively.

3.9 Data Analysis Procedure

To answer the research questions, I performed a thematic analysis of the data (Braun & Clarke, 2006, 2019). The research questions are restated below, followed by an explanation of how each set of data was analysed and contributed to answering each research question:

1. How do art students in higher education in Saudi Arabia experience learning in an immersive virtual museum?

-
-
- 1.1 How do art students in higher education in Saudi Arabia experience presence when learning in an immersive virtual museum?
 - 1.2 How do art students in higher education in Saudi Arabia experience flow when learning in an immersive virtual museum?
 2. How do art students in higher education in Saudi Arabia perceive learning through an immersive virtual museum?
 - 2.1 How do art students in higher education in Saudi Arabia perceive the ease of using an immersive virtual museum in their learning?
 - 2.2 How do art students in higher education in Saudi Arabia perceive the usefulness of immersive virtual museums in their learning?
 - 2.3 How do art students in higher education in Saudi Arabia intend to use immersive virtual museums in the future?

The initial phase of the data analysis process commenced with the meticulous transfer of recorded interview data into a digital written format, ensuring the preservation of participants' exact words and expressions. This crucial step facilitated the subsequent analysis by enabling easy access and manipulation of the data. The chosen platform for this task was the Atlas.ti program, renowned for its support in the coding process, thereby streamlining the organization and interpretation of the vast amount of qualitative data at hand.

Following the transcription and inputting of data into the Atlas.ti program, a thematic analysis approach was adopted to delve into the participants' experiences and elucidate their responses to the immersive virtual museum encounter. Thematic analysis, was particularly apt for uncovering themes and patterns directly from the data itself, as opposed to solely imposing predetermined frameworks onto the analysis (Sönmez, 2013). It allowed themes and patterns to be generated directly from the data while also integrating existing theories or frameworks to guide the analysis. This meant that the themes generated result from interpreting and constructing meaning from the collected data, influenced by both the researcher's perspective and the conceptual frameworks. This methodological choice facilitated a nuanced understanding of the complex personal experiences recounted by the participants.

Upon transcribing the data and importing it into the Atlas.ti program, the analysis commenced with multiple readings of the data to familiarise and immerse oneself in its content and identify initial codes—words or sentences

directly relevant to the research questions. This initial coding process was conducted inductively, allowing for the emergence of codes based solely on the content of the data. As each transcript was examined, additional codes were generated to capture the breadth and depth of participants' experiences, thereby enriching the analytical scope.

After the initial coding phase, a comprehensive review of the codes across all interview transcripts was conducted. This involved systematically reviewing and revising the codes to identify common patterns and themes within the data. This critical step laid the groundwork for the subsequent thematic organization, wherein labels were assigned to encapsulate significant themes within each response. These labels, created to facilitate recall, skimming, and organizational efficiency, were instrumental in the synthesis of common themes and concepts across the dataset.

Following the initial coding stage, a process of code review and refinement was undertaken to ensure consistency and coherence across all interview transcripts. This involved systematically reviewing and revising the codes to identify common patterns and themes within the data. After thorough review, a total of 42 codes were generated, encompassing various aspects of participants' experiences and responses to the immersive virtual museum. These codes constituted the building blocks for the subsequent thematic consolidation, wherein overarching categories were defined for each research question.

These codes were then organised into manageable themes for each research question, facilitating a structured and systematic analysis of the data. By iteratively revisiting the data, a nuanced understanding of the underlying phenomena began to crystallise. Each theme was assigned a label that encapsulates the essence, making it easier to remember, skim, and organise during subsequent analysis.

The thematic analysis process enabled the identification of broad category names that encapsulated the diverse range of experiences and attitudes expressed by the participants. For example, themes such as presence perception, perceptivity, appreciation, flow state, engagement, connection, and emotional response. By examining different data segments and identifying connections within the data, the analysis revealed nuanced insights into

participants' perceptions and experiences of learning in immersive virtual museums.

Importantly, the thematic analysis was conducted without relying on preconceived themes or anticipated outcomes. Instead, themes generated originally from the data, grounded in the participants' responses and experiences and influenced by both the researcher's perspective and the used frameworks. This approach ensured the validity and authenticity of the findings, allowing for a nuanced understanding of the participants' perspectives.

By employing a thematic analysis approach, grounded in an inductive and iterative process, as well as two frameworks, this study employed flow theory to understand how reaching a state of flow - marked by intensive concentration and enjoyment - affects art students' learning experiences, and the technology acceptance model (TAM) framework that focuses on aspects of participants' perceptions of usefulness and ease of use, and how these aspects influence their attitudes and intentions toward using immersive virtual museums. This study was able to gain a rich understanding and insight into the experiences and attitudes of university art students in Saudi Arabia toward immersive virtual museum learning. The resulting themes and findings provide valuable contributions to the existing literature on immersive learning environments and offer practical implications for educators and designers of immersive educational experiences.

3.10 Quality and Trustworthiness

The researcher sought to increase the quality and trustworthiness of the findings by taking certain steps to ensure their credibility, confirmability, dependability, and transferability, as outlined in the sections below.

3.10.1 Credibility

Credibility in qualitative research serves as a cornerstone, indicating the believability of gathered data and the robustness of analysis methods, and ultimately, how faithfully they reflect observable reality (Lincoln & Guba, 1985; Merriam, 1998; Sönmez, 2013). This aspect underscores the essential trustworthiness of a qualitative study (Guba, 1981). Recognising its significance, meticulous efforts were undertaken to enhance the credibility of this research.

Foremost, a comprehensive review of existing literature was conducted to ascertain the alignment of research outcomes with prior studies and establish

meaningful connections (Shenton, 2004). This critical examination not only contextualised the current findings within the broader scholarly discourse but also demonstrated a clear linkage between the research and its antecedents.

Secondly, the research instruments underwent rigorous testing in a pilot study, a practice advocated by Pratt and Yeziarski (2018) to bolster credibility and dependability. The insights gleaned from this preliminary investigation prompted necessary adjustments before the commencement of the main study. Moreover, the pilot interviews provided valuable experiential learning, enhancing the researcher's proficiency in conducting interviews and adeptly handling any potential challenges (Pratt & Yeziarski, 2018).

In the subsequent analysis phase, an additional layer of scrutiny was applied to ensure the integrity of the findings. Specifically, one of the reviewers was tasked with examining the codes and themes vis-à-vis the transcripts, evaluating their relevance to the research questions. This external validation mechanism not only fortified the credibility of the analytical process but also instilled confidence in the fidelity of the research outcomes.

Through these conscientious steps, the credibility of the qualitative research was fortified, engendering trust in the integrity and validity of the findings. By adhering to rigorous methodological practices and incorporating external validation mechanisms, this study upholds the highest standards of credibility, thereby enhancing its contribution to the scholarly domain.

3.10.2 Confirmability

Confirmability in qualitative research refers to the extent to which the findings can be confirmed by the participants (and others) and avoid researcher bias (Lincoln & Guba, 1985). Therefore, to reduce the possibility of researcher bias and increase the level of confirmability, I used Atlas.ti, in which all collected data were archived in a structured and retrievable format, and two reviewers checked and confirmed the analysis of the participant data by reviewing the codes and themes, their representation in the transcripts, and their relevance to the research questions. This process was undertaken to increase the likelihood that the data analysis would represent participants' experiences and ideas instead of simply reflecting the researcher's preferences or biases.

3.10.3 Dependability

Dependability in research means that if a given study is conducted a second time (with the original context, methodology, and participants being the same), the second study should come to similar outcomes as the first study (Guba, 1981). According to Shenton (2004), dependability can be achieved by reporting the processes of a study in detail. Therefore, for the present study to achieve a high level of dependability, I documented in detail the research design, the procedures that I used for the data collection and data analysis, and all of the decisions that I made during the study along with my justifications for those decisions.

3.10.4 Transferability

Transferability is the applicability of a study's findings in one context to a different context (Guba, 1981). Shenton (2004) claimed that qualitative findings are restricted to specific environments and subjects, making it impossible to apply them to other contexts and individuals. To address this issue, he proposed providing background information to set the context for the study and to give a clear explanation of the phenomenon of interest in order to facilitate comparisons and allow for other researchers to transfer this experience to another contexts. To achieve transferability, I have described the research context in detail to help other researchers determine whether or not they can transfer these findings to their own study context. In this chapter, I have documented the following information: the number and relevant characteristics of the participants, the data collection and data analysis methods that were used, the virtual reality headsets that were used, the length of time that the data collection sessions were expected to take, and the entire data collection and analysis process.

In addition to these details, I have included thorough descriptions of the setting in which the study took place, the specific procedures followed during data collection, and any potential limitations or biases that may have influenced the results. By providing comprehensive background information, the study aims to offer a clear and transparent account of the research process. This allows other researchers to critically assess the context and conditions of the study and to judge the relevance and applicability of the findings to their own work. Moreover, by outlining the specific tools and techniques used, such as the type of virtual

reality headsets and the methodological approaches for data analysis, I aim to enhance the replicability and transferability of the research. This thorough documentation ensures that others can make informed decisions about whether the findings can be applied to different settings or populations, thereby contributing to the broader applicability and impact of the research.

3.11 Ethical Considerations

This research was conducted in accordance with the standards established by the ethical review boards of Lancaster University and the two participating Saudi Arabian universities, which reviewed and approved the study proposal before the data collection process began. The participants were given a brief explanation of the study, the nature of their participation during the interview, and what was expected of them. They were informed that they would use a virtual reality headset to explore a virtual museum, followed by an interview, and were given an estimate for the time needed to complete the entire procedure. All participants signed a consent form to show that they agreed to the interview and to being recorded. Participants were informed of their right to withdraw from the study at any time, although it could be difficult to identify and delete their contribution after two weeks, when their data had been pooled with other data.

To protect participants' identities, pseudonyms were assigned to the transcripts and digital recordings using an online random name generator. This method ensured that personal information remained confidential, and that the participants' privacy was maintained throughout the research process. The digital records were securely stored on a server and in a file on my laptop during analysis, which was protected by a password and encrypted. These measures were taken to prevent unauthorised access to the data and to safeguard the information from potential breaches. Furthermore, I informed participants that their digital and transcribed data would be discarded within 10 years of the study being completed. This timeframe was established to comply with data retention policies and to ensure that the data would not be used beyond its intended purpose. Additionally, participants were made aware that their participation was entirely voluntary, and they could withdraw without any consequences.

The ethical considerations outlined in this study were designed to uphold the highest standards of research integrity and to respect the rights and welfare

of the participants. By following to these guidelines, the research aimed to produce valid and reliable results while maintaining the trust and confidence of the participants. The rigorous ethical oversight and transparent communication with participants underscored the commitment to conducting research responsibly and ethically.

Chapter 4: Results

4.1 Introduction

The purpose of this study was to understand the effects that an immersive virtual museum explored through a virtual reality headset had on art students' learning experience at Saudi Arabian universities and what attitudes they held toward using this kind of museum. This chapter summarises the interview data of the 30 art students who participated in the immersive virtual museum experience and presents the findings of the thematic analysis. The interviews were recorded, transcribed, and then analysed to identify common themes. This analysis was based on Braun and Clarke's (2006) six-phase approach, as described in Chapter 3. It involved presenting and summarising the themes, subthemes, and codes from the data, with quotes from interviews that supported the analysis without any prior assumptions or beliefs. The phases in this approach were becoming familiar with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and finally producing the report. The study sought to answer the following research questions:

1. How do art students in higher education in Saudi Arabia experience learning in an immersive virtual museum?
 - 1.1 How do art students in higher education in Saudi Arabia experience presence when learning in an immersive virtual museum?
 - 1.2 How do art students in higher education in Saudi Arabia experience flow when learning in an immersive virtual museum?
2. How do art students in higher education in Saudi Arabia perceive learning through an immersive virtual museum?
 - 2.1 How do art students in higher education in Saudi Arabia perceive the ease of using an immersive virtual museum in their learning?
 - 2.2 How do art students in higher education in Saudi Arabia perceive the usefulness of immersive virtual museums in their learning?
 - 2.3 How do art students in higher education in Saudi Arabia intend to use immersive virtual museums in the future?

The structure of this chapter is designed to address each research question in the order presented. After introducing a given research question individually, it presents a detailed analysis of the results related to that question,

ensuring a clear and organised presentation of the results. The chapter concludes with a summary of the overall findings.

4.2 Interview Data

This section displays the generated findings of subthemes, codes, and numbers of participants which answers the first research questions including the themes of “presence” and “experiencing presence in art learning”, respectively. The same information for the themes related to flow and “experiencing flow in art learning”. Next, perceived ease of use, usefulness, and intention to use are addressed to answer the second research question.

4.3 Presence

To understand the effect of an immersive virtual museum on art students’ experiences in higher education in Saudi Arabia, I started the investigation by addressing Research Question 1.1: How do art students in higher education in Saudi Arabia experience presence when learning in an immersive virtual museum? Answering this question required an initial exploration to understand the learners’ perceptions of presence and to find evidence indicating their actual experience of presence. Subsequently, the focus turned towards investigating how this perception of presence effected their learning experience. In essence, the aim here was to understand not only whether the participating students experienced a sense of presence when they were inside the immersive virtual museum environment but also how this sense of presence effected their art learning experience (see table 4.1).

Table 4.1 Theme: Presence.

Subtheme	Code	<i>N</i>
	Transported to another place	8
Immersion	<ul style="list-style-type: none"> • A feeling of vividness • Experiencing the surroundings • Feeling part of the museum 	10
Interaction	<ul style="list-style-type: none"> • Navigating and moving around • A feeling of natural interaction • Freedom to look around • Zooming in and seeing details 	13
Being in two places at once	Being in two places at once	5

Various codes were identified across all of the interview transcripts to reveal the actual experience of presence without anticipated outcomes. These codes were a sense of being transported to another place, a feeling of vividness,

experiencing the surroundings, feeling part of the museum, moving around, a feeling of natural interaction, zooming in and seeing details, the freedom to look around, and the feeling of being in two places at once. These codes were then classified into two main subthemes: immersion and interaction. These subthemes helped the researcher to identify and understand the art learners' reported experiences and to align them with themes derived from the literature review.

In the interviews, the participants described their perception of presence in the virtual environment as a feeling of being transported into another environment. They attributed this feeling of being present in a physical museum to the main characteristics of the immersive virtual experience, which were immersion and interaction.

4.3.1 Transported to Another Place

The findings suggested that participants experienced a sense of being transported to and being present in a physical museum while visiting the immersive virtual museum using the head-mounted displays. Raneem, for instance, expressed a sense of having gone to and come back from another place, describing the virtual museum experience as if she had physically visited the actual museum, indicating that the virtual museum had generated a feeling of presence in her:

I felt like I travelled and came back. I can describe the museum as if I actually had visited the real place.

(Raneem)

Sahar highlighted the difference between studying artworks in a traditional format and experiencing them within the virtual museum as well as her desire to visit museums to see them in real life. She described a shift from merely listing museums to visit in the future to feeling as though she had actually travelled to the real museum:

We've studied a lot of artworks like this. However, when you study them, and they're all the same, you don't visit the museum; you just put it on the list to visit in the future. But in this experience, there's something like if you travelled to and visited and lived in the real museum. It's

something fabulous. I really see it as effective and helpful.

(Sahar)

Immersive virtual museums offer a simulated experience that can closely mimic the experience of visiting a physical museum. The theme of being transported to another place indicated that learners felt a sense of presence and being within the virtual museum environment.

4.3.2 Immersion

The participants highlighted a number of features of the immersive virtual museum experience when using the virtual reality headset that enhanced their sense of immersion. These included a feeling of vividness, experiencing the surroundings, and feeling part of the museum. The participants noted that this immersive experience gave them a sense of presence and identified more details about this feeling of immersion that enhanced their sense of presence.

4.3.2.1 A Feeling of Vividness

The greater clarity and high resolution of the virtual display allowed the participants to perceive colour and sunlight vividly, as if they were on a visit to the physical museum. For example, Shahad referred to how this experience enabled her to see the original colour of the paintings in natural light, unaffected by a camera flash, which is common in museum photos. This, in turn, enhanced her feeling of being in the actual museum:

In this experience, I can see every detail, including the original colour of the painting, which is completely clear. For example, the colour tone that is influenced and changed by camera flash. The experience helped me to see the details clearly. (Shahad)

Dwaa described how the clarity and quality of the reflection of sunlight enhanced her feeling of being in the actual museum:

The thing I liked the most here was the sunlight that came from the windows and the windows' height, the reflection of sunlight on the columns that are always in church and cathedral photos. (Dwaa)

4.3.2.2 Experiencing the Surroundings

According to the interviews, the immersive virtual museum effectively displayed the surrounding environment. The participants described the immersive virtual museum as providing a sense of being surrounded by another reality, displaying the sensory data that depicted the physical museum. The quality of the display, along with the surrounding sensory data, contributed to the participants' sense of immersion and presence. This type of reaction is exemplified by a comment that Razan made in her interview:

I lived the experience as if it was actual reality. I was in the heart of the museum and surrounded by its walls. (Razan)

The impression of being within the walls of a physical museum, as well as experiencing the effects of natural light, generated a sense of immersion and presence among the participants. This reaction was apparent in an interview response from Areej:

The experience was so pleasant. When I turned around the internal hall, I saw the main hall naturally. I mean, I can see the right side, the light was strong, and on the left side, it was stronger because of the sunlight. The entrance contains clear artworks on the surrounding walls and ceiling that a person might like to see. (Areej)

Similarly, Shatha noted in her interview how the appearance of the natural light spreading across the museum's walls generated a feeling of being in the museum and helped indicate what time of day it was:

I felt I was really there. The light was natural, photographed in the morning, so I felt like I was inside it for real. I was standing in the middle, and I could clearly see the artworks from both sides. (Shatha)

4.3.2.2.1 Feeling Part of the Museum

The participants stated that they felt as though they were part of the museum and had a sense of being present in a particular location at a particular time. They noted looking directly at the artworks and seeing the depth of the museum halls. This reaction could be seen in a response from Razan:

In this immersive experience, I felt like the artwork in front of me was real and I felt like I was in a real museum. I could see the details and contemplate better. (Razan)

Some of the participants described their feeling of being in the museum as overwhelming. An example of this was found in a response from Ghadah:

It was so immersive that it made me see myself really inside. The objects almost came out from the walls and flooded me. It was an amazing immersion thanks to the clarity of the detail. (Ghadah)

Other participants described wanting to physically interact with things as if they were inside the physical museum. This could be seen, for instance, in a response from Sheren:

I was enveloped and wanted to touch the content. I was immersed and interacted physically and emotionally. (Sheren)

This experience enabled participants to perceive depth within the virtual museum halls and the natural quality of light and shadows within the virtual museum environment. Such a reaction was expressed in Jana's interview:

I entered the museum and was able to see the last point in the depth. I mean, I could see the last point that I could reach in the depth and head to it. It was a nice time. Not just the third dimension, but also the light and the shadows were natural. (Jana)

Overall, the participants reported perceiving the museum environment as being vivid. The surrounding walls and halls as well as the naturalistic light and shadow enhanced their sense of immersion in the virtual museum and enabled them to have a sense of presence inside the museum and see its contents more clearly.

4.3.3 Interaction

The participants referred to their ability to interact with the immersive virtual museum environment in various ways, including by being able to navigate through museum halls, a feeling of natural interaction, the freedom to look around, and the ability to zoom in and see elements in greater detail.

4.3.3.1 Navigating and Moving Around

The participants indicated that thanks to the high image resolution, clear field of view, and depth cues of the virtual museum, they could interact and move between the museum rooms smoothly without a drop in display quality. This sentiment was expressed by Rawan in the following extract:

It was closer to reality than other experiences of virtual reality. I liked the multiplicity of rooms and moving between them. Also, I liked the clarity of details in the paintings, which is rarely provided in a virtual museum.
(Rawan)

The degree of immersion reportedly provided Abeer with a sense of physical presence within the museum, stimulating her intrinsic tendency for movement and interaction:

[I was] so immersed to the extent that I walk through and feel I'm alone in the place. I stopped myself and said that I don't know where to walk in reality. It's a fun time. (Abeer)

Participants noted the distinction between directly observing paintings and viewing pictures or videos of them. Through direct interaction with paintings, a learner is able to develop a sense of presence within the museum environment. For example, Areej had this reaction, as shown below:

Looking at paintings directly is not the same as looking at the images and videos that are usually in learning materials and websites. Looking directly at paintings and immediate interaction give me a high sense of presence in the real location and museum. (Areej)

4.3.3.2 A Feeling of Natural Interaction

The participants stated that the representation of their body movement, head tracking, and rapid update rate enhanced their natural interaction with the virtual environment, giving them a strong sense of being in a physical museum. This sentiment was expressed, for example, by Bdor:

I felt like I was really in the museum, moving my head, looking left and right, and interacting with the surrounding scenery as if I was actually in the real site. (Bdor)

Contrasting the virtual experience with traditional ways of representing artwork through static pictures on websites or in books, Kholod described how her physical movements being mirrored within the virtual museum resulted in a more vivid, detailed experience and an overall greater sense of presence in the museum.

It was like a fantasy. I move, it moves with me. Actually, if I see it on the phone or as a picture, I won't see it clearly the way I see it here. (Kholod)

Moreover, Khadijah mentioned the ability to naturally shift her eyes and head in order to explore the paintings within the virtual museum:

It's very clear as my eyes and head move to the left and right to the painting and museum depth, not the same as static images that need to move left and right to see all of the painting. (Khadijah)

The participants realised that they were surrounded by the virtual museum environment, with the ability to move naturally and see the ceiling, walls, and paintings, thanks to the head tracking feature of the virtual reality headset. This finding was apparent in an interview response from Lena:

When I turn around, it turns with me. I mean, it was tracking my navigation wherever I go and I could see the painting from the right or left. Even the ceiling area, I could see it from one side and then change my position and see it from the other side. (Lena)

Rania noted how looking at large static images on a computer screen required moving or dragging the images around and looking at small pieces of the image at a time. In contrast, the immersive virtual museum allowed her to feel as if she were in a physical museum and could see a whole painting simply by moving her head around and scanning parts of it in a natural way without affecting image quality:

It's as if my eyes are looking left and right. It feels different from when you look at static pictures that include large paintings, which have to be rotated to see its parts. Here, I'm looking left and right. (Rania)

4.3.3.3 Freedom to Look Around

The participants categorised their sense of freedom into two types: freedom of control and freedom of movement. Wedad highlighted the freedom to view paintings from different angles, something she could not do with static images:

Usually, the picture is from one side, and as I want to see it from another side, freedom of control helps me especially in directions. I mean I don't want to see from a certain direction. I want to see from all directions in three dimensions not just a still photo, so it was nice. (Wedad)

Furthermore, participants noted being able to move around the museum halls freely and examine specific details up close. This was apparent in a statement made by Shahad:

I felt like I'm in a real museum. I walked around freely, looked, and searched what I wanted freely, which helped me to look closely and use zoom in/out to find more details. (Shahad)

4.3.3.4 Zooming in and Seeing Details

Manipulation is one of the biggest ways that a virtual museum differs from a physical museum. The participants in this study described their ability to zoom in and out on parts of the museum that could not be seen closely in the real world. For example, Areej said the following during her interview:

I can get closer and zoom in and out on the work on the ceiling as much as I want and see the colours and texture. I can even see the texture, the cracks, and the brushstrokes. I was able to zoom in and out on the artwork. I was able to read about the work and the characters in the work. (Areej)

The immersive virtual museum enabled art learners to explore paintings from multiple angles and distances, thanks to the zoom feature. This allowed for detailed examination of specific elements of the artwork, as noted by Alma:

It helped me see the painting in all ways, for example, from the left side, and I move forward and see from the right side.

