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RESEARCHING INFLUENCES OF LEARNER EXPERIENCE ON AR/VR ADOPTION - THE CASE OF VIETNAMESE UNIVERSITIES

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ABSTRACT

Aim/Purpose	The study aims to analyze the elements/factors that impact students' augmented reality/virtual reality (AR/VR) adoption through their behavior in Vietnamese higher education. In particular, the research demonstrates the influences of and relationships between multiple goals, learner experience, and barriers to adopting AR/VR.
Background	The widespread adoption of digital transformation in numerous industries demonstrates its prospects and potential for growth. Many cutting-edge technologies, including AR and VR, have been included in educational activities because they have the potential to elevate academic standards across numerous colleges. However, their implementation and practice within higher education appear confusing to lecturers, organizations, and, in particular, students. Their innovative nature and differences are the fundamental causes. Hence, thoroughly elaborating the elements that impact the adoption of students – the target audience – through investigating the behavior if these factors are crucial to ensure the benefits of AR/VR are leveraged while the implementation procedures are enhanced.
Methodology	By integrating earlier research, the research proposes a theoretical framework to explore how learners of AR/VR adopt these technologies. Discussion group interviews with professionals, namely four lecturers at Vietnam universities, were conducted. The professionals adjusted elements and changed the scales in order to optimize them in accordance with the context

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of Vietnamese universities. Additionally, the authors surveyed 200 students whose responses were transformed into numerical data. SmartPLS-SEM 4.0.9.3 software was used to test whether specific hypotheses were accepted or rejected.

Contribution The research holds immense significance as it employs customer behavior as the foundational theory to construct a proposed model delineating the influence of learner experience on multiple goals and AR/VR adoption. Moreover, the study's findings empower educational establishments to strategically allocate resources toward enhancing student experiences, aligning with learner goals, and consequently augmenting the adoption of AR/VR technologies.

Findings Regarding the relationship between learner experience and multiple goals, the findings indicate that convenience experience greatly impacts academic goals and social goals. Immersive experience also has a remarkable influence on academic goals, social goals, and practical goals. As regards the impact of multiple goals on AR/VR adoption, the research reveals that academic, social, and practical goals have a significant effect on such adoption. Concerning the correlation between learner experience and AR/VR adoption, it can be seen that usage experience and entertainment experience have a beneficial effect on such adoption.

Recommendations for Practitioners In terms of practical contributions, educational organizations in Vietnam can use the research during AR/VR implementation processes to maximize the benefits of AR/VR in education.

Recommendations for Researchers The authors conduct a theoretical research framework for the adoption of AR/VR technology into Vietnam's higher education digital platform. The research approaches a different aspect in the context of higher education, which considers students as customers based on prior research on customer behaviors through multiple goals and learner experiences to evaluate their impacts on the AR/VR adoption of students.

Impact on Society AR/VR has achieved extensive utilization and widespread acclaim across various sectors, notably education. Within the context of higher education institutions, the integration of AR/VR applications not only has advantages but also presents associated challenges. Therefore, the present inquiry was undertaken to elucidate the determinants influencing students' receptiveness toward AR/VR utilization. Educational establishments can leverage the insights gained from analyzing the learner experience and multifaceted objectives of, as well as impediments to, AR/VR assimilation to enhance favorable elements and mitigate unfavorable aspects during the process of AR/VR implementation. The overarching objective is to elevate the degree of AR/VR adoption among students.

Future Research Further research can consult the customer behavior approach regarding technological adoption in educational contexts. In addition, apart from adoption, dependent variables can be studied, such as satisfaction with or decision to use AR/VR in future research.

Keywords education, AR/VR technology, multiple goals, AR/VR adoption, learner experience, barriers

INTRODUCTION

Human beings are standing on the brink of the fourth industrial revolution, namely, the era of communication and technology. Advanced technology is experiencing rapid development and is being used in industry, academia, business, and multiple other areas. Digital transformation is emerging as a new and essential direction to adapt to the era humans are poised to enter. Education is no exception: in recent decades, universities have been vigorously changing to adapt to the technological and social trends toward digitalization (Abad-Segura et al., 2020).

Digital transformation is a crucial way for organizations to acclimatize themselves to the dawn of the information age. The foreseeable strategic approach for a sustainable education management plan is determined by the digital revolution of the global higher education market (Mohamed Hashim et al., 2022). In addition, the Ministry of Education and Training and its affiliated institutes in Vietnam have been holding conferences on and formulating responses to the adoption of information and communication technologies (ICTs) in education renovation and management, assiduously preparing for digital transformation scenarios (Pham & Nguyen, 2020). These activities could indicate that the Ministry is showing interest in digital transformation and that a bright future beckons for the widespread implementation of ITCs in Vietnamese education.

Scientific and technological advancement has generated thousands of advanced educational apparatuses (Nguyen et al., 2022). AR/VR is a state-of-the-art instrument and an example of the digital transformation process. Currently applied in various fields, such as education and workplace training, healthcare, and entertainment, AR/VR is continuously improving to meet the requirements of contemporary life (Yang, 2021).