I can be in the middle and zoom in on both sides. I mean, if I want to focus on something, I can get closer to it. (Alma)

Participants expressed how using the zoom feature enhanced their sense of immersion in the virtual museum, as demonstrated by this response from Rawan:

I lived the experience perfectly, especially the zoom feature. The zoom option made me live and be totally immersed in the experience as in real life experiences. (Rawan)

4.3.4 Being in Two Places at Once

Some of the participants experienced a sense of being in two places simultaneously. They attributed this feeling to factors such as confusion between real and virtual sounds and clicking icons to advance within the virtual simulation, while another participant attributed it to the virtual experience not engaging all of their senses.

Norah said she felt isolated from reality in the virtual museum but remained aware of her physical location. She reported experiencing confusion between real and virtual sounds:

The sense of being in the real world decreased but I still realise that I'm here in the office, communicating with you. At the same time, I felt I was there that I confused the air sound that I heard from the real or virtual environment. I was not completely immersed. (Norah)

Amjad attributed her confusion to the need to click on a button to move in the virtual world, which disrupted her sense of feeling present in that space:

I press on a circle to move on and it partly holds up the immersive experience. In contrast to what happens in advanced games, being in a virtual world allowed me to walk without pressing any buttons. (Amjad)

In virtual reality experiences, while the visual and auditory senses are often stimulated, other senses like smell and touch are not typically engaged. This absence detracts from the realism and completeness of the immersive experience. This finding was apparent in an interview response from Sahar:

I think I felt partly immersed due to the issue of senses. It would be preferable if the sense of smell, sound, and texture were included. (Sahar)

This section summarised the main elements of immersive virtual reality that affected participants' sense of presence within the immersive virtual museum (see Figure 4.1).

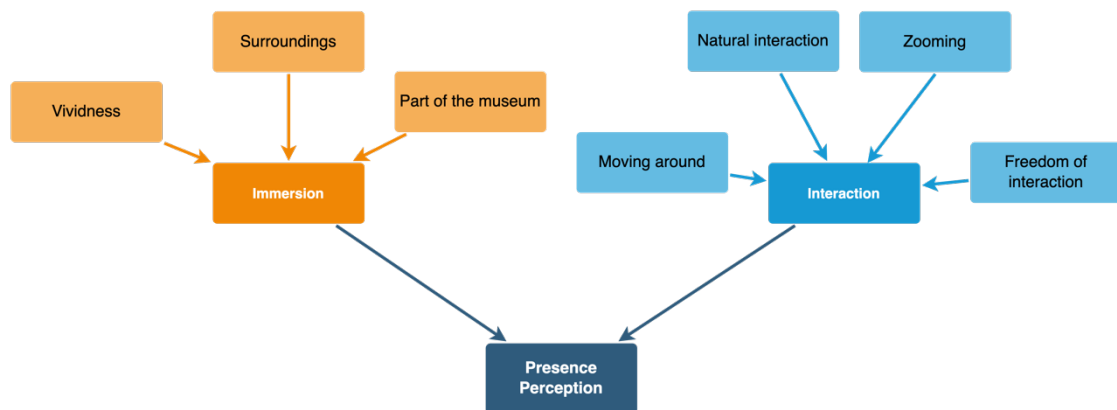


Figure 4.1 Factors contributing to a sense of presence.

4.4 Experiencing Presence in Art Learning

I extended the thematic analysis to understand how having a sense of presence within the immersive virtual museum affected the participants' art learning experience. Codes were identified across all of the interview transcripts that revealed any indication of learning experience related to the participants' sense of presence, without preconceived notions or anticipated outcomes.

The codes obtained from this analysis were classified into two main subthemes: perceptivity and appreciation. The perceptivity codes referred to when a sense of presence enhanced participants' understanding of various aspects of the museum, including the scale of the museum, the dimensions of architectural elements, and the museum content, including artwork, artistic style, and technique. Moreover, the participants acknowledged the educational value of immersive virtual reality environment and the benefits of that experience over traditional art learning methods. The appreciation codes referred to when a sense of presence within the immersive virtual museum provided an experience similar to that of a physical museum without the need to be there physically, the ability to see distant details, convenient navigation, and museum information being within easy reach (see Table 4.2).

Table 4.2 Theme: Experiencing presence in art learning.

Subtheme	Code	N
Perceptivity	Understanding the museum. E.g., the actual dimensions, the paintings' size, and the heights of the walls and columns.	3
	Understanding the museum content. E.g., artistic style and techniques, drawn characters, understand clearly compared to other sources, seeing and understanding the finest details clearly, descriptions help to understand an art movement's characteristics, drew participants' attention to details, understand the whole story.	10
	Understanding the educational value of virtual reality. E.g., visualise paintings, contain visual objects with explanations, clearer than printed pictures, review practical knowledge.	7
	Understanding the power of virtual reality to give more than in real life. E.g., using characteristics like zoom to see unreachable elements, alternative reality, accurate descriptions of the content, provide clear and accurate images.	8
Appreciation	Appreciating a similar experience through a virtual museum. E.g., access to similar experiences, overcoming barriers to accessing the actual museum.	8
	Appreciating the power of virtual reality to give more than in real life. E.g., zoomability, clarity enhanced contemplation, access to distant details, livelier and more active.	8
	Appreciating convenient navigation and interaction. E.g., easily move between paintings, conveniently see the artwork, being alone and avoiding visitors' judgement, frequent viewing and taking photos.	7
	Appreciating the ease of accessing museum information through icons, moving around, and zooming in. E.g., easy access, quick access to information, multiple modes of written and audio explanations of the artwork, access to unreachable details.	9

4.4.1 Perceptivity

The interviews revealed how the perception of presence in the immersive virtual museum affected participants' overall perceptivity. This sense of presence greatly enriched their experience by helping them understand the scale and content of the museum, such as the actual dimensions of walls, columns, and paintings. It also drew their attention to artistic styles and techniques, characters in the paintings, fine details, and the characteristics of a given art movement. Other participants said they learned how virtual reality could facilitate education through showing paintings with explanations, offering clearer images than printed pictures, and helping them review practical knowledge. Finally, they stated that the experience increased their awareness of how virtual reality could do more than real life thanks to it having a zoom feature, offering an alternative reality, providing accurate descriptions of the content, and having clear and accurate images.

4.4.1.1 Understanding the Museum

The participants related how their sense of presence in the museum affected their understanding of the museum's scale, dimensions, and presentation techniques. As one example of this, Rawan said that she got a sense of the actual height of the walls and columns around her, something that is harder to realise through still photographs on websites or in books. She also indicated how the feeling of being in the museum helped her perceive the true dimensions of the paintings:

Very interesting. I felt like I was inside the place and saw the actual dimensions of the place and depth, for example, the size of the paintings and the heights of the walls and columns. (Rawan)

In her interview, Aseel indicated that she had studied the presentation techniques of museums and said that the virtual reality experience she had in this study could be a valuable asset for people interested in having a more realistic depiction of a museum:

I think this is useful, especially for specialists and for those interested in museums. I mean, the ways of displaying artworks, because I have taken the subject, so I think about this hall, how much is its width as well as the paintings' sizes. (Aseel)

4.4.1.2 Understanding the Museum Content

The participants' understanding of the characteristics of art movements was one of the aspects that they felt had been enhanced by the immersive virtual museum. They mentioned taking advantage of the high resolution or vividness of images, head movement, and zoomability to better examine the specific characteristics that distinguished a given artistic movement from other movements, such as in terms of the degree of accuracy, number of details, choice of colours, and techniques. Lena, for example, described her ability to understand the paintings' details more clearly compared to how she had looked at them in the past, highlighting the ability to examine a painting as if it were in a physical museum:

In general, as an educational experience, I think it's useful. For example, I had to study some artworks based on particular subject matters. I think it's really helpful to see the painting in front of me and see its details clearly as we do in a real museum. I mean, I saw the painting clearer, unlike when I saw its description. Now I see the smallest details and understand what they were explaining to us in traditional classes. Now I understand. (Lena)

Participants attributed their greater ability to understand artwork to the features provided by immersive virtual reality, where, in addition to their sense of presence, they were able to use a zoom feature. Observing details by zooming in on them reportedly offered insights into the techniques used by a given artist. This experience gave the participants the sense that they could examine these techniques more clearly, as exemplified by the following interview response made by Norah:

It was helpful to understand the art content, especially the artistic techniques, by zooming in on them. I saw the drawing techniques that are used such as brushstrokes and even cracks. They provide an introduction to the technique that was used. Is it a fresco or something else? It gave me the impression that I could explore these techniques clearly. (Norah)

By using the zoom feature, participants also reported being able to learn more information about the artistic styles and periods of a given painting. Jana, for instance, mentioned in her interview that using the zoom feature allowed her to better understand Baroque art by exploring elements such as the characters in the painting:

It helped to examine the museum paintings' content, for example, the drawn characters, which I was able to zoom in on and see all the details clearly as if they were prominent. As for information, I had not seen Baroque art until the moment I entered this museum. (Jana)

In addition to the features noted above, some of the participants emphasised their ability to manipulate and zoom in on an image to see small

details while maintaining the quality and resolution of that image, which further enhanced their understanding of it. This reaction was apparent in Moneerah's interview, for example:

I felt present, but the difference is that I can get closer. The more I zoom in, the more details I can see to the extent that I can see the finest details, including the method of applying the brush. This is impossible in reality. (Moneerah)

In traditional printed or digital images, small details are often not easily visible. However, in the immersive virtual museum, the participants reported being able to see these details more clearly because the details were presented directly in front of them and because they could control the viewing perspective by zooming in and out or moving around. This sentiment could be seen in the following response that Khadijah gave during her interview:

For example, the details that are small and simple, I won't be able to see them in the images, no matter how much I zoom in. The eye only goes to larger elements. But now, because it's basically in front of me and I'm zooming in and moving around, I can see these small details. (Khadijah)

Descriptive icons within the immersive virtual museum were another feature that the participants found to be instrumental in accessing information and enhancing their understanding of various art movements. For instance, Lora emphasised that using icons enabled her to access detailed information about Baroque art, a subject she was previously unfamiliar with. She said she had the opportunity to explore each aspect of the museum, thereby enriching her overall experience:

It helped me because there were icons. I could click on them to see descriptions of information that I needed to know in the museum. I knew that this museum contained details and information that could help me understand Baroque art, which I didn't know about before. It gave me space to contemplate each part and read its description. (Lora)

More precisely, these icons were designed to draw the viewer's attention to significant elements of the artworks, prompting the participants to pay more

attention to them. This finding could be seen, for example, in a response from Shatha:

There were icons that explained the work and characters. They made me know more about the paintings. This experience highlighted some of the paintings' details and some characters more than others, especially the main characters in each painting, which was actually the first element that drew my attention, providing detailed explanations. (Shatha)

The participants found that the interactive features of the virtual space helped recreate a real-life museum experience that allowed for naturalistic movement as they explored and observed the artwork from different perspectives. They reported that this contributed to a deeper understanding of the elements of the art compared to static images, as exemplified by this response that Dwaa gave:

I like the flying objects, because when I studied them, they were static images, but here I'm moving around, seeing how their size is and from different angles. (Dwaa)

Furthermore, this immersive virtual experience appeared to have enriched participants' overall understanding of the narrative conveyed by the paintings. Instead of viewing isolated parts of the paintings in static photographs, they could use the features of the immersive virtual museum to see and comprehend the overarching story and ideas in the paintings. This sentiment was expressed by Sheren, as shown in the following extract from her interview:

This experience helped me to look at Baroque art more deeply. I didn't know this information before. I really perceived the elements and the things in the painting with the ideas that were drawn on the paintings, famous characters from stories and novels and holographic objects with high accuracy. I understood information on Baroque art and learned more than what I expected. (Sheren)

4.4.1.3 Understanding the Educational Value of Virtual Reality

During the interviews, the participants suggested that the immersive virtual museum outperformed traditional art learning resources, such as static images, in terms of enhancing their understanding of the art and museum content. For instance, Sara compared traditional methods of learning art history, such as viewing printed museum paintings with descriptions, to the immersive experience offered by the virtual museum:

Educationally, it's better than exhibitions and museums, instead of what we got in art history. In art history, we used to see printed paintings with their descriptions, and I had difficulties visualising them. Here, however, there's enough information that evokes my imagination and enhances my understanding. I think they are better than pictures. I saw this museum before and studied it, but it was not in an immersive format. I feel this immersive experience is better.

(Sara)

Participants said that the immersive virtual museum they explored in this study provided them with immersive and interactive content with descriptions. According to them, this helped them absorb information faster and more clearly compared to traditional learning materials, such as the descriptive content typically found in books. For example, Raneem gave the following statement in her interview:

The museum is the artist's visual library that contains pictures and information rather than descriptions in books. Thus, I think the immersive virtual museum can convey the idea more clearly and quickly compared with printed and written references. (Raneem)

In another comparison made in the interviews, the immersive virtual museum surpassed traditional media, such as printed books, in its vivid colours and details. According to this perspective, the immersive virtual museum offered participants a more comprehensive and detailed understanding of the artwork. A statement that Sama made in her interview reflected a common experience among participants in this regard:

I have studied this museum before. So I feel that I focused on particular aspects that were needed for the course. I didn't know that it was exactly like this. For example, I studied one of these paintings before (the sun). I know the painting and its colours, but I didn't know that it's so clear and has rich details like here. (Sama)

The participants suggested that the virtual museum empowered them to interact with the artwork in a more hands-on manner, allowing them to explore beyond theoretical learning. In this way, the virtual environment enabled the observation of details that may not be easily recognisable in traditional media. As an example of this response, Abeer made the following statement:

As an artist, I have information. So this experience helped me review my knowledge. It's more of a practical rather than a theoretical task. Because I'm able to interact with and move the objects, I understood the art pieces more, I saw more details. (Abeer)

4.4.1.4 Understanding the Power of Virtual Reality to Give More Than in Real Life

According to the interviews, the immersive virtual museum's interface gave more options than would be possible in reality, for example zooming in and rotating, which helped the participants see very small details that might not be apparent at first glance. This sentiment was apparent in the following response from Raneem:

As an art learner, I'm interested in the colouring techniques, accuracy and clarity of the details. This is what I noticed in the immersive museum. I zoomed in and out and saw the smallest details. I mean, even in the ceiling, there was a monster hiding under the child and shield that protects one of the women who were there. So here I can see the smallest details and the colour that is actually used. (Raneem)

In addition to the sense of presence in the virtual museum, the participants also described their ability to see the details on the ceiling that could not be seen

as closely in the physical museum. Jana reported enjoying the option to zoom in and wondered if there was something similar to this feature in real museums:

I felt present, but also there was the option of zooming in on the ceiling. I really like it. I don't know the alternatives provided in a real museum. Maybe they use an ocular device or pictures of the ceiling. This option in virtual reality is amazing. (Jana)

The participants added that certain features of the immersive virtual museum had enhanced their ability to learn more about the dominant techniques and style of an art movement since they were very clear, particularly as many art pieces were complemented by accurate descriptions. Razan, for instance, said that she appreciated the immersive characteristics of the virtual museum, which she said had enabled her to identify and understand the unique features of each piece of art:

Art history is one of my current courses. Each art school has artists who have a specific style that distinguishes their work. Thanks to this immersive museum's features, I can find the characteristics that distinguish each piece of art by zooming in and reading the description of elements of it. Unlike the use of normal photos or descriptions, which provide similar results, the immersive options provide more details of the artistic style followed by each artist. (Razan)

Compared to traditional printed formats, which can reduce the quality and clarity of a painting, the immersive virtual museum in this study reportedly offered more vivid and recognisable details, as Areej noticed in the following interview response:

This painting is real and exists but lacks clarity and details. The colours are darker in books. I mean, by transferring the painting to a PDF, the clarity and accuracy are decreased. The immersive experience helped me imagine and recognise the images. (Areej)

4.4.2 Appreciation

Another major theme in this study was appreciation. The participants reported appreciating that the virtual museum made content more accessible while providing a similar experience to a physical museum. They also appreciated the power of virtual reality to give more features than in real life, including a more active experience, zooming in, clarity, and access to distant details. Some of the participants appreciated the convenience of being able to move between paintings, seeing the artwork, being alone and avoiding other visitors' judgements, going back and viewing the material more frequently, and taking photos. Finally, they appreciated how easy and fast it was to get museum information, the multiple modes of written and audio explanations, and having access to normally unreachable details.

4.4.2.1 Appreciating a Similar Experience Through a Virtual Museum

The participants appreciated the immersive virtual museum for providing a similar experience to that of a physical museum without the need to physically be in one. Raneem, for example, explained in her interview how she found the immersive virtual museum beneficial, because it allowed her to experience different museums and learn about various art periods without the need for physical travel, especially during a global pandemic:

It's a nice and useful experience. I'm an artist interested in the arts, but I can't visit places to learn about periods, experiences, and even people who lived those experiences. Thanks to immersive virtual museums, I can visit museums from my place without having to travel to them. I also see immersive virtual museums as very useful during the COVID-19 pandemic. I see it as very useful.
(Raneem)

Furthermore, the participants expressed their appreciation for the immersive virtual museum's comprehensive explanations of content, which enabled them to feel as if they were visiting the actual museum. This suggested that the participants believed virtual museums offered superior experiences compared to traditional museums in some ways, as demonstrated by the following interview response from Ghadah:

Very useful thanks to its thorough explanations. It made me live the experience as if I had visited the museum for real. I think virtual museums provide the best experiences. (Ghadah)

Similarly, Sheren appreciated the opportunity provided by the immersive virtual museum to learn about Baroque art, recognising that physical constraints would otherwise limit her access to such learning experiences:

The experience I gained in the virtual museum about Baroque art was great. Because of their distance and for material reasons, I can hardly visit museums, but virtual museums give me the opportunity to enter this kind of museum. (Sheren)

4.4.2.2 Appreciating the Power of Immersive Virtual Museums to Give More Than in Real Life

The participants appreciated the exceptional qualities of their immersive virtual museum experience because it gave them access to historical, precious, and prominent artistic content in museums that would be difficult for them to reach physically. Aseel, for instance, highlighted the exceptional quality of the virtual museum experience, appreciating the access to details that cannot be observed in real life due to their location inside the museum, such as paintings on the ceiling. She appreciated the ability to zoom in on elements of the ceiling, a feature that she felt would be impossible during a physical museum visit:

As an experience, it's beyond imagination. Especially if I was at the real museum, I would not be able to zoom in on the elements on the ceiling. I like the idea of seeing the elements from my place and zooming in and getting closer to the most difficult details. I mean, if I were there, I could not see these things. It was amazing and I enjoyed it. (Aseel)

The participants appreciated the clarity provided when zooming in on details, which exceeded what they felt would be achievable in physical museums. This allowed them to explore the art pieces more deeply, as noted by Reem in the following interview response:

It helped me explore more aspects than I could in real museums. If I was in a real museum, I would not see the details clearly. I mean, it would be far away from me. But here, I can zoom in as much as I need to. Details are clearer than other photos. I could focus more and contemplate the artworks. (Reem)

In her interview, Abeer said that she believed zooming in on the images of paintings captured with a mobile phone resulted in lower clarity than using the zoom feature in the immersive virtual museum. At the same time, using a mobile phone to take pictures would result in static images, while the immersive virtual museum was more dynamic and active, as explained in the following excerpt:

If I go to a museum, I can take pictures, but if I zoom in, pictures become less clear, their accuracy changes, but when I'm in a virtual environment, I have more control. Also, the pictures might be static. This is livelier and more active. You can move freely. (Abeer)

4.4.2.3 Appreciating Convenient Navigation and Interaction

The participants appreciated the convenience of being able to move around and interact within the virtual museum compared to the limitations experienced in physical museums, where visitors may face crowded pathways and have restricted movement around certain artworks. For example, this sentiment was expressed by Shatha during her interview:

In a real museum, using the chairs helps because the movement is divided into two parts, so it's less crowded. The bad thing about it is that if a person stops or many people stop, the corridor gets crowded. I can't see further unless I ask them to open the way for me, or I have to go back or see other works around me. I see them in the virtual museum better. There's no disturbance or crowd. I was able to move around as I wanted. (Shatha)

In physical museums, crowded conditions and restricted access may limit the depth of exploration, hindering a visitor's understanding of the artwork on display. However, in the immersive virtual museum, the participants appreciated

the ability to revisit paintings multiple times, conveniently spend as much time as they wanted examining the artworks in the museum without being constrained by the presence of other visitors waiting next to them. For example, this sentiment was apparent in Jana's response given below:

This experience made me go deeper than I could go if I was in a real museum. A real museum may be crowded. There are things that I can't reach, or unclear information. In the immersive virtual museum, everything is clear. I can see clearly and return to the paintings more than once. I can spend as much time as I want staring at pieces of art and explore them without feeling awkward around other visitors.
(Jana)

In line with the responses given above, the participants mentioned several psychological barriers that they faced when visiting a physical museum. More specifically, they expressed feelings of discomfort and embarrassment when seeing pieces of art and not understanding them. Thus, they said that the immersive virtual experience in this study offered a potential solution to these concerns. For example, Raneem appreciated using immersive virtual museums from the comfort of her home, having the freedom to access museums worldwide and examine paintings without the pressure of external judgment, as shown in the extract below:

Sometimes I'm unable to go to a museum or an exhibition as I feel that I'm not welcome. For example, if I don't know the artworks or don't understand them, I feel embarrassed. The idea is that, in this virtual experience, I'm at home in my room, I can enter this place, and no one knows about me. I can watch something very beautiful and make my own choice about what I want to see and what matters the most to me. Also, I can choose to see museums in Italy or Britain. I can decide what I want to see. (Raneem)

In the interviews, the participants emphasised the ease of revisiting artworks and taking pictures of specific details with clarity in the immersive virtual museum environment, activities that may be more challenging to do in a physical

museum without feeling judged. This observation was seen, for example, in a response by Amjad:

I can go around and come back. If I was in a real museum, I would not feel free to go back to artworks as people might look at me and wonder why I went back. Here, because I'm in a virtual museum, nobody is here, I can see and go back as much as I want. I can do things here that can't be easily done in reality, such as clearly photographing particular details. (Amjad)

4.4.2.4 Appreciating the Ease of Accessing Information Through Icons, Moving Around, and Zooming in

Most of the participants in this study stated in the interviews that the immersive virtual museum provided them with easy access to information and helped them understand the artwork around them more easily and clearly. Furthermore, they said that they preferred the immersive virtual museum for art learning due to certain positive characteristics, such as icons that participants could select, which facilitated access to more information about the objects. For example, Sameerah said that the virtual museum provided quick access to information, saving her time having to look up details about paintings, thanks to the virtual museum providing written and audio explanations of the artworks and details inside the paintings:

It's sufficient to understand many things and get information, I mean, instead of wasting my time to search for information and paintings. (Sameerah)

As another example, the participants appreciated immersive virtual museum characteristics that helped them access details that would be hard to reach in a physical museum by zooming in on them, as exemplified by the following interview response from Dwaa:

I can zoom in as much as I want. It's much better than reality. Now, when I visit real museums, staff don't allow me to approach or touch some artworks. I can't zoom in or get closer to the artworks to see their details. So, it makes a difference when artworks are three-dimensional. (Dwaa)

In her interview, Ghadah mentioned that the zoom in feature provided by the immersive virtual museum allowed her to more easily access and get close to fine details that would be inaccessible in a physical museum:

There are strengths, such as how they can easily be accessed, how close you can get to the artworks, how you can see their details and information at the same time, as well as how many modes are provided, such as audio and visual ones. The limitation in real museums is that we are not allowed to touch the artworks. Here, the content is maintained, and easy access is provided. (Ghadah)

Compared to more traditional media, such as photographs of paintings, the participants referred to how the immersive virtual museum helped them more easily access some information about paintings. This sentiment was expressed by Hayat, for example, during her interview:

I have the ability to access information and details that can't be reached by seeing ordinary photos and reading their description for financial and distance reasons. (Hayat)

Overall, this section summarised the main effects of the sense of presence within the immersive virtual museum that affected the participants' art learning experience (see Figure 4.2).

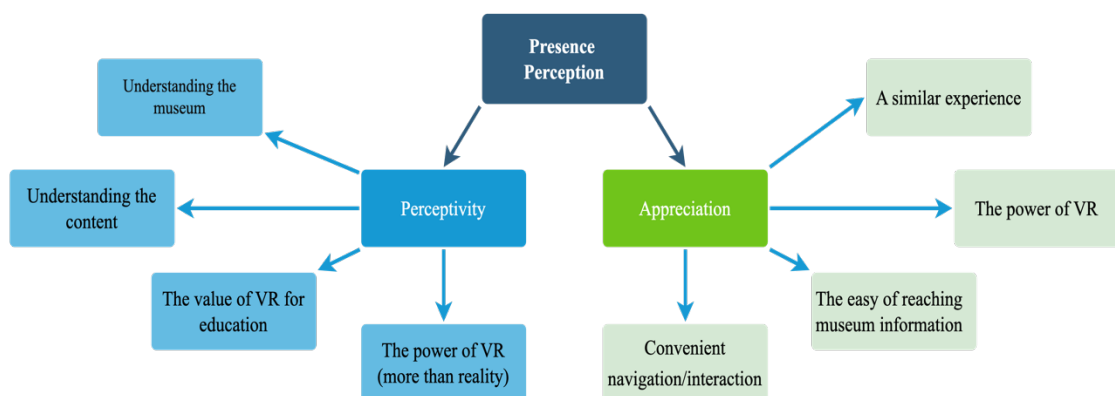


Figure 4.2 Codes for presence (perceptivity and appreciation).

4.4.3 Being in a State of Flow Is Stimulating

This section addresses Research Question 1.2: How do art students in higher education in Saudi Arabia experience flow when learning in an immersive virtual museum? As with the first sub-question, I started by identifying evidence about

their actual experience of a flow state. Subsequently, the focus shifted to how this flow state affected their learning experience. As mentioned earlier, the aim was to understand not only whether students experienced flow within the immersive virtual museum environment but also how this flow state affected their learning.

Based on their interview responses, the participants appeared to have entered a flow state during their experience of the immersive virtual museum. Codes were identified across all of the interview transcripts without any anticipated outcomes, aligning them with themes derived from the literature. These codes consisted of focusing on the details, losing track of time and the real world, reduced external distractions, matching learners' interests, and enjoying the experience (see Table 4.3).

Table 4.3 Theme: Being in a state of flow is stimulating.

Subtheme	Code	<i>N</i>
Focusing on the details / concentration	• Focused on the content. Focused as if they were in front of the real thing	7
	• Dig in to find more details	12
	• Became more focused after starting to interact and read the information	5
	• Some details draw their attention, making them pay more attention	2
Losing track of time and the real world	• No sense of how much time goes by	7
	• Willing to spend as much time as possible	6
	• Feeling isolated and lost awareness with the external	4
	• Lost sense of themselves	1
	• Lost connection with others around them	2
Reduced external distractions	• Not seeing anything except the content inside the virtual museum	4
	• Away from visual distractions	3
	• Isolated from the surrounding distractions	3
Enjoying the experience	• Enjoy museum characteristics. E.g., being alone, zooming in	12
	• Enjoy being surrounded by very clear and vivid scenery	8
Matching learner interests	• Part of their study	6
	• Find out more interesting details	4

The data clearly showed varying degrees of flow state indicators among participants. For example, flow indicators such as heightened focus and losing track of time were prevalent in participants' experiences, enhancing their enjoyment due to the sense of being immersed in vivid and attractive imagery. This difference in indicators could be attributed to the characteristics of the immersive virtual museum using a virtual reality headset, which gave participants the ability to control viewing angles, zoom in on minute details, use a plus icon to

access additional information, and remove surrounding visual distractions to focus on content relevant to their interests. This experience created the right conditions for entering a flow state.

4.4.3.1 Focusing on the Details / Concentration

According to the interview data, the virtual reality headset provided vivid imagery and control in viewing different angles and minute details. As a result, the participants became deeply focused on the art, entering a flow state while experiencing a sense of presence in the virtual space. Razan described this deep immersion while exploring the artwork's aesthetics and details:

I lived and coexisted as if it was something real. I felt that the artwork was in front of me, and I could see its details. The finer cracks, the lustre of the shadows, the folds in the cloths are things that are so nice. (Razan)

This feeling that the artwork was right in front of them was repeated by most of the participants in the study, suggesting their sense of presence and heightened perceptiveness of their virtual surroundings, which enhanced their concentration on the details of the artwork.

The participants' responses in the interviews suggested a deep sense of immersion and concentration, which deepened when interacting with the museum content. Sama, for example, noted that using a virtual reality headset enhanced her immersion, while interactive elements like a plus icon directed her attention to additional details within the virtual museum, encouraging exploration and attention to details that might have gone unnoticed otherwise, as noted in the interview excerpt below:

Once I put on the virtual reality headset, I felt immersed and focused because it felt more serious. After I read information, I started to focus more, and there was a plus sign that showed me more details and made me focus more on a lot of things. (Sama)

In another interview response, Abeer's initial attention upon entering the virtual museum was on how well it was organised and lit, showing an awareness of the virtual environment around her. After that, she directed her attention to the

artwork on display, focusing on depictions of important historical figures, noting the narrative quality of the exhibition:

The first thing that drew my attention is how the museum is organised and how good its lighting is for the recipient or those inside it. Then I start staring and reading the content about the king or the president, their families, and how children are lined up as if they are telling a historical story. (Abeer)

The participants noted that the visual clarity of the virtual museum content greatly enhanced their ability to concentrate, encouraging them to delve deeper to uncover details that were not immediately apparent. This was apparent, for example, in the following statement made by Norah:

The level of concentration became very high. The finest details were so clear, which motivated me to look more and closely observe particular details and information that I didn't notice at first glance. (Norah)

The quality of the immersive virtual experience and its content led the participants to concentrate more than they were used to doing. Sameerah, for example, noted in her interview that the immersive virtual experience heightened her sense of focus, differing from her usual observations of paintings in traditional media:

It made me focus hard, not like the normal sight at the paintings. It made me want to bring my sketchbook and paint. It immersed me so that I wanted to make the same drawings. (Sameerah)

4.4.3.2 Losing Track of Time and the Real World

The participants indicated that the immersive virtual museum created a sense of being within a museum space and temporarily disconnected from the external world. This is because the virtual reality headset restricts the wearer's field of view to only what is presented within the virtual environment of the museum. This experience made them feel as if they had been transported to an alternate reality, leading them to lose their awareness of time and the real world around them.

As one example taken from the interviews, Sheren described feeling as though she were truly inside the museum, suggesting that the virtual reality experience was highly convincing and offered sufficient opportunities for deep exploration and engagement, which in turn encouraged her to spend more time in that virtual environment:

I felt like I was really inside [the museum]. I had the whole time to explore. I really felt like I was in it. (Sheren)

In another interview response, Sama said that she became so immersed in exploring the virtual museum that she forgot about the researcher's presence near her until she took the headset off and saw the researcher again. This striking episode highlighted how immersive the virtual museum could be by isolating her mentally from her immediate surroundings. It indicated that the headset essentially erected a wall between her and the real world, enabling her to completely devote her attention to the virtual world:

I was immersed to the extent that I forgot that you were here. Once I removed the VR headset, I noticed that you're here. It isolated me from the place, I got immersed. (Sama)

Along similar lines, the participants noted how interacting with the immersive virtual museum environment using the zoom controls reduced their awareness of their surroundings outside of the virtual space. This enhanced their concentration and ability to examine different pieces of art more closely. For example, Jana described how, as she zoomed in to explore the details of the artwork around her, she felt a growing level of interaction and immersion as well as a disconnect from the external world:

Once I entered the museum, I started looking at the paintings and zooming in on the artworks. I started losing my sense of connection with the external world and you. After I started using the zoom control, my focus became deep. (Jana)

In her interview, Shatha mentioned spending a long time examining the artwork and moving around inside the virtual museum without being interrupted. This indicated a high level of interest and immersion in the experience:

I spent some good time focusing on the ceiling and the work in front of me. It enabled me to go forward and come back

easily inside the virtual museum without a feeling of interruption. (Shatha)

Similar to the others, Moneerah described losing herself while immersed in the virtual museum, feeling as if she were physically within the virtual environment:

I forgot myself while I was inside. I felt like I was really present in the museum. (Moneerah)

4.4.3.3 Reduced External Distractions

As hinted at before, the virtual reality headset isolated the participants from external distractions, such as those caused by visual cues, other people, and crowds. They could not see anything except the content inside the virtual museum, which made them feel alone. Thus, in contrast to regular museums and learning environments, in the virtual museum, the participants were less prone to being distracted, as exemplified by the following interview response from Abeer:

So immersed to the extent that I walk through and feel like I'm alone in the place. (Abeer)

The participants said that they focused on more details in the artwork displayed in front of them because they felt as if they were the only viewers of the paintings, away from visual distractions. They were deeply immersed in the paintings as the details were more visible. This sentiment was apparent in the following interview response from Hayat:

The glasses are on my face while I'm inside the museum and the artwork is in front of me. Therefore, the only thing I can see is the artwork. So I felt like I've become more immersed with the painting, and I've seen the painted characters and what they do. I focused on the details of the holder of the crown and scales after the war, as if they had won and made a new law. (Hayat)

Participants described a deep immersion with the artwork and isolation from external distractions, where they felt a sense of complete focus on the artwork they were observing. This in turn led to a loss of awareness of their physical environment and a sense of being in a physical museum. For example, Moneerah made the following statement along these lines:

I merged with the artwork while standing in front of it. Moreover, I felt completely isolated, away from the surrounding distractions that occur in real museums. I forgot that I'm in this room. I felt like I'm in a real museum. (Moneerah)

4.4.3.4 Enjoying the Experience

The participants said that they found the immersive virtual museum to be more enjoyable than a physical museum due to the free interaction and ability to zoom in and out to check details freely, which increased their accessibility. This comparison was made by Kholod, for example:

It's more enjoyable than in a real museum because in the real one, I can't zoom in or out and check details due to museum restrictions. Here, I can zoom in as much as I want. (Kholod)

Several participants noted how they enjoyed spending an extended period of time exploring the beauty and details of the artwork and museums that they had studied previously through traditional media. Lena, for example, attributed her enjoyment to the deep sense of immersion she felt from the vivid scenery of the virtual museum:

I was immersed, and I could stay there for hours because I really benefited from and enjoyed the experience. Everything was beautiful. I enjoyed discovering the details of the artwork. I could see for real the information that I had studied. (Lena)

4.4.3.5 Matching Learner Interests

Based on the interviews, the immersive virtual museum experience met the art students' need for a realistic embodiment of what they were learning through lectures in their theoretical courses. They were interested in delving deeper into the subject matter and gaining a more comprehensive understanding of it because they were participating in activities related to their studies. Sama, for instance, said in the interview that she focused on understanding the details and characteristics of specific drawings that captured her attention and aligned with her interests during her visit to the virtual museum:

I was immersed because it's part of my studies. If I think like ordinary people or like someone who doesn't really understand art and design, I wouldn't be focused. So it's easy. I directly thought about the characteristics of art instead of just enjoying the art. I understood art but when I studied it in an immersive museum, I understood the details and characteristics that exist in particular drawings that interest me. (Sama)

In addition, the participants said that if this type of virtual museum had been used as a learning tool in their courses, they would have discovered more details about the art they had been studying. They attributed this to the possibility of zooming in and finding information that matched their interests, as Rania noted in the following response:

An interesting tool as it's helpful for my studies. During our studies, we see, research, explore, and describe artworks like these. Especially in the subject of art criticism. So, if this experience existed at that time, it would have been possible to write more details about the artworks. There's a significant difference, when I see the artwork, get closer to it, thoroughly explore it more than how I do when it's on a mobile phone or in a picture in a book. It has more details, provides more perspectives and details. I actually felt engaged. (Rania)

Overall, the immersive virtual museum experience reportedly enhanced participants' state of flow. According to the analysis of the interview data, this was because the virtual museum was able to increase their focus on details, make them lose track of time, shut out external distractions, increase their enjoyment, and match their interests. (see Figure 4.3)

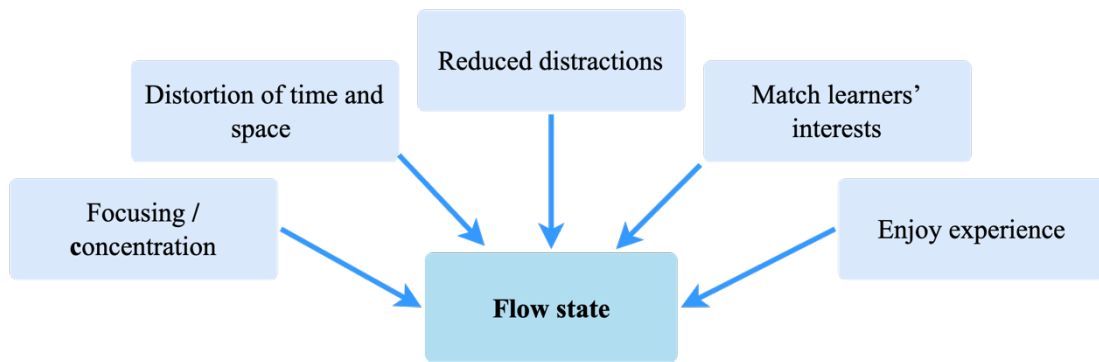


Figure 4.3 Codes for the flow state.

4.4.4 Experiencing Flow in Art Learning

Continuing to answer Research Question 1.2, I extended the thematic analysis to examine the effect of the flow state within the immersive virtual museum on the participants' art learning experience. All of the interview transcripts related to this question were coded without preconceived notions or anticipated outcomes. The codes that emerged were classified into two main subthemes: engagement and connection (see Table 4.4).

Table 4.4 Theme: Experiencing flow in art learning.

Subtheme	Code	<i>N</i>
Engagement	Active participation. E.g., full control, can freely move and choose	6
	Curiosity. E.g., dig deeper and spend more time exploring the paintings, concentration on the clear and vivid content, clarity and being alone	7
	Implicit symbols. E.g., through accuracy and zoomability, enhanced close observations and discovered details hardly noticeable before	5
	The implicit story and theme. E.g., through concentration, being able to look around and zoom in, pieced paintings together, follow a historical sequence, general view of the story and find out more details	6
	Absorption	3
	Self-regulation. E.g., freedom to select objects and angles, using zoom in, and movement	2
	Learning experience aligned with interests. E.g., freedom to look, movement and zooming in, enhanced ability to explore information that interests them	3
	Connection	Evoking deep contemplation
Evoking thoughts and questions. E.g., follow and understand the story, convey the artist's impression		3
Communication. E.g., direct contact, clarity and zooming in, contact with interesting topics		5

4.4.4.1 Engagement

The participants' statements about the capabilities of the immersive virtual museum directly reflected their engagement in that environment. Their

responses suggested that the virtual museum's features facilitated a flow state through interactivity and giving them a sense of control. This in turn increased their concentration and enjoyment in their exploration of artistic content, providing conditions conducive to deeper mental engagement. The codes within engagement consisted of active participation, curiosity, a desire to explore implicit symbols, an implicit story or theme, absorption, self-regulation, and alignment with learner interests (see Figure 4.4).

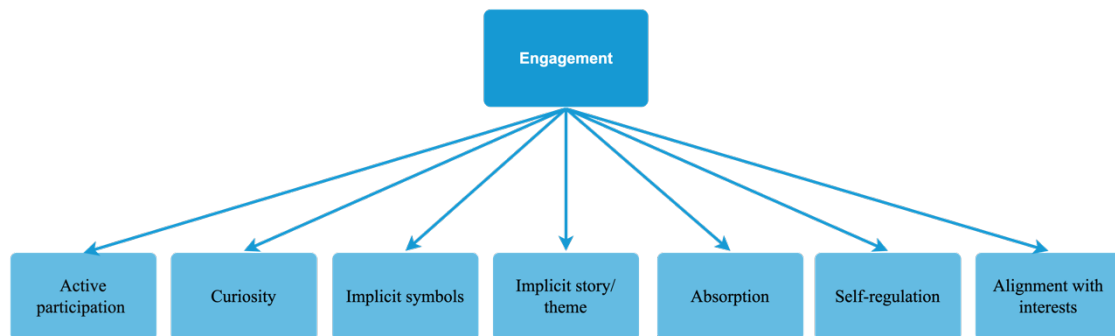


Figure 4.4 Codes for engagement.

4.4.4.2 Active Participation

In the interviews, most of the participants referred to the high level of freedom and control they felt they had to manage and direct their learning based on their needs, such as through zooming in and selecting perspectives, in addition to display quality, as making them more engaged with the museum content. Such features enabled them to more deeply engage as they explored and sought to understand the content.

In her interview, Razan emphasised the freedom to select specific details to focus on, in contrast to traditional videos and images. This response suggested that the sense of control that she felt over her interaction with the virtual museum allowed her to focus more on the task at hand without getting distracted, contributing to a heightened sense of engagement:

Full control of interaction. In contrast to videos which can't be navigated in a non-optional way as well as images that lose their quality once zoomed in, in the virtual museum, I can choose my position and viewing angle. I can choose the details that I want to zoom in and out on. (Razan)

The participants preferred the immersive virtual museum over traditional media, as they could choose what to focus on without restrictions, enhancing

their interaction and engagement with the museum content. This sentiment was expressed, for example, by Sara in the following extract from her interview:

I used to see just a picture taken from a person's viewpoint, or recorded videos force you to move and see specific areas chosen by another person's viewpoint. You aren't able to move freely. But in this immersive virtual museum, I can go ahead, zoom in on the painting, and click on an element to see accurate details. (Sara)

4.4.4.3 Curiosity

The participants reported that the immersive virtual museum experience increased their curiosity and, in turn, their engagement. Several identified the interactive features of the virtual environment as instrumental in this regard. Hayat, for instance, noted in her interview that these interactive features intensified her desire to delve deeper into the narratives of the museum, leading her to become more engaged with its content:

It made me more curious to know what comes next. I kept moving around the museum. I felt the story more, I felt that I understood it more and became more involved. (Hayat)

The participants highlighted how the vividness and richness of the content stimulated their curiosity about details of the artwork around them, causing them to spend more time exploring. As an example of this, Abeer expressed curiosity about the details on the ceiling. She said that her concentration within the virtual museum and ability to focus on details by zooming in on them increased her curiosity to explore further:

I was curious to find out about the crowded details on the ceiling, examine people through zooming in on them. Some of them were stacked on top of each other, but they were clear. I felt that I was really inside it. I wish I could get into it more and never stop. (Abeer)

Based on the interviews, the explanation icons and sense of control within the immersive virtual museum likewise fed participants' curiosity and engagement. They tended to spend more time examining the details of artwork

in order to reach a more profound understanding of it. This point was made, for example, in the following interview extract by Reem:

I could control the screen and I could use the explanation buttons to delve deeper into the details. This feeling made me spend more time and get deeper. It was a beautiful thing. I was meditating more and more. It was a useful experience. (Reem)

In her interview, Hayat gave a reply along similar lines in terms of focusing on the details. She said that the sense of control she felt over her exploration increased her curiosity to find out additional information in the virtual museum:

I've seen the painted characters and what they do. I focused on the details of the holder of the crown and scales after the war, as if they had won and made a new law. (Hayat)

Other participants similarly mentioned how these features enhanced their curiosity to gain more information about the museum content. This could be seen, for example, in Sheren's reply below:

It contained many options and buttons which helped me delve deeper into information about the paintings and details related to these paintings. I benefited from these features that made me learn all the details in the museum and enjoy it. (Sheren)

According to the interviews, the sense of being immersed in the virtual environment to the extent that they lost awareness of their surroundings enhanced the participants' concentration on the artwork, as noted above. This state of immersion also increased their curiosity to explore various aspects of the museum. Sama, for example, reported concentrating so hard in the virtual museum that she lost track of her surroundings, filled with curiosity about details such as the colours used in the paintings around her:

I was so immersed that I could no longer hear any sound around me. I could focus more and dig deeper into it. I could see more details than I used to see in pictures. If it were a printed picture, I wouldn't be able to see the same details; the details are clear. The detailed information is authentic

and natural. This is what I understood from the painting. I knew that the drawing they chose for their painting was their own. It's clear that they combined two colours, and that is what made me zoom in to see it. It's clear that this mixture came from these colours. (Sama)

Similar to Sama's response above, Dwaa likewise compared the virtual images she saw in this study with the lower-quality images typically found in books. She was particularly curious about the accuracy of the images, describing a higher curiosity than she felt when looking at a normal picture of the same type of content:

The accuracy of the classic objects in artworks, the fabric, the scarf, and their texture, the accuracy of their details and the details of jewellery. The prominent sculptures on the jar that I wanted to touch to know what they are made of. These feelings don't usually come to me when I see a picture. (Dwaa)

4.4.4.4 Implicit Symbols

The participants' descriptions of their immersive virtual museum experience showed a deep level of concentration and close observation, reflecting a heightened visual sensitivity. They referred to how visual clarity and the ability to closely observe elements enabled them to discover details they could not see before. This sentiment was reflected in the following response from Raneem:

I noticed the accuracy of the details of the artwork. They are strong and clear. There's even a monster behind a child, the child is brown. I mean, this can't be easily seen, but here I can see it. (Raneem)

Expressing a similar feeling as Raneem, Razan described in her interview being actively engaged in the intricate details of the virtual artwork around her, which had previously been overlooked because of her focus on major elements. She was especially engaged by the centre of the ceiling, taking advantage of her sense of freedom and control in exploring the paintings. Thus, she shifted her focus from the main elements to their surrounding details, transitioning from a

passive observer to an active, in-depth explorer, as described in the interview extract below:

I felt like I was present in the museum. I saw the artworks and their details. I enjoyed discovering the artwork's details. There are details related to famous figures and 3D objects. I can see that the angels are children. Each adult and child are in a different look and age, or not human at all. I like the demons that are presented in some works, in the centre of the ceiling. They look as if they are a frame for the work without drawing a frame. These details were not clear before because my focus was always on the centre. I used to consider the centre the important part and ignore the rest of the details. (Razan)

Similar to Razan, a statement that Bdor made in her interview reflected a heightened level of engagement with and appreciation for previously unexplored details. In Bdor's case, this involved seeing more of Baroque art than she had before. She moved beyond the main features to explore the smaller nuances of the paintings, as noted in the extract below:

We studied the characteristics of art. I studied it before, but in this experience, I saw many characteristics and details that I had never seen before. I had never laid eyes on them. I noticed this aspect and I focused on the big characters only, not prioritising the details and the small creatures that are drawn. I could see the details. I always focus on the big elements and miss the details. Here, I see the details of Baroque art. Earlier, I focused on the magnificent characters with wings and a crown. I didn't see the simple things drawn, but now I see them. I entered the field and saw other details in different works instead of large elements only. (Bdor)

Razan reported experiencing a disconnect from her physical surroundings, enabling her to focus more intently on architectural elements and small details, similar to the others' comments. This experience enhanced her

ability to appreciate minute differences that might go unnoticed with the naked eye, as described in the following extract from her interview:

I had a strong feeling of disconnection from the external world. I focused on the details such as the chimney and the sculptures where we can see the arches' columns and the entrance. I could see how it was so realistically sculpted.
(Razan)

4.4.4.5 The Implicit Story and Theme

Another theme that emerged from the interviews was understanding the overarching story or theme in the artwork. As each painting in a museum tells a story, the participants tried to understand the implicit meaning of that story and how different works complemented each other. They emphasised the importance of concentration and the ability to look around freely. Sheren expressed this view in her interview:

I can see it from more than one perspective. Also, I can see the works that are next to the painting. So I can see how they're connected to each other and understand the whole story. (Sheren)

The visual clarity and ability to trace connections between paintings in the virtual museum reportedly enhanced participants' understanding of the implicit meaning of stories and themes as well. Hayat noted in her interview that the paintings followed a historical sequence that could be seen while moving from one painting to another and exploring the progression from war to peace, for instance, considering the details within the paintings that reflected the roles of different figures, as described in the extract below:

I checked the details more than with printed pictures. I understood the story and the painting's role. The significance of the painting was power grading. It talks about war. The second is about a victorious king, and after that there's a painting portraying people in peace. The paintings look real. They tell a real story with details. For example, every person is well dressed. Their place in the picture talks about their status. (Hayat)

The participants were also engaged in the story that the paintings told by being able to zoom in on details, allowing them to explore the implied meaning of each part of the paintings within a larger story. For instance, Norah stated the following in her interview:

The most interesting thing was that I could get closer and closer to see the details. Especially when I wanted to read the painting, then I understood it and read it as a whole. I saw its parts, then came back to see the whole picture and consider the role of each part. This was the most wonderful aspect in the experience. (Norah)

Compared to other media, the participants suggested that their experience with the paintings in the immersive virtual museum used in this study had encouraged them to be more engaged. They were able to focus on details, which led to a deeper understanding of the connection between stories across paintings, as noted in Sama's interview response below:

It gives me a general view of the work as a whole and helps me see more details than those found in printed formats and books. Since I could focus on the details and colours more than how I could with normal photos, I could link the story of the paintings. Normal photos can tell only some parts of the story. As an educationist, I feel this is a better option. (Sama)

4.4.4.6 Absorption

The participants compared their sense of absorption in the virtual museum content to being immersed in a novel. According to them, the immersive nature of the virtual museum experience captured their attention much like the captivating narrative in a novel. For example, Norah said the following during her interview:

Interesting experience at the artistic level. I felt like I was in a novel. Do you know the enjoyment and engagement you can have when you're browsing through a novel? Now, I got the same feeling. I was intensely engaged. (Norah)

In her interview, Ghadah also described her virtual museum experience in terms of reading a book. This reflected a feeling of intense absorption in the paintings and a deep focus on the artistic elements and themes, as shown in the following excerpt:

It was a beautiful experience for me personally, as if I had opened a book and started browsing. I felt like the characters came out of the wall and entered the world I was in. (Ghadah)

Compared to a traditional museum, some of the participants highlighted how being in the quiet virtual museum without external distractions allowed for a deeper level of absorption in the artwork. For instance, this type of response was seen in Kholod's interview:

I'm here alone in the museum. In a real museum, there are families and children, I mean there are a lot of people around, voices and distractions. Although I look at paintings, I keep losing focus. Here, I felt totally engaged. Nobody talks to me; I look at paintings and focus on them. I feel more comfortable because I'm alone. No one talks to me. I'm the only viewer here. (Kholod)

4.4.4.7 Self-Regulation

As noted in previous sections, the participants stated that they had more freedom in the immersive virtual museum, such as the freedom to select elements for examination as well as to read descriptions. The resulting engagement increased their self-regulation as learners to direct their attention toward specific elements that aligned with their interests and learning objectives. Aseel, for instance, described museums as vast libraries for artists, allowed her to deeply engage in exploring information depending on her needs and interests:

Museums are our largest visual libraries and the main reference for us as artists. I not only can search for a specific image, but also see accurate details without the photographer's bias. I entered and saw the information I would like. It's definitely an amazing experience. (Aseel)

In her interview, Jana highlighted how the immersive virtual museum enhanced her sense of control and self-regulation as well. Through this technology, learners can observe with greater clarity, manipulate their viewing experience, and explore from different perspectives according to their preferences and goals, thereby increasing their engagement:

The sense of control in virtual reality is better than in reality. In virtual reality, I can zoom in on the artwork and other objects on the right and left walls. I can see them from all sides. When I rotate from different angles, the details become very clear. Unlike in reality, I can clearly see the shadows. I feel like I have better control in virtual reality. In reality, I don't have all of these options. Here, I can zoom in and see artworks from all directions. (Jana)

4.4.4.8 Learning Experience Aligned with Learner Interests

According to the participants, the immersive virtual museum experience aligned with their learning interests as art students, which made them more engaged. They evidently valued the freedom to explore information and any details that interested them. As an example of this finding, Raneem highlighted in her interview the limitations of photographs that do not show the details she finds important. She stressed the ability to explore the viewpoints and aspects of art that resonate with her:

There are some images that are not available, and as I've said, photographers provide very accurate pictures but only of things that matter to them. Also, museum websites display the photos of the artwork as a form, not prioritising their finest details. I might not be interested in this angle; my interest might be in the other angle. I want to see what I'm interested in. (Raneem)

The participants could also follow their interests because of their ability to manipulate the virtual environment around them. This made them able to focus more on the details that interested them. For example, Reem described her ability to zoom in on specific details and explore elements of artwork according to her

preferences, allowing her to get a deeper understanding of the art, as shown in the interview excerpt below:

When I zoomed in, I was able to see the overlooked parts, thinking that they might be a frame, a shadow, or something else. So, I noticed that they were overlooked characters. Also, I understood that the strong characters are prominent, and the weak ones are not prominent. Unlike the museum employees or photographers, while being there, I could get closer to things that I needed to know more about. They zoom in on parts based on their preferences without taking into consideration what we might prefer. In this experience, I zoomed in according to what I wanted. (Reem)

The participants' interests in specific topics encouraged their engagement and desire to learn more. For instance, Sameerah's interest in the third dimension in drawings encouraged her to explore Baroque art and deepen her understanding of depth, shadows, and other objects and elements that were relevant to her art interests, as shown in the interview excerpt below:

I really liked this experience because I'm interested in the third dimension. It's what interests me the most in drawings. I mean, I could see the depth of the painting and that helps me know how to use the shadows, depth, lights, and many more aspects that interest me in painting. I had little knowledge about Baroque art like depth and the third dimension, but now I understand it. (Sameerah)

4.4.5 Connection

The immersive virtual museum helped participants see the virtual content as real, encouraging them to be more connected to the content. Disconnection from the external environment and its distractions increased the participants' ability to contemplate the emotions that the artists sought to convey. The connection theme encompassed how the flow state affected the art learning experience in this way and was divided into three codes: evoking deep contemplation, evoking thoughts and questions, and communication (see Figure 4.5).

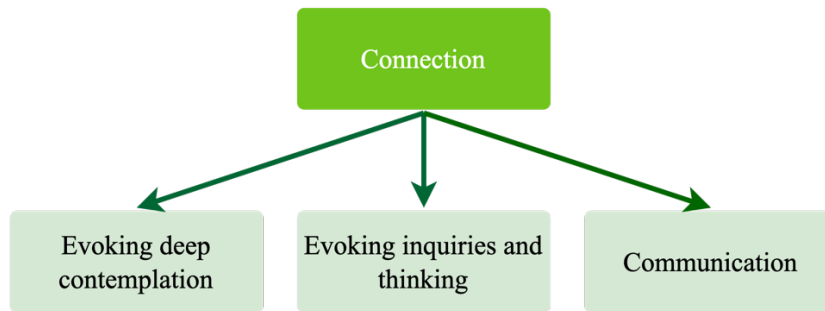


Figure 4.5 Codes for connection.

4.4.5.1 Evoking Deep Contemplation

The learning experiences that the participants described having revealed how the immersive virtual museum fostered a deep engagement with and contemplation of the artwork on display. The reduced awareness of external visual distractions enabled intense focus on the artworks and their stories.

Beyond simply observing visual elements, Lora connected with the narratives illustrated in them. She described in her interview how she deeply contemplated the themes and emotions underlying the artworks' symbols, giving her a more profound insight, as shown in the excerpt below:

The sense of the external world decreased so much that I felt like I engaged, as if I was in a real museum. I saw the stories and was contemplating them and seeing what they mean. In one picture, I felt they were in peace, because the children had wings and leaves, as if they were signing a peace treaty. In another picture, there was a king who came from a victorious war. I felt like I was immersed in the heart of the story. (Lora)

The immersive virtual museum displayed vivid colours and other details that triggered a deep sense of the underlying meanings and emotions in the paintings, which enhanced the participants' contemplation. Jana, for instance, perceived the paintings to be imbued with emotions, suggesting that artists effectively convey a variety of emotions through their paintings. In the interview, she expressed a desire to delve deeper into the painting:

I feel like these paintings are full of feelings and life. Their expressions are very bold and clear. Their colours—such as the colour of the skin and hair—as well as the details of

the body in the drawing, the metal pieces in the painting, and the embodiment of the characters are bright and attractive. I mean, I not only learned new things but also felt like I enjoyed following the paintings. I think I'll explore this subject further. (Jana)

4.4.5.2 Evoking Thoughts and Questions

The various experiences that the participants related having in the virtual museum illustrated how the flow state that they achieved within the virtual museum could facilitate deeper engagement, prompt a deeper level of thought, and cause them to ask deeper questions. This was apparent in a response from Hayat, for example, who wondered about the artist's intentions behind character placement and symbolism. Her response is given below:

It's really amazing, it made me deeply engaged. I can see and follow the story of the painting in front of my eyes. Here, I looked at it, contemplated it, and asked why the artist put the story like this. Why are they gathered around this person who is holding the stick? And why are the children with wings like this and far away? It was an exceptional experience. (Hayat)

4.4.5.3 Communication

The flow state in the immersive virtual museum experience also had an effect on communication with the artwork, encouraging deeper connections and understanding among the participants. This experience enabled participants like Raneem to make direct contact with the art, allowing her to deeply focus on its details to try to sense the feelings and thoughts the artist aimed to convey. She communicated this in the following excerpt taken from her interview:

Because of the immersive environment, I felt so present and immersed. I deeply felt what the artist was thinking, their feelings and thoughts while painting. (Raneem)

During her interview, Sameerah stated that having the immersive virtual museum experience in this study helped her to emotionally connect more with the content of the museum displayed around her, such as the elements and characters in the paintings. According to her, this experience enriched her

understanding of the artistic content. An excerpt from her interview on this point is given below:

This experience helped me understand the artwork and connect with its content, feeling the objects and characters.

(Sameerah)

Based on the interviews, the immersive virtual museum allowed the participants to communicate more deeply with the paintings on display. The clear, vivid images that they saw enhanced their ability to see and analyse the fine details of these works of art. This response was apparent in the following excerpt taken from Lena's interview:

I felt like I communicated with the details and the classic paintings. I really wanted to deeply scan all the details. It was so clear and precious. I felt as if I'd gone abroad and entered the museum and saw it in person. (Lena)

Moreover, this experience enabled the participants to make contact with different civilisations that were on display in the virtual museum. Such a view can be seen in the following excerpt taken from the interview with Raneem:

It's interesting and something new to see different civilisations and ancient history and be able to study them more deeply by reaching the ceiling details. I could see its information. I know who the artists are and why they did it.

I really benefited from this experience. (Reem)

In another response, Ahlam described feeling as if she were living within the paintings themselves, indicating a strong sense of immersion and connection with the artwork, as shown in the interview excerpt below:

This experience is different because when I look at the paintings, I feel like I'm living in the painting, and when I start drawing, my drawings will be driven by what I felt while looking at the paintings. (Ahlam)

4.4.6 Emotional Response

The immersive virtual museum experience in this study reportedly triggered a number of emotions that could be interpreted in light of the concepts of flow and presence. These emotions were coded in the findings as awe, fascination,

pleasure, amazement, excitement, and enjoyment, as detailed in the sections below.

Table 4.5 Theme: Emotional response to virtual museum.

Subtheme	Code	<i>N</i>
Awe	<ul style="list-style-type: none"> • Being inside historical places • Being present in another place while still in their place 	5
Fascination	<ul style="list-style-type: none"> • Vividness, free control, deep feeling of the museum atmosphere • Ability to reach ceiling and see objects that were not clear 	6
Pleasure	See realistic details, concentration and control, and feeling of pleasure towards the paintings' content	3
Amazement	Amused by the clear details and described as visually nourishing	3
Excitement	Thanks to the high sense of presence, they want to continue navigating around the museum and to draw the same details	4
Enjoyment	Enjoying navigating around the museum as a person and looking and zooming in on clear details	10

4.4.6.1 Awe

During their interviews, the participants demonstrated a deep sense of awe after their experience in the immersive virtual museum. They attributed this feeling of awe to the sensation of being present inside a real museum, or in other words, being transported to another place. For example, Rawan emphasised the physical attributes of the museum, highlighting the sensation of being inside a museum with the actual scale of artwork and architecture, as shown in an excerpt from her interview given below:

I felt awe. I was inside the museum and saw its huge walls and columns. I saw the actual size of the paintings, the height of the walls, and ceilings that were full of details.
(Rawan)

In her interview, Rania likewise expressed a feeling of awe when describing the emotional impact of the deep sense of presence in London in the United Kingdom while remaining physically in Riyadh in Saudi Arabia, as detailed in the following quote:

I could feel awe of the museum. I mean I felt awe that I'm in Riyadh but present in London. I mean it's something very beautiful. I'm in that place; the feeling is undoubtedly different from the physical experience. (Rania)

4.4.6.2 Fascination

A sense of fascination with the artwork was also evident in the participants' statements about the immersive virtual museum, and the depth and detail of the virtual reality experience apparently increased their sense of presence in that space. For example, Moneerah described being fascinated with the experience and captivated by feeling as if she were in a richly detailed physical museum, as shown in the following interview excerpt:

I was fascinated by this experience. I didn't expect to visit a museum with these fine details. In general, the experience was beautiful, and I enjoyed it. I'll come back again. It was rich as an experience. (Moneerah)

Moreover, Aseel found the immersive virtual museum more fascinating than a physical museum due to the simulation having a quiet atmosphere that allowed her to explore more than she might have been able to do in a physical museum. A quote from her interview describing this reaction is given below:

Sometimes museums need to be quiet to feel the museum atmosphere more deeply. I think it's better than real museums because in real museums, I can't see the details and get close as much as I want. I see this [the virtual museum] as fabulous. (Aseel)

4.4.6.3 Pleasure

According to the participants, the sense of presence they felt in the virtual museum induced a feeling of pleasure as they could see realistic details. For example, Reem emphasised feeling pleasure when she could see details in the paintings, as shown in the following quote from her interview:

It was a pleasant experience and had some good harmony. I could explore in depth as I saw clear, precise details. It was an amazing time compared to when I use a normal mobile phone image or a picture with explanation. I can understand more details when I see the details myself. The easy interaction with the details is incredible. (Reem)

In her interview, Ghadah likewise expressed a feeling of pleasure after being able to see certain elements in the paintings that were displayed in the

virtual museum. She described a positive emotional reaction more specifically from seeing the details of children, flying objects, and flowing water in the paintings, as shown in the following interview excerpt:

The children organised and the flying objects induce nice feelings. Water flowing like in a fountain. Everything is cute and attractive. It was a pleasant experience. (Ghadah)

4.4.6.4 Amazement

The participants described feeling amazed in the virtual museum. For instance, Raneem's response in the interview revealed how profoundly amazed she was by the visual richness around her:

I was amazed. I felt like I had to seize the opportunity and be present. As soon as I entered the place, I fully focused my attention on it. Everything was attractive and nice. (Raneem)

4.4.6.5 Excitement

Participants described feeling excitement about engaging with the artwork, reflecting on their experience, and reaching a deeper appreciation of it. For example, Hayat expressed excitement about continuing to explore the virtual museum and observing fine details, like the reflection of light, which enhanced her sense of presence. This reaction is apparent in the following quote taken from her interview:

If they offered me more, I would continue. I was excited to look at the reflection of light. I mean, this is something that gives a sense of being there. Nice! I feel like my experience was enriching. (Hayat)

4.4.6.6 Enjoyment

During the interviews, the participants indicated that they enjoyed exploring the virtual museum environment and becoming immersed in it. For example, Rawan said she enjoyed navigating through the virtual museum, comparing it favourably to similar previous experiences she had encountered in the past, as shown in the interview excerpt below:

It was an enjoyable and enriching experience. It was better than any previous experience I've had in a virtual museum.

Wandering around as a person was enjoyable. (Rawan)

The participants also reportedly enjoyed exploring the emotional depth and expressions of the paintings. This response is highlighted in the quote from Lora's interview below:

I really enjoyed it. It was a beautiful experience full of nice feelings. I enjoyed the scenes that contain expressions and feelings, fear, anxiety, and tension. (Lora)

The participants reportedly enjoyed manipulating museum content and zooming in on details, which allowed for a greater focus on intricate elements like brushstrokes and jewellery. This was apparent in a response from Sahar's interview given below:

I usually enjoy looking at the artworks with such detail; however, in this experience, the ability to zoom in on these details was fabulous. I like this kind of museum and painting, and in this experience, I focused deeply and more on details such as the brush movements and sparkling jewellery. It was a pleasant experience. (Sahar)

The participants also enjoyed how they could reach normally unreachable areas, so much so that they spent a fair amount of time looking at those details. For example, Areej had the following to say on this topic in her interview:

I spent about 10 minutes in one area. I focused on it, especially the ceiling. When I go to a museum, I can't reach it. (Areej)

Shatha described the immersive virtual museum experience as both strange and enjoyable. Despite its initial strangeness, she found it enjoyment due to its accuracy and sense of sincerity, as shown in the interview excerpt below:

I really enjoyed the experience. It was a weird experience but at the same time very nice. I saw things accurately. That was the best thing, seeing even the details of the walls. I felt sincerity inside the museum. (Shatha)

In her interview, Reem gave a similar response to Shatha. Although Reem found the virtual museum enjoyable, interesting, and beneficial for other

students, she initially felt apprehensive due to a fear that she might fall while wearing the headset, as seen in the following interview excerpt:

I was afraid I'd fall, but it was nice and enjoyable. Even other students, if they used it, it would be interesting for them compared to the traditional shows. I used to see these glasses and I dreamed about trying them. I enjoyed it, and I think that others would benefit. It's a useful experience.
(Reem)

The participants expressed a sense of enjoyment in the experience, as shown by their fascination with their sense of control and access to detailed information. Referring to the balance between challenge and skill, Raneem expressed a sense of control and ease in interacting with the virtual environment, which enhanced her fascination and enjoyment:

I can zoom in and photograph the smallest details. It's really fascinating. The control was so nice and simple. I mean that the control is the most effective because I can zoom in to the maximum possible zoom. (Raneem)

Accessing audio-visual information also fed into participants' excitement about exploring more details, contributing to a sense of enjoyment, as Ahlam mentioned in the interview:

What fascinated me the most was the zoom option. The detailed explanation on the paintings and colours are aspects that I can hardly see from far away. When I use the zoom, I explore more things. Also, I can reach more audio-visual details and information. (Ahlam)

4.5 Participant Attitudes

In relation to the second research question (How do art students in higher education in Saudi Arabia perceive learning through an immersive virtual museum?), most of the participants showed a positive attitude about the virtual museum's ease of use, its perceived usefulness, and their intention to use something like it again in the future (see Figure 4.6).

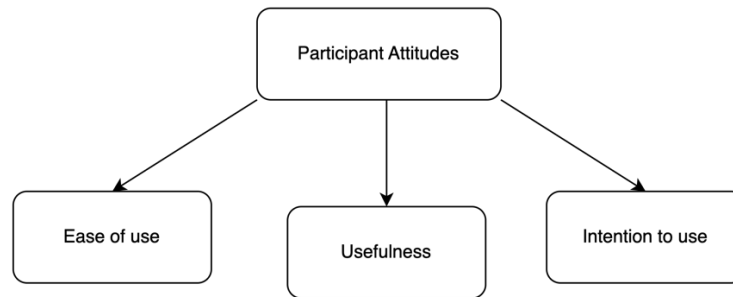


Figure 4.6 Perceived ease of use, usefulness, and intention to use.

4.5.1 Ease of Use

Under Research Question 2.1 (How do art students in higher education in Saudi Arabia perceive the ease of using an immersive virtual museum in their learning?), the codes identified across the interview transcripts were move/change viewpoint, easy access and interaction, easy to log in, easy to click buttons for more information, easy to zoom in for more details, and no budget or transportation needed (see Table 4.6).

Table 4.6 Theme: Ease of use.

Subtheme	Code	N
Easy access and interaction	<ul style="list-style-type: none"> • Log in • Move/change viewpoint • Click on buttons for information • Zoom in for more details • No budget or transportation needed • Easy to use device and follow the instructions • Easy to use for the first time 	10
Difficulties	<ul style="list-style-type: none"> • Technical issues • Find similar museums 	3

4.5.1.1 Easy Access and Interaction

The participants reported finding it easy to move around the virtual museum. For instance, in her interview, Lora expressed her ease in logging in and moving inside the museum the first time she tried it, noting a desire for tactile interaction with the content, as shown in the quote below:

It's easy. As a person who wants to learn, it was not hard for me. I easily logged into the museum and navigated in it. I hoped to touch the content and could actually touch it.
(Lora)

The participants found it easy to interact with and explore the immersive virtual museum. Rawan, for example, said that despite using this type of

technology for the first time, she was moving around and interacting easily, as shown in the quote below taken from her interview:

It's very easy. Although it's an advanced device that I hadn't tried before, it was easy. I can easily move around. Even when I look up, the paintings move with me. The buttons are easy and clear, and I could see them in my hand during the experience. (Rawan)

The participants also mentioned the ease of changing their place or perspective and concentrating on the content, such as in the statement below that Razan made in her interview:

It's very easy to use. It's easy to move around the museum. I can walk, look, and contemplate every work and detail. Even the murals, columns, and the things around the chimney look real. This is all while I'm in a virtual world. (Razan)

The participants valued being able to access the virtual museum without a heavy financial burden from transportation costs or entry fees. As Ghadah said during her interview, there was no budget needed to use this type of museum, meaning that art learners would not have to pay anything:

I can enter the museum whenever I want. I don't need a budget to travel to it or a ticket. (Ghadah)

Moreover, the participants mentioned interactive features such as clickable buttons that enabled them to more easily access information in the virtual museum. Alma, for instance, stated in her interview that she could get more information by simply clicking on buttons:

I understood the information I wanted. When I needed more details, I clicked on the plus icon and saw more explanation. (Alma)

Additionally, the participants valued having easy access to small details using the zoom control, which is not available to the same extent in traditional media. During her interview, Ghadah emphasised this feature's superiority over looking at static images or videos, as shown in the excerpt below:

Virtual reality is actually much better than seeing pictures or videos. Nothing's perfect, but the positive side in this

experience is the level of zoom, which is not provided in other experiences. (Ghadah)

Furthermore, the participants found it easy to use the virtual reality headset and follow the instructions, particularly the first time they used it, as illustrated in the excerpt below taken from the interview with Bdor:

It's easy to use and understand the instructions. I hadn't used it before, and I didn't expect it to be this easy. From the beginning, I understood and continued as I knew the basics. (Bdor)

The codes that indicate participants' attitudes and justifications for their responses towards ease of use are summarised in Figure 4.7.

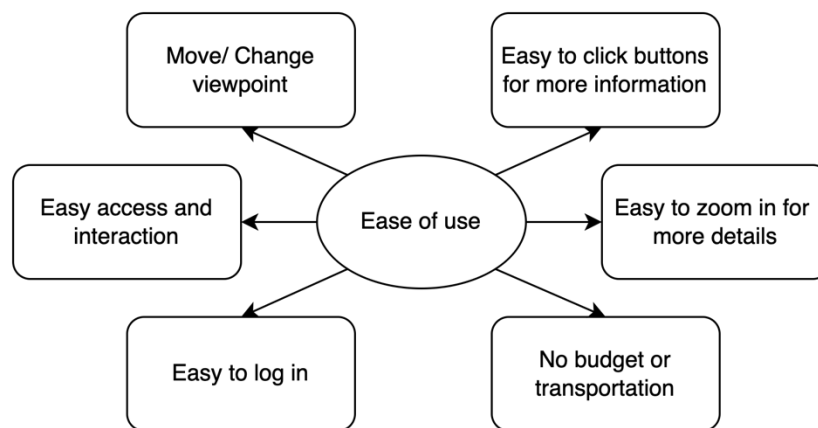


Figure 4.7 Codes for ease of use.

4.5.1.2 Challenges

While most of the participants perceived the virtual museum as being easy to use, some of them nevertheless encountered technical problems that interrupted their virtual reality experience. For example, Dwaa mentioned occasional suspensions when zooming in, impacting her ability to see some details:

I had smooth control, but there were some suspensions in some artworks. Sometimes, it stops zooming in. I mean, I could move right and left but couldn't zoom in. (Dwaa)

In her interview, Rania acknowledged that technical problems negatively affected the experience that she had in the virtual museum, as shown in the following excerpt:

The virtual museum's technical issues disrupt the experience. (Rania)

Other participants mentioned challenges related to the availability and reliability of such museums. For example, while Hayat said that she found the virtual museum easy to use, she also said that it was difficult to find such high-quality virtual museums with sufficient information, as shown in the following excerpt taken from her interview:

Although it's easy to use, the problem is in finding these types of museums. Are they available with enough information as needed? I think this is the hard thing. (Hayat)

4.5.2 Usefulness

To answer Research Question 2.2 (How do art students in higher education in Saudi Arabia perceive the usefulness of immersive virtual museums in their learning?), codes were collected on their responses without preconceived concepts or anticipated outcomes. The codes that were identified across all of the interview transcripts were classified as follows: reliable information, clear information, foster learning, modify conceptions, recall information, enjoyable learning, alternative to physical visits, meet learner needs, and frequent access (see Table 4.7).

Table 4.7 Theme: Usefulness.

Theme	Code	<i>N</i>
Help convey information to learners	<ul style="list-style-type: none"> Artists' thoughts and styles Painting details and compositions 	7
Access to reliable information using multiple modes	<ul style="list-style-type: none"> Multiple modes Easy access to reliable information 	5
Foster learning	<ul style="list-style-type: none"> Understand information quickly Find more information in a short period of time Improve practical performance Content visualisation 	5
Modify conceptions	<ul style="list-style-type: none"> Contemplation to see the details better Change viewpoints on art schools 	6
Displaying clear information	<ul style="list-style-type: none"> Similar to a real museum Display unreachable parts of museum clearly See the artwork from different angles with high quality 	4
Recall information	<ul style="list-style-type: none"> Recall details 	2
Enjoyable learning	<ul style="list-style-type: none"> Enjoy using navigation option and ability to directly see artwork 	2
Alternative to visiting a physical museum	<ul style="list-style-type: none"> During term/class time Alternative to museums located abroad 	4
Meeting learner needs	<ul style="list-style-type: none"> Recognise the actual dimensions instead of descriptions 	7
Frequent access	<ul style="list-style-type: none"> Frequent return to the museum and its paintings 	3

4.5.2.1 Conveying Reliable Information

According to the participants, the immersive virtual museum as a learning tool conveyed reliable information clearly and easily. This sentiment was apparent, for example, in the following quote taken from the interview with Sheren:

It's very useful. It conveyed reliable information easily.
Because some sources don't have the ability to convey information clearly. (Sheren)

The participants also stated that the immersive virtual museum conveyed the artists' thoughts, stories, and artistic styles reliably, as exemplified by the following response taken from Amjad's interview:

In addition to the aesthetic role of the artwork, it plays a crucial role. The artists can deliver their thoughts, story, a possible performance or artistic style that shows he or she is here at work. So, it has two advantages. (Amjad)

Moreover, the participants said this experience was useful because they saw more details than in regular photographs. This was apparent in the interview with Khadijah:

It's actually useful. I felt the picture and its details such as the perspective and the third dimension in a better way compared to when I see photos on websites and phones.
(Khadijah)

Easy access to reliable information in multiple formats was another stated advantage of the virtual museum. The participants compared the virtual museum experience with visits to physical museums in this way. In doing so, they emphasised their ability to get information in the immersive virtual museum in multiple ways, such as audio or visual information or by zooming in. This was apparent, for example, in the following interview excerpt from Ghadah:

The strong and positive points of this experience are the easy access to details and information in artworks, multiple formats, such as the audio and visual options. There are some limitations in real museums, like not being able to touch or get closer to artworks. Here, the content is protected with easy access. (Ghadah)

In addition, the participants said that the virtual museum helped them get reliable information while saving them time and effort and improving their information-seeking skills, as illustrated in the quote below that was taken from Lora's interview:

I was struggling to get reliable information like this. It took time and effort to find it, but now I'm able to get any needed information easily. (Lora)

4.5.2.2 Displaying Clear Information

The participants stated that the paintings were very clear. Kholod described the paintings' details as if they were physically near her, suggesting a deep immersion in the virtual museum and connection with the artwork:

It was useful. Often, there are no clear pictures with enough details of artworks. The pictures rarely arouse feelings like in this immersive experience. I described my experience and felt as if the painting was right in front of me. (Kholod)

The participants mentioned that the details in the artwork displayed in the immersive virtual museum were very similar to the real pieces. As a result, Sara asserted in her interview that using the immersive virtual museum was more effective than looking at a regular photograph:

This technology is better than showing a sample or telling me where I can find the paintings. I could see some artworks more accurately and realistically, unlike when they are in small pictures. (Sara)

Unlike in normal pictures, the participants said that they were able to look at the artwork from different angles in the same high degree of quality. For instance, Shahad noted this advantage of the virtual museum during her interview:

I could see the artwork, get closer to see the details, move away to see the whole artwork. Unlike pictures, which loose quality when my hands are trembling, or are transferred to mobile phones and converted into video. So I consider this experience better. (Shahad)

The participants added that the immersive virtual museum displayed normally unreachable parts of the museum clearly and from different angles, unlike in static images. This response is illustrated in the quote taken from Lena's interview below when she mentioned the ceiling:

It helped me, in terms of the ceiling. I could see all of its details and all of the angles. I went to every angle, and I was seeing more things clearly. (Lena)

4.5.2.3 Foster Learning

The participants perceived virtual reality technology as a valuable tool for accelerating learning, as highlighted in the following quote from Sheren's interview:

Understanding these things clearly helped me develop my learning skills quickly. I needed more information and advanced technology to understanding and develop quickly. (Sheren)

The participants discussed how the use of this type of museum in their studies could enable them to find a large amount of information in a short period of time, as explained by Kholod in the following interview excerpt:

This tool would make a significant change if it had been used in art learning. I mean, if I went back to study these topics and used this tool to explore and describe the artworks, it would make a difference for me. I would learn many things in a short time. (Kholod)

Moreover, the participants indicated that having access to an immersive virtual museum could speed up their progress as developing artists. For example, Bdor said that the virtual museum could have an indirect effect on the development of her drawing skills, as shown in the quote below:

I think if I used this in practical subjects, my performance progress would be indirectly improved. I mean I would learn how to draw the details faster because I'd seen them clearly. (Bdor)

Furthermore, the participants indicated that the way the virtual museum visualised content could foster their learning in general. This sentiment was

apparent in a response that Rania made during her interview, as shown in the quote below:

The visualisation of museum content helped me learn in a faster and better way without barriers or difficulties. (Rania)

4.5.2.4 Modify Conceptions

The participants discussed how the clarity of the virtual museum content had shifted their perspective to focus more on smaller details, suggesting a change in how they conceptualised the artwork. This shift was apparent, for example, in the following response by Reem:

It changed my view towards this sort of painting. I went to museums, but I was not really focused. Now, it's clear that I'm absorbed and contemplating the details. I enjoyed it. (Reem)

Similarly, Alma said in her interview that the immersive virtual museum had increased her understanding of the Baroque art movement and its aesthetic value, which was not clear to her before, as shown in the following quote:

We studied art movements before, but I was expecting these pictures to follow the realistic school. Now, I can identify the aesthetic values in Baroque art through the accuracy of the drawing's details and the colours that have been selected by the artist. (Alma)

The immersive virtual museum reportedly increased the participants' understanding of the paintings on display; in contrast, they said that finer details were rarely clear enough in traditional exhibition methods, such as photographs or museum exhibits. In this way, the virtual museum changed some of the participants' viewpoints on schools of art. This view was apparent in a response from Khadijah, who discussed a notable change in her perception of art. More specifically, she noted a change in how she looked at the fine details within paintings, which had previously gone unnoticed or had been glossed over as abstract, non-specific imagery:

I like this kind of art and I like to see it, but I didn't know that they drew some details such as scorpions or the plant that comes out of its mouth or is in its mouth. I didn't see the

public image where people are magnified, having wings and crowns. I've never noticed details such as animals, abstracting the painting. I mean, there was not a plant in its mouth. It looks like abstract art. I didn't notice that. I used to see it as an exaggerated art. I've never seen precise details like a plant with a mouth. (Khadijah)

4.5.2.5 Recall Information

The participants reported learning in the immersive virtual museum to be superior in terms of accuracy and effectiveness, implying that it enhanced their information retention and learning outcomes. This sentiment is exemplified by the following quote taken from Moneerah's interview:

If I studied art courses using this method, it would have made a big difference. More information could have been kept in my mind as I feel present. This experience is completely different than any previous experience where the main tools are pictures in books or websites that aren't accurate. I'm sure that these outcomes are better. (Moneerah)

In addition, the participants noted the potential that immersive virtual museums had for providing a richer learning experience for art students. Rawan, for example, said that a clearer understanding and observation of details would improve practical skills such as drawing and enhance theoretical knowledge, as shown in the following interview excerpt:

This tool could make a significant change in art learning, because we go to real places to see information more closely. Even in the practical subjects, it would have an indirect impact. If I decided to draw, I would draw the details in a better way because I've seen them clearly. (Rawan)

4.5.2.6 Enjoyable Learning

The participants found that this experience made the learning process more enjoyable, encouraging them to continue studying the art on display. Wedad, for example, referred to the combination of enjoyment and learning during this experience, as shown in the following interview excerpt:

It was a useful time where enjoyment and learning were combined. I learned and enjoyed, benefited and expanded my horizons. I mean, even if there were some artworks that I didn't like, I could still be immersed and enjoy it. (Wedad)

During the interviews, the participants said that they enjoyed using navigation options and the ability to see and understand artwork more directly than would be possible with two-dimensional pictures. This was clear in Sahar's response in the quote below:

I was immersed in the artworks and understood them more. I enjoyed looking at different paintings in front of me. It's certainly better as an experience than seeing pictures. The navigation options helped to move within the museum. I can see this part and other parts. It's brilliant. (Sahar)

4.5.2.7 Alternative to Visiting a Physical Museum

The participants reportedly found the immersive virtual museum to be an excellent alternative to visiting a physical museum. In her interview, for example, Norah said that she thought it could be especially useful if she needed to see museum content and analyse paintings in detail for her coursework, as shown in the quote below:

Very useful, especially in the theoretical subjects like art criticism. I don't have to go to a museum to critically analyse artworks. This is a very excellent alternative, especially during classes or when I don't have time to visit museums. (Norah)

Areej expressed a similar sentiment to Norah, stating that the virtual museum could replace in-person visits to museums while providing essentially the same experience, especially in situations when going to the physical museum would be difficult or impossible:

It will be better if it's applied in classrooms. Not all of us can go and travel to attend exhibitions or visit museums. Even if it's not in another country, we can't always go due to studies or because some artworks can't be reached or seen from all parts for safety reasons. (Areej)

The participants discovered that the virtual museum they explored in this study offered a good alternative to real museums, particularly those featuring artwork from the Middle Ages, which they found to be an important period in art history. Virtual museums could be especially useful in this context because works from this period are typically located outside the Middle East in Western countries. This sentiment is illustrated in the following quote taken from Dwaa's interview:

They're all excellent. Seeing the works as if in reality helped me, especially the artworks of the Middle Ages, which aren't found in our museums [i.e., museums in Saudi Arabia]. (Dwaa)

4.5.2.8 Meeting Learner Needs

The participants referred to how their experience using the virtual museum helped them recognise the true dimensions of museums and the real size of artworks, as opposed to simply reading descriptions of them in books. This is illustrated in the following response taken from Hayat's interview:

It's very useful and would help more in art education. For example, in our studies, we need to see the real size of artworks and paintings. When we read the size number, we can't imagine it like that. I mean now I've almost seen its real size. (Hayat)

4.5.2.9 Frequent Access

Another benefit to the virtual museum, according to the participants in this study, was that it gave them the ability to easily return to the same content as many times as they wanted. For instance, Shatha gave the following response on this issue during her interview:

I could see clearly and return as many times as I want. I move in the museum by myself. I'm comfortable without making any physical effort to reach this information. (Shatha)

The codes that indicate the participants' positions and justifications for their responses towards usefulness are summarised in Figure 4.8.

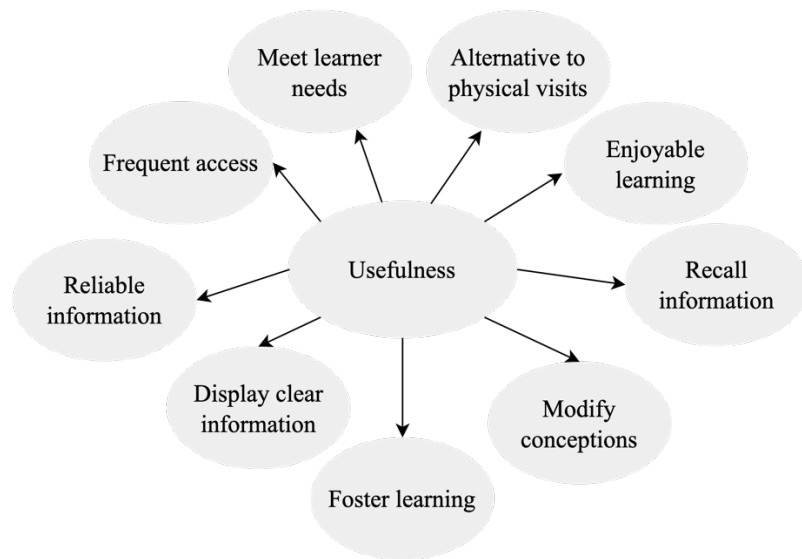


Figure 4.8 Codes for usefulness.

4.5.3 Intention to Use

To answer Research Question 2.3 (How do art students in higher education in Saudi Arabia intend to use immersive virtual museums in the future?), responses were coded into three themes: to see unreachable museum content easily, to learn quickly, and to visit a real museum in the future (see Table 4.8).

Table 4.8 Theme: Intention to use.

Theme	Code	<i>N</i>
Seeing normally unreachable content easily	<ul style="list-style-type: none"> • No need to travel • See from home • Minimal effort or cost • Save time and effort • Alternative experiences • More information in one place • Access the museum content at any time 	6
Learning	<ul style="list-style-type: none"> • Display various information in different ways • Clarify information • Lived museum story • Shortage of Arabic language content • Freedom to find out information • Find information themselves 	7
Visiting a real museum in the future	<ul style="list-style-type: none"> • Excited to visit real museum • Real museum atmosphere 	4

4.5.3.1 Seeing Normally Unreachable Content Easily

The participants justified their intention to use the virtual museum again in the future by saying that with it there was no need to travel to visit a museum, it

offered similar content with less effort and lower cost, it made it easy to access museum content at any time, it offered alternative experiences, and it let them reach more information in one place. Thus, participants stated that they would keep using the immersive virtual museum to avoid travelling to museums, particularly when the location was inconvenient, as illustrated in the following quote taken from Sama's interview:

I will visit museums that I could hardly go to. If all museums do the same, it will be a good and nice experience and people will no longer need to travel to learn about art and museums. (Sama)

The participants said that the virtual museum was a satisfying and sufficient experience as they could stay home and still see a museum's content directly, as shown in this interview excerpt from Khadijah:

I really enjoyed it. I don't need to go to a particular place to visit a museum. This immersive experience is sufficient, especially for those who can't travel and go far. There's a difference when I see the artwork or museum content myself directly while I'm sitting in my house. It's more satisfying. (Khadijah)

As Jana noted in her interview, the immersive virtual museum could provide a similar experience to a physical museum with minimal effort or cost:

Earlier, we were travelling to search for such arts and contemplate them. Now I see them while I'm sitting at no cost. I like to visit museums physically, but when I can't, the VR headset helps me live the same experience. (Jana)

For art students, getting aesthetic information about art in person can be very time consuming. However, like Jana, Raneem noted that the immersive virtual museum saved considerable time and effort, as shown in the following interview excerpt:

It reduces time and effort getting information, especially for art students who really need this sort of technology as they spend a lot of time to find a painting's details. I mean, I have a passion to visit real museums, but if I can't go, I'll try this

experience again and suggest it to anyone in art schools.
(Raneem)

As Sameerah stated in her interview, users can navigate the virtual museum as a convenient central location to find information:

I can access all the information in one place. I mean, through the VR headset, I can reach everything easily and wander around the museum. I feel like these museums teach me useful information. (Sameerah)

The participants also referred to other reasons that encouraged them to visit this sort of museum, such as it gives them more time to examine the art. For instance, this sentiment was apparent in the interview with Ahlam, who said the following:

After this experience, I'll definitely visit this type of museum again. It was very useful. I'll visit more museums as I can spend more time staring at paintings. (Ahlam)

4.5.3.2 Learning

Many of the participants indicated their intention to use the immersive virtual museum for learning purposes again in the future. Some of the reasons they gave for doing this included displaying information in different ways, clarifying information, bringing the museum story to life, and the freedom to find information themselves.

Some of the participants justified their intention to use the immersive virtual museum again by stating that it offered a single location to find different paintings and museum information. This reasoning can be seen in the following interview excerpt from Sheren:

These types of museums will reduce the many sources and tools needed in art learning. They gather paintings and museum information in one place. I hope this kind of experience will be supported by universities and educational materials. It would be a great experience for art learners. (Sheren)

Other participants justified their intention to use the immersive virtual museum again because it had the ability to clarify information for them. For example, Sameerah said the following to this effect during her interview:

It helps to clarify things that are difficult to understand in traditional sources. In the future, I'll go back to this kind of museum to understand difficult topics. (Sameerah)

Another reason given for using this immersive virtual museum again was to be able to "live the story" of the art and present all the museum's content right in front of them, as Hayat suggested in the following interview excerpt:

The experience encouraged me to visit museums like this. A new and interesting experience. The most interesting aspect is that I lived the story, saw everything in front of me. This is why I might visit them again in the future. (Hayat)

In contrast to other media, the participants said that the virtual museum used in this study gave them the freedom to discover information by themselves without the need to get descriptions from another person. Amjad suggested that this experience was much better than using photographs or a real museum visit due to her ability to observe museum content and details by herself, as shown in the interview excerpt below:

These museums replace videos, YouTube, and websites where people speak and narrate, which I don't find sufficient compared to seeing the artwork myself. There's a difference between someone describing it to me and seeing it by myself. This experience is sufficient and even much better than a real museum visit. (Amjad)

On the other hand, some of the participants mentioned challenges that they encountered with a virtual museum. Reem, for example, said in her interview that going to a virtual museum was not enough for learning about art because of a shortage of content available in Arabic:

Although it's a great experience, there's still the need to use Arabic in museums in the option menu for a better understanding. (Reem)

In her interview, Alma said that while Arabic content availability was more useful for Arabic learners, its quality remained a concern, particularly in art fields, due to a lack of accuracy or depth:

If the topics I'm interested in are available, it will be more useful, although the Arabic content in general is still limited with lower quality. I mean, if I search in the Arabic language, I won't find enough museums specialised in certain fields. I can find random museums but with less depth and accuracy. (Alma)

4.5.3.3 Visiting a Real Museum in the Future

Some of the participants reported that this experience encouraged them to visit a real museum. For example, Norah said it made her excited to see the real museum, as shown in the interview excerpt below:

Personally, I need to live the real experience. If this virtual experience is wonderful, how will a real experience be? I'm excited to visit one. (Norah)

Along similar lines, Lena said in her interview that she wanted to experience the atmosphere of a real museum, despite acknowledging the value of virtual museums in the quote below:

The virtual experience is useful when I can't visit real museums. This technology helps me live a similar experience to visiting real museums. However, I'm still excited to visit the real museum. (Lena)

In summary, intention to use immersive virtual museum was coded into three themes: to see unreachable museum content easily, to learn quickly, and to visit a real museum in the future (see Figure 4.9).

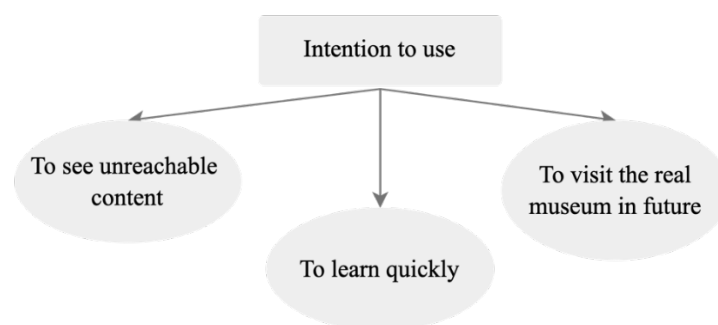


Figure 4.9 Codes for intention to use.

4.6 Chapter Summary

This chapter presented the analysis of the interview data, supported with relevant quotes from the interviews. Based on the findings, the participants experienced a strong sense of presence in the virtual museum due to heightened immersion and interaction with the virtual environment. Perceptivity and appreciation appeared as the most significant consequences of this sense of presence. In addition, the immersive virtual museum facilitated a flow state among participants, characterised by a more intense focus, losing track of time, ignoring external distractions, and an overall enjoyable experience that reportedly met their learning needs. In turn, presence and flow enhanced their engagement and connection with the museum content. Most of the interviewees reported having a positive attitude toward using the immersive virtual museum again in the future because they felt it was easy to use and useful to them as art students.

The present study has generated new themes that have not been sufficiently explored in the literature, such as connection and appreciation. In terms of appreciation, participants valued the virtual museum's enhanced features and greater convenience. They also appreciated how the virtual environment made content more accessible and provided a richer experience than a physical museum, including the ability to zoom in on details, move freely between exhibits, and access detailed and information easily.

The connection theme highlighted the greater connection art learners experienced, beyond a physical museum visit. Participants reflected on and appreciated the emotions and messages conveyed by the artists, fostering a connection between themselves and the artwork. This connection facilitated their understanding, interpretation, and emotional response to the art. In addition, the study gives a summary of the emotion's participants reported feeling during the experience and provides detailed data about how art learners in Saudi Arabian universities experience the immersive virtual museum.

Chapter 5: Discussion

5.1 Introduction

The aim of this study was to understand the potential ways that exploring an immersive virtual museum through a virtual reality headset could affect Saudi Arabian art students' learning experience and attitudes. More specifically, the study sought to gain a better understanding of how such students experienced a sense of presence and flow while learning about art in an immersive virtual museum as well as the effect of their participation in that environment on their attitudes and intention to have a similar experience in the future. As such, this study addressed the following research questions and sub-questions:

1. How do art students in higher education in Saudi Arabia experience learning in an immersive virtual museum?
 - 1.1 How do art students in higher education in Saudi Arabia experience presence when learning in an immersive virtual museum?
 - 1.2 How do art students in higher education in Saudi Arabia experience flow when learning in an immersive virtual museum?
2. How do art students in higher education in Saudi Arabia perceive learning through an immersive virtual museum?
 - 2.1 How do art students in higher education in Saudi Arabia perceive the ease of using an immersive virtual museum in their learning?
 - 2.2 How do art students in higher education in Saudi Arabia perceive the usefulness of immersive virtual museums in their learning?
 - 2.3 How do art students in higher education in Saudi Arabia intend to use immersive virtual museums in the future?

The data for this study were drawn from one-on-one interviews with 30 art students from Saudi Arabian universities after they had participated in a visit to an immersive virtual museum while wearing a virtual reality headset. The results provided a variety of perspectives on this immersive experience in terms of their sense of presence and flow and their attitudes about the experience.

This chapter discusses and interprets the findings in light of the relevant literature and theory, such as active learning theory and flow theory. It reviews the implications for theory, policy, and educational practice and discusses the

contribution this study makes to the field. It also discusses the limitations of the study and gives suggestions for further research.

5.2 Summary of the Findings

This section summarises and interprets the study findings in light of the relevant literature and theory in order to answer the research questions. First of all, this section begins by answering and interpreting the initial research question concerning how using virtual reality headsets to explore an immersive virtual museum reportedly affected the art students' learning experience in this study. In doing so, the section focuses on the participants' perceived sense of presence in the virtual museum, the flow state they achieved, and the individual effects of those factors on the art learning experience. The thematic analysis revealed a series of themes that emerged from interpreting the participants' interview responses regarding the immersive virtual museum and the resulting learning experience. These themes are discussed in the following sections to answer the research questions.

5.2.1 The Immersive Virtual Museum's Effect on Perceived Sense of Presence

The first set of themes, discussed in this section and the following section (Sections 5.2.1 and 5.2.2), answered Research Question 1.1 (How do art students in higher education in Saudi Arabia experience presence when learning in an immersive virtual museum?). Based on the findings presented in the previous chapter, the art students in this study showed a sense of presence in the immersive virtual museum while using a virtual reality headset, with many saying that they felt as if they had been transported to a different environment. Thus, the immersive virtual museum appeared to give participants a sense of being present in a real museum by simulating that type of environment. This corresponds with Slater's (2003) definition of presence as a subjective feeling that is experienced when people feel transported to a virtual space.

The participants in this study attributed this perception of presence in the virtual museum experience to two main factors: immersion and interaction. Immersion as the first factor affecting presence agrees with Slater's (2003) statement that presence is viewed as "a human reaction to immersion" (p. 2). The second factor affecting presence, interaction, agrees with Chrysanthopoulos et

al.'s (2021) claim that immersive virtual reality technology can help engage various senses and that interaction in such an environment can effectively enhance the perception of visual realism and evoke a stronger sense of presence. Moreover, the findings support Ochs and Sonderegger's (2022) claim that virtual reality headsets can enhance a user's sense of presence in immersive virtual reality.

The findings highlighted several characteristics helping to generate a sense of immersion, and therefore presence, among the participants as they explored the virtual museum. The analysis of the interview data suggested that immersion was mainly generated from (1) a feeling of vividness that was related to the high resolution and clarity of the museum halls and content, (2) experiencing the surroundings, and (3) feeling as if they were part of the museum, i.e., feeling as if they were inside the museum. These immersion features correspond to those mentioned by Witmer and Singer (1998), i.e., that virtual reality immersion is a response to technology characterised by perceiving oneself to be included in and interacting with an environment that provides a continuous stream of stimuli (for example, visual stimuli).

The features of virtual reality enhancing this sense of immersion noted throughout this study underscored the key role of the quality and capabilities of virtual reality headsets. This finding agrees with assertions made by Bowman and McMahan (2007) and Sanchez-Vives and Slater (2016) that immersion depends on the capabilities of a virtual reality headset, such as resolution, refresh rate, and field of view. In the current study, the immersive virtual museum reportedly surrounded the participants with sensory data mimicking a real museum to stimulate their sense of presence in the virtual space. The virtual reality headset's clear, vivid display of visual data, including colour and light, gave the illusion of being present in the real museum and enabled them to see the museum content more directly. This aligned with the art students' need to see museum content as it would appear in the real world.

In this study, exploring the immersive virtual museum through a virtual reality headset provided participants with the depth cues of the museum halls and the last point in the depth that they could reach, making use of naturalistic light and shadow. This finding agrees with Hendrix and Barfield (1995), who mentioned how the accuracy of spatial transformations is affected by the

geometric field of view, display update rate, motion parallax, and depth cues like linear perspective, aerial perspective, and occlusion.

Additionally, the participants reported feeling immersed in this virtual experience thanks to their ability to turn around freely in a manner that simulated the natural movement they typically experienced in the real world, thereby enhancing their sense of presence in the virtual environment. According to Slater et al. (1995), immersion refers to the level at which computer displays are extensive, surrounding, inclusive, vivid, and match a user's proprioceptive feedback regarding the movement of their bodies and display information that changes with head movement.

The perceived ability to move and interact within the immersive virtual museum reportedly led the participants to continue their experience and move around in the virtual museum. This finding supported the idea that the first impression of realism in an immersive virtual experience may vanish if this immersion is not fed by natural and meaningful interaction within the environment (see Perez-Marcos, 2018). Thus, the illusion of movement through the immersive virtual museum and the ability to zoom in on content encouraged the participants in this study to start naturally interacting with the virtual environment around them, realising it responded to their actions. They explored the virtual museum by turning their head around as they would in the real world and zooming in for more details. These findings agree with Seo's (2011) claim that when a person's senses have been convinced that a virtual environment is real, they will be able to interact and engage with it naturally. Along similar lines, Bystrom et al. (1999) stated that motion parallax is a crucial component of spatial perception that is provided by head tracking in virtual environments. When display technologies and interaction techniques, such as head tracking, provide motion parallax and update rates rapid enough to create the illusion of continuous motion within the simulation, this will typically result in a strong sense of presence in the user.

One of the main features of virtual reality is that the experience occurs in two places at once, one in a virtual space and the other in a physical space (Smith, 2020). In the current study, the virtual space was a virtual museum, and the physical space was the place where the learning experience took place (a university campus). This phenomenon has been referred to as double consciousness (Salen & Zimmerman, 2003) and happened in the present study

when the participants were fully aware of the museum as an artificial environment. Similarly, Salen and Zimmerman (2003) found in their study that double consciousness enriched play in video games; players may feel immersed, but they are also aware that they are playing a video game. The findings of the current study attributed this feeling to technological limitations, such as the need to click on icons to move around and the absence of other senses, such as smell and touch.

Museums represent a vital resource that students can use to learn and explore art. However, art students generally learn from museums passively through printed images in books, websites, or lectures. As a result, they often fail to perceive the actual size, lighting, texture, and colour of a given work of art (Cecotti, 2020). However, as the present study demonstrated, an immersive virtual museum can enhance art students' perception of this content by simulating a physical visit to a museum instead of simply offering static images to look at. In fact, the participants in the current study claimed that they could interact in the immersive virtual museum more effectively and actively than they would have been able to do in a physical museum. This finding could have been due to the participants being able to find out and see more than they normally could in a regular visit to a physical museum. For instance, they had the opportunity to see elements that would have been difficult to observe closely in reality, such as the ceiling, by using the zoom in feature in the virtual museum.

5.2.2 The Effect of Presence on the Art Learning Experience

The previous section showed that the art students who participated in this study perceived themselves as being present and actively involved in the immersive virtual museum experience when using a virtual reality headset thanks to certain factors (i.e., immersion and interaction). This section discusses art students' perspectives about their learning experience in the immersive virtual museum.

Many of the participants mentioned during the interviews that they had felt present in a museum that closely resembled a real one due to the virtual museum showing a high degree of fidelity to a physical space, and their participation in the immersive virtual museum indicated an increase in their perceptivity and appreciation. This aligns with a study by Barab et al. (2000), who found 3D virtual worlds to be an effective tool for fostering university students' understanding of

course content. It also aligns with the finding of Chrysanthopoulos et al. (2021) that instilling a sense of presence in an immersive virtual environment could enhance the educational and informative experience provided by a museum.

According to the literature, artists and art students benefit from being able to directly perceive museum dimensions and content. In the current study, the participants were able to move around and turn their head to look left and right instead of merely viewing static photos of paintings. This in turn helped them examine each painting's story and gain a more comprehensive understanding of its sequence, the dominant techniques used, and the style of the art movement in the museum, compared to viewing still photographs. This finding agrees with Cecotti et al. (2020), who found that virtual reality technology transported students to an environment specific to the learning content and displayed content to students in the same way that it would be presented in its physical form. The findings of the present study also agree with Dede's (2009) claim that the multiple perspectives and authentic experiences provided by a digital environment have the ability to improve the learning experience, as an immersive virtual museum can allow learners to more directly experience the material and to actively interact with it through multiple perspectives, angles, and positions. Moreover, Dengel and Mägdefrau (2019) claimed that this immersive virtual experience supported Dewey's learning-by-doing approach, which they defined as learning by being in a compelling setting and perceiving it as an actual reality with the capacity for interaction and choice.

Many of the interviewees in this study felt that their participation in the immersive virtual museum experience increased their perceptivity, due to their impression of being present inside the actual museum. Perceptivity was defined by Uhrmacher (2009) as follows:

Racing through a museum to recognize the Cezanne, the Picasso, the Van Gogh, is one thing. To really perceive a given painting by one of these artists is another. To perceive, one must really look, take in the qualities of the painting: its colors, textures, and lines. (p. 18)

According to the data analysis, the participants could create their own experiences that would suit their personal interests. This finding aligns with Tripathi's (2020) claim that museums usually provide their visitors with the

opportunity to independently learn in their own way. The students in the present study demonstrated knowledge of the true proportions of the museum and its content, including the size of the walls, columns, and paintings, as well as lighting, texture, and original colours, which may not be clearly visible in still images on websites or in books. This supports Dewey's (1934) claim that "A crowd of visitors steered through a picture-gallery by a guide, with attention called here and there to some high point, does not perceive.... For to perceive, a beholder must create his own experience" (as cited in Uhrmacher, 2009, p. 18). Similarly, Cecotti et al. (2020) reported that a virtual museum can allow visitors to view artworks more effectively than they could by looking at a printed image. The printed image strips away the size, texture, and lighting perceptions that can be experienced when viewing the original artwork. Consequently, viewing a picture in a virtual museum boosts the perception of its scale, light, texture, and true proportions (Cecotti et al., 2020). This is in line with Alawad et al.'s (2015) claim that direct experience in virtual museums can enable students to participate more actively in their learning. It also aligns with the studies by Leung (2018) and Chen (2010), which stated that the ability to experience, manipulate, and interact with a 3D virtual representation and visualise abstract concepts in a virtual environment contributed to active learning, as individuals could explore different artistic styles, techniques, and concepts more freely in a way that might not have been possible in real life.

Along these lines, interviewees in the present study mentioned that certain features of the immersive virtual museum, as seen through a virtual reality headset, exceeded the affordances of a physical museum and provided them with a more effective educational experience. Two of the main features they mentioned were icons and zooming in. The icons that appeared throughout the virtual museum were beneficial by attracting the viewer's attention, explaining significant museum elements, and helping the participants understand certain characters and symbols. Being able to zoom in also helped the participants notice certain details that would have been difficult for them to see close up in the actual museum, such as the details on the ceiling. This finding corresponds to a claim by Mulders et al. (2020) that turning and rotating parts of mechanical installations that are not physically possible in the actual world is just one example of how this technology delivers an authentic learning experience that other media cannot

achieve. Within the immersive virtual museum, participants could explore a number of paintings in their original sizes, even artwork on the ceiling. This ability to zoom in and see details up close would be difficult in a physical museum.

Moreover, the feeling of being inside the immersive virtual museum allowed the art students in the present study to appreciate the possibilities of that environment. While it allowed them to have a similar experience to a real museum, interviewees also said that it facilitated access to even more information of historical, precious, and prominent artistic content in the museum by providing icons that contained explanations of a given element, enabling zooming in and out to see details on the ceiling, and moving freely around the virtual museum without restraint between the pieces of art. This finding aligns with the view of Katz and Halpern (2015) that by providing richer perceptual cues and multimodal feedback (e.g., users being able to view 3D objects from multiple points of view or to zoom in and out on objects), this type of environment may enhance the learning experience.

In physical museums, a piece of art is often provided with a plaque or card containing basic information about the work of art, such as its title and date of creation. However, the immersive virtual museum used in this study offered more textual and audio-visual explanations of the details of a painting, for example, regarding the characters presented in it. This made learning more efficient by saving students time having to look up in other resources what elements of a work meant. Thus, the findings of this study support Bekele and Champion's (2019) claim that recent advances made in head-mounted virtual reality displays that allow for both audio and visual immersivity and expanding libraries of educational applications, coupled with lower costs, have removed many of the barriers that had previously prevented widespread adoption of this technology in academia. In contrast, Lin et al. (2020) noted that head-mounted virtual reality displays hindered the ability to freely appreciate artwork because of the restrictions of its operation, such as having to move the mouse to adjust the viewing position. Furthermore, they noted the issue of the artwork size being fixed, preventing viewers from zooming in to appreciate its details. In contrast, the immersive virtual museum and headset used in the current study featured zooming in and out as well as free movement, which appeared to increase the participants' appreciation of the artistic content displayed in the virtual museum.

Overall, the findings of this study suggested that the sense of presence afforded by the immersive virtual museum increased the art students' perceptivity and appreciation of the experience. Furthermore, the virtual museum offered visual and interactive resources not available in books, websites, or physical museums. This experience allowed the participants to more actively and directly see and interact with the museum content, compared to passively looking at a picture in a book and reading a description of it. As a result, they reported a more positive art learning experience. These findings agree with studies by Leung (2018) and Chen (2010), which highlighted the pivotal role that interaction could play in facilitating a more meaningful learning experience. Thus, the type of immersive virtual museum used in the present study could serve as a powerful tool for creating a more effective learning experience. This is especially relevant to art students in Saudi Arabia, where it is difficult to access original works of art displayed in European museums.

5.2.3 The Immersive Virtual Museum's Effect on Perceived Sense of Flow

A second set of themes answered Research Question 1.2 (How do art students in higher education in Saudi Arabia experience flow when learning in an immersive virtual museum?) Summarised and interpreted in this section, these themes are related to the flow state within the immersive virtual museum and its effect on the art learning experience of participants while wearing a virtual reality headset.

Based on the responses from the participants in this study, the immersive virtual museum allowed them to enter a state of flow. They described this experience as one that facilitated focusing on the art in front of them and losing track of their surroundings, while it reduced external distractions, increased their enjoyment, and matched their learning interests. They attributed this state of flow to a variety of features of the immersive virtual museum and virtual reality headset.

This study's finding that the virtual reality headset isolated participants from their surroundings, enabling them to concentrate more intently on the virtual environment, aligns with a study by Ochs and Sonderegger (2022). Their study likewise found that using a virtual reality headset isolated users from distractions influenced by visual cues, helping them concentrate on content because they

could not see anything else. Several interviewees in the present study stated that the immersive virtual museum gave them the impression of being alone in a real museum while not being able to see anything except the museum content displayed through the virtual reality headset. It blocked out external distractions, such as visual cues, in the real world. This allowed participants to devote their full attention to the museum content. Similarly, Csikszentmihalyi and Robinson (1990) recommended enhancing museum experiences in ways that would facilitate a flow state by more effectively handling crowds, noise, and other distractions.

In addition, the immersive virtual museum in this study provided vivid scenes and control over how the material could be viewed. This led to the participants feeling disconnected from the real world in terms of time and space. As a result, they showed a desire to continue exploring a painting's elements, taking advantage of virtual reality features such as freely moving around the museum halls and zooming in and rotating to examine details. Such features encouraged the participants to spend more time exploring specific elements of the artworks in the virtual museum. As a result, they lost their sense of the surrounding stimuli in the real world and other outside interruptions, which further enhanced their concentration. Thus, this experience supported the idea that being in a flow state can encourage individuals to spend more time on flow-inducing activities, such as browsing for more information online. This finding is consistent with several studies, including those of Novak et al. (2000), Webster et al. (1994), and Hassan et al. (2020). In addition, the findings of this study indicated that virtual reality could have a strong ability to induce a flow state by transporting users to another world, where they become engaged in immersive experiences, in keeping with the study by Hassan et al. (2020).

Another finding of this study was that the immersive virtual museum generated a feeling of enjoyment among the participants. The participants reported that the feeling of being inside the museum created an enjoyable experience for them, that is, being surrounded by clear and vivid scenes, being able to explore whatever they wanted for as long as they wanted and being able to zoom in on fine details. As Mansour et al. (2017) noted, art by itself is an experience that individuals can become deeply absorbed in and derive significant joy and satisfaction from.

As illustrated in this study, being able to examine clear, high-resolution images of art is an important way for art students to learn and develop their skills. The participating art students showed a strong interest in exploring the museum content partly because it was relevant to their educational goals. Virtual reality provided greater realism than still images, allowing them to look at a piece of art more closely and from different points of view, as if they were physically in the same room as that piece of art. The immersive virtual environment also made it easier for them to deeply contemplate the details that most interested them, exploring the art in a way that might not be possible in a physical museum or with still photographs. This finding aligns with Csikszentmihalyi's (1990) description of flow as a subjective experience of perceiving an activity as enjoyable and intrinsically interesting.

Being able to examine clear, high-resolution images is a major need for students of the visual arts. As a result, art students often examine reproductions and photographs of art in books and on websites, with those reproductions and photographs shaped by another person's perspective. In the current study, the participants noted that another advantage of the virtual museum was that they could learn about museum content without needing another person to filter information through their perspective. This finding aligns with Winn's (1993) claim that museums can often facilitate a "first-person" experience to get the attention of visitors and to encourage them to reflect more deeply on a given piece of art. Furthermore, the findings align with Lankford's (2002) conceptualisation of an artist's experience with art in a museum being one in which they are fully immersed in the work and unaware of thinking, feeling, seeing, or empathically connecting as separate processes. Moreover, the findings align with Latham's (2016) description of flow as a significant form of museum visitor experience and one of the potential outcomes of visiting a museum.

Overall, the findings of this study suggested that the immersive virtual museum facilitated a flow state among art students, removing distractions that could have disrupted their learning experience and increasing their ability to concentrate on museum content. As explored in the next section, this state was expected to make their learning experience more effective.

5.2.4 The Effect of Flow on the Art Learning Experience

Based on the responses to the interviews in this study, the flow state achieved while exploring the immersive virtual museum reportedly had an effect on the learning experience of the participating art students in Saudi Arabian universities, including a higher level of engagement and a deeper connection with the museum content. Certain characteristics of the virtual museum created a sense of presence that aroused this flow state, agreeing with Hoffmann and Novak's (1996) claim that presence creates a powerful effect on flow during the learning experience. The characteristics of the virtual experience leading to this sensation included (1) a feeling of vividness related to the high resolution and clarity of the museum halls and content, (2) experiencing the surroundings, (3) feeling as if they were part of the museum, and (4) free interaction, movement, and a sense of control. All of these factors led to participants feeling more immersed in the virtual museum experience. This finding agrees with Ha and Im's (2020) claim that interaction plays a crucial role in fostering a flow state and influencing the learning experience, helping individuals concentrate and become more absorbed in what they are doing.

According to the interview data, the flow state achieved in the immersive virtual museum in this study enabled the art students to better engage and connect with the museum content by increasing their concentration, enjoyment, and interest in that content while simultaneously decreasing their awareness of their physical surroundings, thus shutting out external distractions. The virtual reality headsets effectively minimised external and visual distractions, allowing the art students to feel more fully immersed in the virtual museum and focus on the pieces of art in front of them. Overall, this finding revealed the effective role virtual reality headsets can play in enhancing the flow state.

The interviews indicated that the flow state reported in the immersive virtual museum increased learner engagement. This is consistent with the results of the engagement comparison conducted by Allcoat and Mühlénen (2018) between three learning conditions—conventional textbooks, virtual reality, and passively controlled video—with the same text and 3D model used for all three conditions. The participants who were exposed to the virtual reality condition in their study reported higher levels of engagement than the other two conditions.

Similarly, Perry et al. (2017) stated that immersive virtual reality increased learners' engagement and helped them better understand course content.

A major factor contributing factor to the participants' perceived experience in this study was the feeling of being alone in the virtual museum and the ability to decide what they were interested in and wanted to see. This consequently induced curiosity, absorption, and self-regulation. In this environment, the participants said that they felt better able to discover implicit and normally unnoticeable elements (such as the figures on the ceiling) that they might have missed in a physical museum, partly because they were alone in the virtual museum and partly because of the tools that were available to them there, such as being able to zoom in and select icons. This finding aligns with Sylaiou et al. (2009) and Sylaiou et al.'s (2017) claims that when online museums offer visitors the ability to interact with and manipulate images, this can make the museum more interactive, allowing visitors to see things that might not normally be apparent in the physical museum due to size or spatial restrictions. Participants in the present study felt as if they were learning about the Baroque art movement for the first time because of the amount of detail they were able to see that was missed in static photographs.

Moreover, the results of this study support Guerra-Tamez's (2023) finding that the flow state mediated the influence of the learning experience variable by its effect on motivation, curiosity, cognitive benefits, reflective thinking, and the perception of value. In that study, immersion in virtual reality improved students' ability to explore and engage with their surroundings.

The interactive features of the virtual museum mentioned above, such as free movement and zooming in, fuelled participants' curiosity to explore details at their own pace. They expressed a desire to delve deeper into the museum's content, examine hidden details, and understand the stories behind the artwork, well-documented hallmarks of the flow state. This finding aligns with Csikszentmihalyi's (1990) claim that flow is an aesthetic experience that greatly affects art learning, as well as Mundy and Burton's (2013) assertion that access to 3D interactive content in a museum could increase one's aesthetic sensitivities to art.

Several of the interviewees in this study stated that because of their ability to observe content more closely while in the virtual museum, they could discover

symbols and stories and follow connections between different works of art, for example, following trends in a sequence of works that could not be seen at first glance or in individual paintings. This result supports Guerra-Tamez's (2023) finding that immersive virtual reality can let learners see historical art and design in greater detail, thereby helping them to better understand its context. Furthermore, the immersive virtual museum enabled art students in this study to deeply engage with museum content in a manner that some of them compared to the engrossing experience of reading a novel. The virtual museum's features thus allowed art students to self-regulate their learning. While interacting with the virtual environment, the participants said that they focused on elements that personally interested them, which increased their engagement and desire to discover and understand more. This finding highlighted the role that virtual reality can play in supporting the active construction of knowledge (see Evans & Gibbons, 2007). Contrary to the criticism often levelled at constructivism that learning with minimally guided instruction can be less effective and efficient, leading to learners feeling lost and frustrated (see Kirschner et al., 2006), learning in an immersive virtual museum in the present study appeared to enhance art students' engagement and enjoyment of the experience (see section 4.4.4), and they showed a desire to continue this experience in the future. (see section 4.5.3 and 5.2.6).

As noted above, the immersive virtual museum allowed art students in this study to make a deeper connection to the museum content around them. Here, connections refer to the deep experiences one has with a museum object during a numinous experience (Latham, 2016). According to the participants' responses, the affordances of the immersive virtual museum (i.e., separating themselves from the external world, vividness of content, and freedom of movement) helped them concentrate on the virtual content around them. This in turn induced contemplation and inquiry that allowed the participants to better explore an artist's ideas and emotions, producing a stronger personal connection with the artist's works of art. Exploring the artist's ideas and emotions is a major challenge for many museum visitors. Normally, these visitors seek primarily to find or construct meaning in the experience of artworks, which are visual representations of a person's ideas and emotions, expressed in the symbolic vocabulary of a particular human community embedded in a specific historical

period (Csikszentmihalyi, 1990). The flow state in the immersive virtual museum in this study corresponded to the concept of flow in physical numinous museum experiences mentioned by Latham (2016), where visitors deeply connected beyond the typical museum visit, reporting a more spiritually enriching experience. This finding also aligns with the study by González-Zamar and Abad-Segura (2023), which suggested that immersive virtual museums could enable a deeper connection to the environment.

According to the themes derived from the data analysis, the immersive virtual museum allowed participants in this study to better understand the artistic movements and styles featured in the paintings on display in the museum. In addition, it more effectively conveyed the emotions and messages embodied in the artworks on display, such as peace and conflict. Csikszentmihalyi and Robinson (1990) suggested that people can relate to a work of art through the artist, the culture, or the time period. Thanks to information, imagination, and empathy, viewers can try to share the dreams, emotions, and ideas of artists from different eras and places around the world. This aligns with Ryan's (2003) description of emotional immersion, which is a reader's emotional investment in the fate of the characters in a narrative. The findings agree with Grau's (2003) claim that immersion generates an intimate connection as "a constitutive element of reflection, self-discovery, and the experience of art and nature" (as cited in Seo, 2011, p. 286). While the concept of connection is often found in museum literature, few studies on immersive virtual museums have referred to it.

The results of this study support Guerra-Tamez (2023) and Ochs and Sonderegger's (2022) findings that virtual reality experiences using a head-mounted display can improve the flow state of students as they become immersed in the learning context and isolated from external distractions. At the same time, this finding runs contrary to Yow's (2022) concern that the isolation of online learning could harm university students' learning experiences. Lin et al. (2020) similarly expressed a concern that head-mounted displays would hinder the free appreciation of artwork. Some of these concerns may be due to technological limitations of certain displays, such as the inability to zoom in and out on content. For instance, Sylaiou et al. (2017) found that a virtual museum experience enhanced participants' appreciation of the ability to see the details of paintings, such as the work of Van Gogh, but did not have a noticeable effect on

their learning. In contrast, the present study's findings suggested that immersive virtual museums can serve as a powerful tool for enhancing the participants' engagement and connection with the museum content and context, leading to a more effective learning experience.

5.2.5 The Immersive Virtual Museum's Effect on Emotional Response

Given the effect that emotions can have on learning and the overlap of emotions reported in this study during the immersive virtual museum experience, generated from presence and flow, this section discusses participants' emotional response to this experience.

The characteristics of the immersive virtual museum had a notable effect on participants emotionally. This supports Marín-Morales et al.'s (2019) claims that there is a significant connection between brain synchronisation and the emotional processing during virtual reality experiences. During such experiences, flow and presence were closely linked to the emotions expressed by art learners. Previous studies have likewise claimed that immersive virtual reality, by stimulating presence (Slater, 2003) and flow (Csikszentmihalyi, 1990), fed emotional responses ranging from simple enjoyment to interest. Similarly, Dengel and Mägdefrau (2019) stated that presence is a crucial factor for inducing emotions in virtual reality.

Participants in the present study showed considerable overlap in the emotional responses they reported having to the immersive virtual museum that had an effect on their learning experience. The emotional responses reported in this study could be divided into reactions to the artistic content itself and reactions to the immersive virtual museum experience.

The immersive virtual museum experience in this study triggered a number of emotions in the participants. These emotions included awe, fascination, pleasure, amazement, excitement, and enjoyment. Some of the participants described their first impression of the experience as strange, but those feelings were a first-time reaction to the technology; when they focused on the experience itself, these feelings largely disappeared, and their enjoyment and other positive emotions appeared. Overall, positive emotions outperformed negative emotions. This supports the finding of Allcoat and Mühlennen (2018) that a virtual experience increased positive emotions (interest, amusement, surprise,

and elatedness) and reduced negative emotions (sadness, anger, fear, anxiety, and disgust).

Awe, one of the emotions that the participants reported experiencing in this study, was associated with the sense of being present within a physical museum. In the interviews, several of the participants reported feeling physically transported to the immersive virtual museum, surrounded by its walls. They reported that perceiving the high ceilings and vivid artworks on the walls in their actual sizes and the ability to interact with their surroundings created the perception of being present inside the physical museum. This experience elicited awe from a sense of transcending geographical limitations.

The immersive quality of the virtual museum triggered art learners' fascination and amazement because they were finally able to see precise details of paintings more clearly while experiencing a sense of transportation to another place. This in turn triggered excitement to begin the experience, explore the environment, and reflect on their experience.

In addition to enhancing the art students' enjoyment of the experience, exploring the immersive virtual museum encouraged them to keep finding out more and to spend more time on the activity. This aligns with the assertions of Guerra-Tamez (2023), who noted that virtual reality offered an attractive immersive experience that helped learners stay interested in their activities. Art students in the present study reported that they enjoyed contemplating details such as gloss and brushstroke that revealed the art movement and style of the artwork, as well as the subjects and characters of the paintings, increasing their ability to follow the overall story of the work. In addition, their enjoyment was increased by being able to freely move around the museum as if they were there in person and to zoom in on fine details showing the feelings expressed by the paintings, such as fear and joy. This finding supports Kucuk and Richardson's (2019) claim that interactive features can help keep learners emotionally engaged, as well as Sylaiou et al.'s (2017) finding that an immersive virtual museum that provided a panoramic tour where the user could navigate the site induced a higher level of enjoyment than virtual museums that simply embedded narrative videos.

The feelings reportedly stimulated by the immersive virtual museum in this study were aligned with the flow state and aesthetic experience. Aesthetic

experience is a mental state in which a person is fascinated by a particular object, while the surrounding environment is shadowed, self-awareness is reduced, and one's sense of time is distorted (Marković, 2012). Higher attention provides the additional energy needed to effectively appraise symbolism and composition in a virtual reality aesthetic. Thus, the stimuli from this experiment substantially increased the aesthetic and artistic experience of the participants.

The emotional responses to the state of flow and sense of presence among participants in this study showed a profound positive effect on their learning experience, helping them become emotionally immersed and actively engaged in the immersive virtual museum. These responses helped participants delve into the artwork and gave them opportunities to contemplate and interpret it in a meaningful way, finding connections between the art, the artist, and themselves. This is in line with Brinck's (2018) claim that interacting with a painting or sculpture creates a feeling of connection or empathy, which not only enhances engagement with the artwork but also facilitates a deeper understanding of cultural heritage and artistic expression. Similarly, Kucuk and Richardson (2019) claimed that when the interface of online learning platforms showed strong design features, learners appeared more engaged on a mental and emotional level.

Finally, although previous research has identified several potential negative physical side effects of VR, such as motion sickness and discomfort (e.g., Mazloui Gavani et al., 2018; Davis et al., 2014; Ochs & Sonderegger, 2022), these issues did not appear in the present study. This could have been due to the short duration of VR exposure, which might not have been long enough to trigger such symptoms, as well as the quality and design of the VR system used in this study. Since the participants were volunteers who were likely interested in or enthusiastic about the virtual reality experience, this might have also reduced the likelihood of negative side effects.

5.2.6 The Immersive Virtual Museum's Effect on Art Student Attitudes

The second set of themes, discussed in this section, answered Research Question 2 (How do art students in higher education in Saudi Arabia perceive learning through an immersive virtual museum?). Based on their interview responses, the art students who participated in this study adopted a positive

attitude toward using the immersive virtual museum because of its ease of use and usefulness, and they reported an intention to use it again in the future. People's experiences can affect their attitudes (Bandura, 1977). In the case of this study, the participants' sense of presence and flow and the emotions elicited by the immersive virtual museum experience all contributed to the development of the positive attitude conveyed through participants' answers to the interview questions. Furthermore, emotions direct and motivate learner behaviour (Konečni, 2015). Studies in education and the field of human-computer interaction have demonstrated that feelings of presence in a mediated environment can impact user attitudes (Li et al., 2002). Learners tend to have a positive attitude toward virtual reality learning when those virtual environments elicit their interest and enjoyment and are easily understood (Shim, 2003).

With regard to Research Question 2.1 (How do art students in higher education in Saudi Arabia perceive the ease of using an immersive virtual museum in their learning?), the participants agreed that the virtual reality headsets made visiting the immersive virtual museum easier. Most of the participants said that this was their first experience in an immersive virtual museum but still found using the virtual reality headset and exploring the museum to be easy; for example, they said it was easy to log in, move around and change viewpoints, and use the buttons and zoom controls. Cecotti et al. (2020) indicated that it would be challenging to engage students when the source of the instructional content is difficult to access. That is the situation for art history, when paintings and sculptures are housed in museums that are inconveniently located outside of large cities. In addition, Europe has a great number of paintings (Cecotti et al., 2020), making it harder for those outside of Europe to access those works directly. Hence, the immersive virtual museum in this study which is a virtual representation of a museum in London, UK, made it simpler for Saudi Arabian art students to visit such a museum. In this way, art students interested in visiting museums are able to more easily access, learn from, and interact with a simulation of those museums in a virtual environment overcoming a geographical barrier.

However, the interview data also revealed certain issues with the immersive virtual museum used in this study, including technical problems, which disrupted the participants' experience. Another issue was the difficulty of finding

high-quality and reliable immersive virtual museums in the first place. This is because the educational implementation of this type of technology in museums is still in its infancy compared to its implementation in the gaming industry, for example. Finally, there is a lack of Arabic-language content for immersive virtual museums.

With regard to Research Question 2.2, (How do art students in higher education in Saudi Arabia perceive the usefulness of immersive virtual museums in their learning?), many of the interviewees confirmed that the immersive virtual museum was a useful and valuable experience. Its value came from its role in conveying reliable information to art learners from reliable sources, meaning the content in the immersive virtual museum was curated by the museum officials. They claimed the immersive virtual museum provided enjoyable, easy, and frequent access to the museum; displayed clear information; fostered learning; modified their conceptions; and helped them recall information. Furthermore, it made learning more enjoyable by allowing the students to see and understand artwork directly and meet their interests or needs; in this way, the participants said that it served as an excellent alternative to visiting a physical museum. Similarly, in a study by Yildirim et al. (2018), 25 undergraduate students studying in a primary school teaching department were interviewed for their opinions and suggestions about using virtual reality glasses (see section 2.3.3) in history education. They reported liking this implementation of virtual reality glasses, saying that the feeling of being present in virtual reality increased their interest in the course. Furthermore, they said that it would enable individuals with disabilities, limited time, or limited money to participate in active learning and promote equal opportunity learning. This finding agrees with the notion that people need to be motivated to learn (Rogers, 1957) and that as a result educators should consider students' interests when designing learning tools and activities (Kampourpoulou et al., 2013).

The findings also addressed Research Question 2.3. (How do art students in higher education in Saudi Arabia intend to use immersive virtual museums in the future?). Most of the participants agreed that they intended to take advantage of this type of museum again in the future. First, several of the participants reported having the intention of using immersive virtual museums to explore and see the museums around them more easily without the need for travel time and

expenses. In other words, immersive virtual museums can provide an alternative experience with less cost and effort. According to Katz and Halpern (2015), the closer an experience comes to resembling the in-situ exhibition, the more positive users' perceptions will be of a museum environment, based on the framework introduced by social presence and media richness theories in the fields of communication and human-computer interaction. Similarly, Guerra-Tamez (2023) stated that this technology could allow learners to attend universal virtual museums, galleries, and art shows and explore the works of artists from around the world. This means immersive virtual museums could meet art learners' needs to visit museums easily and more often without incurring related travel and material expenses in a way that would offer a more direct, realistic experience.

Second, participants indicated that the immersive virtual museum facilitated the learning process because more reliable information on pieces of art and the museum was easily accessible through the virtual reality headset at any time until the content was understood. Furthermore, they could access the virtual museum content from their own perspective with the freedom to discover knowledge themselves without the need for a third party to filter it through their perspective. These findings agree with those of Yildirim et al. (2018), who found that the feelings of realism and presence generated by virtual reality increased participants' interest in a course. Moreover, Hassan et al. (2020) discovered that the sense of flow in virtual reality positively correlated with continued use of virtual reality and longer virtual reality sessions in the future. This suggested that learners used this technology to spend more time in front of the art to explore its details.

Third, participants stated in the interviews that the immersive virtual museum inspired them to visit physical museums. This could be because the immersive virtual museum experience presented the museum content in an attractive light, prompting students to want to experience the ambiance of a physical museum, including other visitors' whispers and side conversations, which they viewed as essential components of the museum-going experience. Similarly, Styliani et al. (2009) found that museum website visitors were more likely to visit the physical museum.

Overall, few studies have looked at how flow, presence, and emotional response can affect art students' attitudes toward using immersive virtual

museums. In light of this, the present study examined how these factors influenced how art students perceived a virtual museum's ease of use and usefulness and their intention to use this type of resource again in the future.

5.3 Contribution to Knowledge

According to González-Zama and Abad-Segura (2023), the United States, Spain, the United Kingdom, Canada, and Russia have, in descending order of importance, made the largest contributions to virtual reality as an area of research. Of these, the United States has the most published papers (273), the most citations (3,443), and the highest average number of citations per publication (12.61). In contrast, publication on this topic is very low in Middle Eastern countries, including in Saudi Arabia, where the present study was conducted. As a result, this study presents a valuable contribution to the field by drawing data from a group of Saudi Arabian art students who varied in terms of education, prior learning experience, and location, in contrast to other studies. Analysing the perspectives of this understudied group can offer valuable new insights for policymakers, academics, and researchers.

A number of studies have reached findings comparable to those of the present study, but the majority of those employed only quantitative data collection instruments. Very few studies have used qualitative methods to evaluate both presence and flow in the art learning experience inside an immersive virtual museum. Some quantitative studies have measured presence in an immersive virtual museum. For example, Chrysanthopoulos et al. (2021) employed quantitative measures to show that a fully immersive 3D environment enhanced the perception of visual realism and presence among their participants, making museum visits more effective at helping visitors understand historical events. Other quantitative studies, in contrast, have measured the flow state. For example, Guerra-Tamez (2023) distributed a survey to 200 undergraduate university art and design students. The results of that study indicated that the flow state mediated the learning experience variable through motivation, curiosity, cognitive benefits, reflective thinking, and value. Furthermore, they noted that immersion in a virtual museum improved students' ability to explore and engage with their surroundings. In addition, immersive virtual museums provide greater equality and freedom in choosing how to access resources and

learning experiences, especially in situations where real-world learning environments are not possible. This is particularly useful to ensure a university's readiness for a pandemic by adopting a dual mode of learning (Roberts et al., 2024).

With the above in mind, the present study helps address a gap in the literature by using qualitative interviews to examine the effect of an immersive virtual museum on the art learning experience of university students with regard to both presence and flow as well as the effect of their beliefs on their attitudes toward visiting this type of museum again in the future. The present study found several themes similar to those in previous quantitative studies, as anticipated from a reading of the literature. However, the thematic analysis of the data revealed new themes as well. These new findings depended on analysing the responses of participants to interview questions, whereas previous findings were based on hypotheses derived from earlier research and theories. Thus, the current study distinguishes itself from previous work by drawing on self-reported data, which revealed themes directly related to the impact of this virtual reality experience on art learners. In addition, the findings demonstrated how an immersive virtual museum could help forge a connection between the museum content and the viewer. In contrast, few studies have investigated this connection in an immersive virtual museum.

Furthermore, this study contributes to the literature by providing more evidence of how an immersive virtual museum focusing on visual art could affect undergraduate art students as well as the influence of those students' perceptions of that experience on their attitudes toward using this type of museum again in the future. The study thus contributes to the existing literature on perceptivity, and engagement in the immersive virtual museum experience (cf. Guerra-Tamez, 2023; Hassan et al., 2020; Kuen, 2018; Styliani et al., 2009; Yildirim et al., 2018).

In addition to perceptivity and engagement, the data analysis generated additional themes that have not been sufficiently explored in the immersive virtual museum literature. One of these themes was connection, referring to a deeper engagement beyond a typical museum visit, where individuals reflect on and appreciate the artists' messages, fostering communication between visitors and artworks and enhancing understanding and emotional responses. The second

was appreciation, where participants valued the virtual museum's enhanced accessibility, features, experiences, and convenience.

The study also outlined themes associated with participants' emotional responses to experiencing presence and flow in addition to the positive effect that the study found on art students' attitudes about and intention to use this technology again. Moreover, it provides more details and a deeper explanation of Saudi Arabian university art students' attitudes toward using this immersive virtual museum.

These new themes are central to the contribution of my research, highlighting the unique effects of immersive virtual museums that have not been sufficiently documented in previous work. By distinguishing these novel insights from themes supporting the results of the existing research, I underscore the importance and originality of my findings. Future research can build on these themes to further explore the potential of virtual museums to enhance art learning.

In contrast to previous research, the unique contribution of this study is that participants formed a deeper connection with the immersive virtual museum content, which encouraged greater focus, contemplation, and a more reflective interaction with the artwork. This connection extended beyond simply viewing art, involving a deeper exploration of the messages conveyed by the artists, leading to a stronger emotional response and a sense of communication between the learners and the art. The immersive virtual museum's design features, such as vivid content and freedom of movement, enhanced participants' understanding of artistic movements and messages, highlighting the potential of immersive virtual museums for more meaningful interactions and a more profound learning experience.

The results of this study support the recent findings by Cecotti et al. (2020) and Guerra-Tamez (2023) that an immersive virtual museum can have a positive effect on the art learning experience. However, these studies addressed learning in an immersive virtual museum without referring to how the immersive experience's characteristics—such as presence and flow—could affect learning. This agrees with Ochs and Sonderegger's (2022) statement that despite increased research efforts in recent years on immersive virtual reality, very few studies have examined the effect of presence on the learning experience in such

environments. In contrast, the present study suggested that a sense of presence in the immersive virtual museum provided a better learning experience for art students.

In contrast to Cecotti et al. (2020), who developed their research according to the demands of instructors who require various types of materials, the current study invited students to explore an immersive virtual museum mimicking a physical museum. By doing so, it examined art students' perceived experience in the virtual museum as they contemplated and explored its content.

This study also suggested that presence, flow, and the associated emotional responses to these sensations could enable learners to have a more positive attitude toward the use of an immersive virtual museum. Many of the studies that have been done on the emotional response to virtual reality experiences have employed quantitative measures (Allcoat & Mühlénen, 2018; Marn-Morales et al., 2019). In contrast, this investigation was based on the participants' self-reported feelings that they mentioned during qualitative interviews. As a result, this study shed light on the emotions elicited by the immersive virtual museum, illustrating how they were inherently intertwined with that experience. Positive emotions were one of the most important factors that increased art students' intention to have this experience again.

This study contributes to a deeper understanding of the experience of art students in an immersive virtual museum using a virtual reality headset. In doing so, the study offers significant contributions to the literature as well as university art education. The study found that perception, appreciation, engagement, and connection were significant aspects of this type of learning experience, resulting from a presence perception and state of flow, similar to the experiences that, according to Mihaly (1991), occur during aesthetic experiences. According to Csikszentmihalyi and Robinson (1990), people can relate to a piece of art through the artist, the culture, or the time period. This study added that a viewer could connect with works of art through the apparent emotions and thoughts of the artist, which the viewer could explore inside an immersive virtual museum.

The framework developed in this study offers a new approach to evaluating the effectiveness of immersive virtual museums in enhancing both the learning experience and the attitudes of art students. This framework is depicted in Figure 5.1.

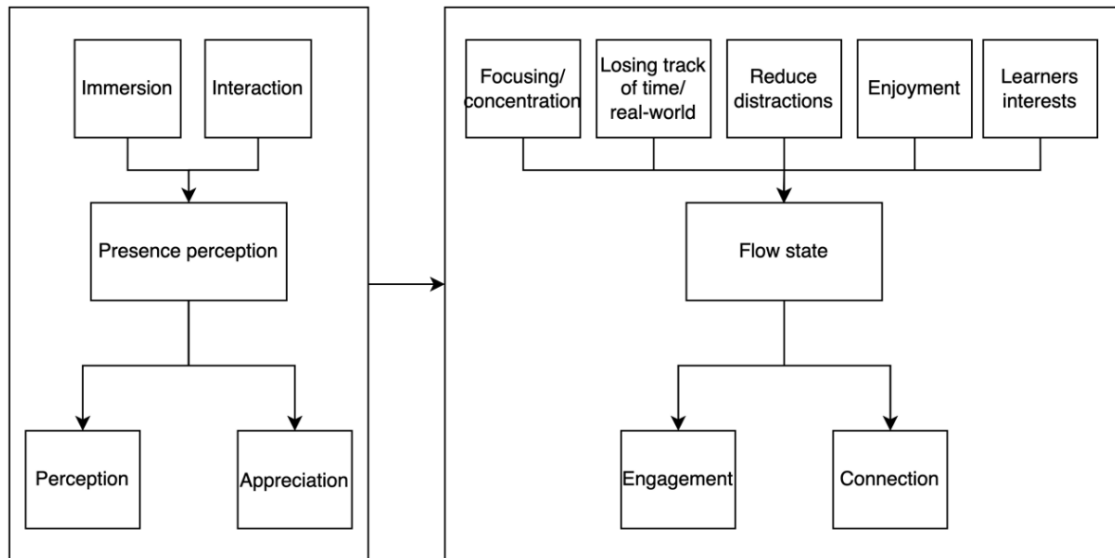


Figure 5.1 Framework for evaluating virtual museums.

This framework was based on the existing literature on flow theory, active learning, and immersive learning environments. Key studies by Cecotti et al. (2020), and Guerra-Tamez (2023), and others were analysed to identify crucial factors such as immersion and interaction as primary drivers of presence perception, which in turn led this study to the themes of perceptivity and appreciation. Reviewing these studies also helped with identifying significant components such as concentration, losing track of time, reduced distractions, enjoyment, and interests. When these components were found, users entered a flow state characterised by deep engagement and optimal experience. The subsequent effects of these factors on the art learning experience, generated from the data, were engagement and connection (a deeper emotional and cognitive bond with the content).

This framework provides a comprehensive approach to understanding the effects of immersive virtual museums on the art learning experience. Future research can use this framework to further explore and validate its components in different educational settings.

This study's conceptual framework highlights how the immersive virtual museum's characteristics (i.e., immersion and interaction) when viewed through a virtual reality headset can create an environment that fosters a sense of presence in art students by offering a more realistic experience, ultimately enhancing their learning (i.e., their perceptivity and appreciation). This framework

was supported by the findings, which indicated that the immersive and interactive aspects of the virtual museum through a virtual reality headset significantly contributed to the sense of presence experienced by art students. This presence perception was directly linked to improved perceptivity and appreciation of art. For example, students reported that the ability to interact with and immerse themselves in the immersive virtual museum allowed them to understand and appreciate the museum content more effectively than traditional methods. This sense of presence enhanced the learning experience by making it more realistic and engaging, which ultimately improved students' perception and appreciation of art.

Furthermore, the effect of experiencing presence through immersion and interaction in the virtual museum can enhance the flow state. The key factors contributing to that state were deeper concentration, enhanced by such elements as the vividness of the museum content, as learners were able to see and explore the details of various pieces of art; time distortion and losing track of time and the real world, where learners spent more time interacting with and examining the details of the works of art, a strong sign of the flow state; using the virtual reality headset to isolate art students from external distractions; and matching the content to learners' interests. These factors could be expected to lead to a deeper engagement and connection with the learning content.

Based on this framework, the immersive virtual museum experience not only enhanced students' perceptivity and appreciation of art but also promoted a flow state that led to greater engagement with the content. These findings showed the potential of an immersive virtual museum as a powerful tool in art education, offering new ways of enhancing the art learning experience.

This study also contributes to the literature by examining Saudi Arabian university art students' attitudes regarding an immersive virtual museum and virtual reality headset. The review of previous research employing the technology acceptance model helped identify factors such as ease of use, usefulness, and intention to use that enabled the researcher to better understand the participants' attitudes. The use of a qualitative research approach contributed to providing a comprehensive approach to understanding the effects of immersive virtual museums on art learners' attitudes. In doing so, the study explored participants' reasons for their stated attitudes and intentions in detail. Future research could

use this framework to further explore and validate its components in different educational settings. These attitudes and the participants' justifications for them are summarised in Table 5.1.

Table 5.1 Attitudes and justifications.

Attitudes	Participants' Justifications for Their Attitudes
Perceived ease of use	Moving around and interaction, ability to change perspective, access to virtual museum and easy to log in on museum website, access to information, access to fine details
Perceived usefulness	Conveying reliable information, feelings and thoughts, displaying clear information, fostering learning, modifying concepts, recalling information, enjoyable learning, alternative to the physical museum, meeting learners' needs, frequent access
Intention to use	Seeing museum, learning, visiting the physical museum

5.4 Implications for Educational Policy and Practice.

This study could help improve art education practices in several ways. Immersive virtual museums have the potential to enhance the experience of art students by providing them with a more interactive and immersive learning environment where they can explore the museum and its content in an experience that is similar to being in a physical museum. In addition, an immersive virtual museum can stimulate a flow state that allows people to engage and connect with the museum and its content. This meets art learners' need to be present in museums and to contemplate the details in works of art. Art students in this study found that immersive virtual reality technology improved their learning experience and led them to have a more positive attitude toward using it for learning in the future. Finally, by incorporating more factors relevant to art learning, this study supports the conclusions of previous research that has linked presence and flow in immersive virtual reality with positive learning outcomes (e.g., Guerra-Tamez, 2023; Katz & Halpern, 2015).

Based on this study's finding that a museum can more effectively share art within an immersive and interactive environment, compared to static images and descriptions in books, immersive virtual museums represent an effective means of improving the art learning experience. Therefore, the current study has implications for policymakers, art education, and museums, which could collaborate to improve the art learning experience.

The findings highlighted the benefit of policymakers acknowledging and supporting the use of virtual reality technology in art education curricula. The immersive virtual museum provides a more interactive and immersive

environment for exploring works of art, historical events, and artistic techniques compared to more traditional or less interactive methods, such as textbooks, lectures, and websites. Based on this finding, policymakers could increase funding for the development of more virtual museum resources, the implementation of immersive virtual learning in art schools, and the integration of these experiences into education policy.

The educational efficacy of the immersive virtual museum found in this study should encourage further investment in immersive virtual museums, which appear to generate a greater sense of presence and flow in art learners. This in turn appears to improve their learning experiences and support a more positive attitude toward these museums in terms of their perceived ease of use, their perceived usefulness, and participants' reported willingness to visit physical museums in the future. This aligns closely with current efforts to provide immersive virtual museum opportunities to more people. During the COVID-19 pandemic, museums across the world deployed a number of digital projects to maintain public engagement while physical museums were closed or operating at limited capacity. At the same time, the Network of European Museum Organisations (2020) argued that despite the importance of online museums as extensions and complementary arms of physical museums, there is not yet a solid way to evaluate online visits. This highlights the importance of helping museums overcome barriers to creating high-quality immersive virtual experiences and improve immersive virtual museum projects as a library with interactive visual stimuli. After the initial investment involved in the construction of immersive virtual museum experiences, once established, these resources can be accessed widely by a large number of art learners at minimal cost.

Moreover, the reported positive effects of an immersive virtual museum on the art learning experience in this study highlighted the profound value of collaboration between educational institutions and physical museums. Policymakers should thus encourage and support initiatives that facilitate this type of collaboration. The quality and reliability of museum content, available for use with immersive virtual reality technology, is still very limited. Although the immersive virtual museum employed in this study offered a high level of immersion and interactivity that enhanced learners' perceived sense of presence and flow, it would be difficult to find many comparable experiences. Due to

financial constraints, not all museums can independently create immersive virtual experiences for art learners. To provide such rich experiences, museums require technological and financial support, such as that seen in the computer game industry. The money and effort that games companies put into their titles significantly improves the user experience. They constantly evaluate and address technological problems to develop their products. As a result, virtual museum production quality is still much lower than what is seen in immersive virtual reality games. Therefore, collaboration between educational institutions (i.e., art schools), museums, and video game companies could enrich learning opportunities by facilitating access to advanced immersive virtual museum experiences for learners, including those with limited access to physical museum spaces. As mentioned earlier (chapter 2), in alignment with Saudi Arabia's Vision 2030, the nation has created several virtual museums showcasing historical sites., such the Kingdom of Dadan and Lihayan 900 BC to 200 BC in the north west of Saudi Arabia (AlUla, 2020). However, there is still a need for greater investment in converting museums and archaeological sites into immersive virtual reality experiences to preserve this heritage and share it with visitors from around the world.

It is also essential to make content available in as many languages as possible. This would not only improve learners' experience in general but ensure that learners from diverse backgrounds had access to high-quality art learning regardless of their location, language background, or financial circumstances. This would ensure that more learners could benefit from more digital learning resources, thereby promoting better opportunities for all students.

Therefore, the education sector's support of these immersive virtual experiences may contribute to its further development. Curriculum designers, administrators, and educators could use the results of this study to inform curriculum development and practice. For instance, art teachers could incorporate visits to immersive virtual museums into their lessons. Such an opportunity would enable students to examine art from a variety of viewpoints, enhancing their critical thinking skills. In addition, art schools might encourage educators to integrate immersive virtual museums into their teaching approaches

and revise curriculum criteria to include immersive virtual museum experiences as a recommended learning activity and tool in art education.

Educators need to create more effective high-quality learning experiences that cater to different learning preferences and prepare learners to take full advantage of modern technology. As this study has demonstrated, an emerging tool for this purpose is to incorporate a well-designed, immersive, and realistic virtual museum with vivid and interactive visual stimuli that display the fine details of the artwork. Such an experience could trigger a sense of flow and presence in learners, thereby facilitating various types of learning. Policymakers and educational practitioners should thus support using immersive virtual museums in art schools to enhance learning experiences and provide school computer labs with virtual reality technology. There should be increased investment in technology (VR headsets), in higher education in Saudi Arabia to support the Vision 2030 goal of adopting the latest technologies across all sectors, of the country, including education. This investment will improve the performance and stay current with the digital era. As a result of this immersive and realistic virtual environment, learners could be more engaged, knowledgeable, appreciative, and connected to the content. They could also become more prepared for interacting in an increasingly digital world and become more familiar with emerging technologies, increasing digital literacy and reducing the digital divide.

This study's findings have clear implications for art education policy and practice. One implication is the importance of recognising the immersive virtual museum as a valuable educational tool. Another is the need for educational institutions and museums to work together to bring these experiences to a larger number of learners.

5.5 Implications for Future Research

By leveraging immersive, interactive virtual environments and virtual reality headsets, the virtual museum stands out as an effective tool for active art learning, going beyond the descriptions and static photographs in books and websites. Consequently, the present study has implications for future research.

The findings of this study suggest that an immersive virtual museum could act as an effective visual learning tool for university art students in Saudi Arabia. These findings were based on a thematic analysis of four key themes

(perception, appreciation, engagement, and connection) based on reactions to the experience of presence and flow within the immersive virtual museum. Researchers could use these themes as a model for conducting further investigations into immersive virtual museum experiences in university art schools, both within Saudi Arabia and in other countries. The themes could help them delve deeper into this topic and validate the existing results. These themes could also be applied to immersive virtual reality in other educational fields for example, architecture and history and to the development of learning experiences through immersive virtual reality in general.

Furthermore, the study explored art students' personal perspectives and attitudes toward using immersive virtual museums. Collecting qualitative data through interviews provided more detailed insights into the factors justifying those attitudes. As such, researchers could use this study to gain insights into the factors that can influence the ease of use and usefulness of immersive virtual museums as well as understand how art students intend to pursue such experiences in the future. Researchers could also test these factors across different contexts i.e., countries where the study could be applied. In addition, the findings could help researchers design better instruments to measure learner attitudes in line with their needs and preferences.

After participating in the immersive virtual museum experience, many of the participants in this study said in the interviews that they felt as though they were in a real environment during that experience, were able to see the virtual environment clearly, and did not notice external distractions. The data analysis indicated that the immersive virtual museum stimulated participants to be in a state of flow. Hoffmann and Novak (1996) hypothesised that a sense of presence would draw more users' attention into the computer-mediated environment, resulting in a flow state. Csikszentmihalyi (2000) defined this state as "the holistic sensation that people feel when they act with total involvement" (p. 36). However, the studies that have explained the relationship between flow and presence are limited, so the present study could help researchers further investigate the relationship between them by shedding light on flow stimuli when participants feel a sense of presence in an immersive virtual museum.

The study found that an immersive virtual museum could generate a strong sense of flow, which in turn enhanced participants' engagement in the

learning experience and connection with the virtual museum content, potentially leading them to, more critically and deeply, examine the immersive virtual museum and its paintings. While exploring the artwork, participants said that they engaged in contemplation of a painting's colours, elements, and meaning. This would align with the notion of aesthetic experience proposed by Wanzer et al. (2020), who claim that contemplating an artwork's composition (i.e., the form, colour, and textural quality of the object) and positive and negative emotions derived from viewing that artwork suggests that aesthetic emotions result from aesthetic experiences. The findings of this research may therefore help with interpreting the relationship between feelings of flow in an immersive virtual museum and the resulting aesthetic experience.

The results of this study highlighted the importance of immersive virtual museums as effective methods of active learning in art education, since participants engaged in active exploration of the virtual museum content. Similarly, Katz and Halpern (2015) claimed that virtual reality in museums can help users engage more with concrete objects. Likewise, Chen (2010) claimed that virtual experience provides a space where students can freely explore and examine works of art. The present study thus deepens the current understanding of how immersive virtual reality contributes to art learning experiences in alignment with constructivism and active learning theory. This may encourage researchers to test similar strategies for actively engaging students in the learning process.

5.6 Conclusions, Limitations, and Suggestions for Future Research

This study examined Saudi Arabian university art students' self-reported experience in an immersive virtual museum with a virtual reality headset and their attitudes towards that experience. The study aimed to identify the states of presence and flow and understand their perceived effect on art learning. Conclusions could reasonably be applied to similar immersive virtual museums and virtual reality headsets not included in the study. The theoretical foundation of the study was that museums have certain elements in common with the active learning promoted by constructivism, such as active engagement, direct experience, and autotelic experience. These elements are also present in immersive virtual museums thanks to their ability to simulate real-world

experiences and provide users with immersive and interactive learning opportunities that can enhance the active learning process, aligning with the principles of constructivism. The participants' attitudes about using this type of museum again were investigated based on factors examined in previous studies in the same context: perceived ease of use, perceived usefulness, and intention to use.

One immersive virtual museum was selected for the participants to visit according to specific criteria. A group of 30 art students explored the museum using a virtual reality headset and answered 14 open-ended semi-structured interview questions that encouraged a conversation in order to understand their perspectives, experiences, and feelings during the virtual museum visit.

The majority of the participants in this study acknowledged that the immersive virtual museum and virtual reality headset, which allowed them to move around in a virtual space replicating the architecture and layout of a physical museum, had a positive effect on their art learning experience. The study focused on demonstrating how the sense of presence and flow within the immersive virtual museum might enhance art learning. The findings highlighted the potential of an immersive virtual museum as an effective tool for enhancing the art learning experience of university art students.

Four themes generated from the data analysis that reflected the effect of presence and flow on art learning: perception, appreciation, engagement, and connection. In addition, the study acknowledged the importance of active learning in enhancing students' learning experience instead of passively receiving knowledge from books or lectures. In this way, the study shed light on the art students' perspectives and attitudes about this learning tool, in line with previous studies (e.g., Guerra-Tamez, 2023; Katz & Halpern, 2015).

The rest of this section details the limitations of the study and how those limitations could be used as a foundation for further research in this area. This study was limited to a single immersive virtual museum using a particular model of virtual reality headset. Furthermore, its goals were limited to understanding the learning experience and attitudes of Saudi Arabian university art students, focusing on the presence and flow states and their perceived effects. Nevertheless, the conclusions could be used to anticipate similar findings given a similar virtual museum accessed through similar technology. Further research

could explore whether these findings would hold true with different museums or virtual reality headset models to widen the understanding of immersive virtual museum experiences.

One of the main limitations of this study was the short period of time in which it was conducted. The participants' initial response to a relatively brief immersive virtual museum visit was collected during a single interview session. If they had been able to explore the virtual museum for 10 or 20 hours, for example, they might have expressed different feelings about its value and their intentions to use it again. Alternatively, if the study had employed a longitudinal design in which participants were asked the same questions multiple times in multiple interviews, the results might have been different as well. While a longitudinal design was not possible given the limitations of this study, future research could apply such a design to reach more reliable results.

Another limitation of this study was the nature of participation. The students from art and design schools who chose to participate in the study may have been more motivated or interested in virtual reality, potentially bringing with them a personal bias. This study was not applied in a classroom, where art students could be expected to have varying levels of interest in this technology. Thus, if the virtual reality experience were conducted as part of a mandatory activity in a classroom, it may have resulted in different outcomes.

While interview methods are effective, I was only able to conduct interviews with a small number of learners at one point in time. If a questionnaire had been used, data could have been collected from a much larger sample. Thus, future research could build on this data through a more comprehensive statistical analysis using the themes that were derived from the interview responses of students in this study.

This study was conducted at a single university in Saudi Arabia. Due to the gender segregation of Saudi Arabian higher education, the gender of the researcher, and the fact that no male students were enrolled in the School of Arts at the universities where the study took place, all of the participants were women. Thus, future studies could seek to interview male participants as well as female participants in order to make the data more representative of Saudi Arabian art students. Gathering such data would enable the study to capture a wider range of perspectives and experiences, resulting in findings that would be more

accurate and relevant to Saudi Arabian art students as a whole, rather than only women.

Future research could seek to confirm the results of the self-reported data gathered in this study by creating a questionnaire, which would improve the trustworthiness of the self-reported data. The questionnaire could also be based on the findings of this study, since the majority of related questionnaires have been based on previous studies and theories in the field of information and communications technology.

In addition, the participants in this study were all art students, and their views could easily differ from those of teachers. For instance, students may see virtual museums as advantageous to their learning, while their teachers may believe that using such technology would not make a difference in learning outcomes. Thus, interviewing or surveying teachers for their viewpoint could complement and extend these results.

Finally, the findings might not be generalisable to other art learning institutions or groups of students outside of Saudi Arabian undergraduate female art students. Nonetheless, the results contribute to previous research and, when combined, could provide a more comprehensive picture of how an immersive virtual museum can affect art students' experience and attitudes toward this learning tool. Thus, the present study offers a foundation for additional discussion and research.

Immersive virtual museums offer considerable promise for art education. In order to take full advantage of them, however, it is important for policymakers to recognise them as effective learning tools and allocate funding to support their use. In order to meet the needs and desires of visitors, museums should also keep pace with this developing technology. The positive experiences and attitudes expressed by art students in this study suggest the need for more collaboration between educational institutions and museums to develop high-quality immersive virtual museums and to allow for more equitable access to enriching and active art learning experiences. Based on the findings, this study suggests that when an immersive virtual museum is designed by experts in the museum and education sectors to stimulate active learning among art students, such a museum has the potential to positively affect the learning experience.

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