Modern-day educational content is presented as more attractive than it used to be in order to motivate and increase learners' interests (Ardiny & Khanmirza, 2018). The traditional university model, full of lectures and examinations, is being gradually replaced by the use of digital transformation and innovation agendas (Hong & Ma, 2020). In terms of drawing in more and better students, enhancing the learning process, and improving the quality of courses and instructional materials, higher education institutions (HEIs) need to digitalize (Abad-Segura et al., 2020). Thus, AR/VR is an innovative way to combine "digital solutions with classroom experience" (Dick, 2021, p. 1). Indeed, many global educational systems have been implementing AR/VR in their academic training and gaining satisfactory results (Papanastasiou et al., 2018). Notwithstanding, in Vietnam, AR/VR has been employed in a few universities and is at a more nascent stage (Chuah et al., 2016). According to previous research, one of the benefits of AR/VR technology is that it offers virtual experiences, such as visualizing 3D mathematical structures and natural disaster events or can combine real-world and virtual environments (Al-bashki & Oogle, 2023; Fegely & Cherner, 2023; Gopalan et al., 2015). With technological advancement, AR/VR technology engages students more than traditional video technology and provides a more convenient, immersive, and intuitive experience of learning (Arents et al., 2021; Krüger et al., 2022; Yip et al., 2019).

In this paper, the authors primarily focus on learners' AR/VR adoption. Applying AR/VR in education helps students attain better learning results (Zhang & Wang, 2021), which is one of the ways in which educational institutions (suppliers of service) satisfy and bring benefits to their customers (students/learners) (X. Huang et al., 2021). Therefore, the research applies customer behavior theory compared to the technology acceptance model (TAM) or unified theory of acceptance and use of technology (UTAUT) approach. For the research environment in the field of technology and education, many studies use models such as TAM (Davis, 1989) or UTAUT (Venkatesh et al., 2003). However, no research has approached and discussed how experiences affect learners' goals and their behavior. Based on the theory of learner experience, the authors selected the research problem to consider the impact of learner experience on multiple learning goals, the decision to accept the use of AR/VR in learning, and barriers that affect learners' behavior. In reality, the adoption of AR/VR has the potential to enhance students' learning behaviors (Zhang & Wang, 2021). Concentrating on the relationship between experience and human behavior, the effect of experience on human behavior has been featured by authors such as Mandel and Johnson (1999), who claim that the level of experience significantly influences people's choices and ultimate predisposition. This study also examines the correlation between goals and human behavior, specifically the adoption of learners using AR/VR. Wood et al. (2021) stated in their research that every human action is motivated by specific goals. Therefore, the theory of multiple goals is included in the research model to confirm that it is necessary to influence the learner's goals by experience.

The research considers AR/VR as a package, as the two technologies have similar characteristics when used in education to enhance student learning outcomes. AV/VR offers an enhanced learning experience by facilitating interactive and immersive simulations, which are especially valuable in improving the general education system (Vásquez-Carbonell, 2022). The technologies enhance traditional learning modalities, allowing for the safe and controlled replication of real-world scenarios (Silva et al., 2022). The synergy of AR and VR in education – AR's enhancement of real-world environments and VR's creation of immersive virtual spaces – justifies their collective application as a unified educational tool (Sun et al., 2023).

Certain objectives were set for the current research. First and foremost, this research aims to create a theoretical research model for the adoption of AR/VR technology in Vietnam's higher education digital platform. In addition, it is necessary to determine the factors influencing students' adoption of AR/VR technologies in higher education in Vietnam. Last but not least, based on the research findings, solutions for educational organizations are proposed to enhance an AR/VR integrated program that can meet the needs and goals of learners, enabling them to compete in modern society and improving their efficiency in learning.

To achieve the objectives of this research, the authors adopted a mixed-methods approach that combines quantitative and qualitative data collection and analysis. The quantitative data were obtained from a survey of 200 students and educators from different universities in Vietnam, who were asked about their perceptions, attitudes, and intentions to use AR/VR technologies in their learning. The qualitative data were collected from interviews with four lecturers to adjust the questionnaire. Analyzing the data enabled the relationships between key factors that influence students' adoption of AR/VR technologies in higher education in Vietnam to be identified. Theoretically, the authors approached adopting new technology from the perspective of learning experience and multiple educational goals, in addition to research articles using TAM and UTAUT. Moreover, based on the research findings, the authors propose a set of recommendations for educational organizations to develop and integrate AR/VR programs into their curricula to promote awareness and acceptance of such technologies.

LITERATURE REVIEW

DEFINITION OF AR/VR

According to Cabero-Almenara and Barroso Osuna (2016), VR can be understood as "the real-time combination of digital and physical information through different technological devices." AR, meanwhile, can be defined as a "virtual world augmented with the mapping of an image or video from the real world in virtual objects" (Valente et al., 2016). Recent developments have seen AR/VR applied to various fields, such as advertising, tourism, maintenance, and training (Ardiny & Khanmirza, 2018). As regards education, the application of AR/VR is gaining more and more interest (Oh et al., 2018), partly because the use of AR/VR enhances the achievements of students/learners (Badilla-Quintana et al., 2020). According to Fazel and Izadi (2018), utilizing AR throughout the learning process assists students in generating a link between environments in real and virtual life. The application of VR empowers students to partake in immersive simulations to enhance learning encounters (Tan et al., 2022). Moreover, these technological devices "provide relevant information for learners to fit their personal goals" (Cheng, 2017). In general, AR/VR will bring opportunities to increase learners' motivation and engagement and provide virtual experiences that traditional learning methods struggle to offer (Ardiny & Khanmirza, 2018).

AR/VR ADOPTION

Straub (2009) found that "adoption theory examines the individual and the choices an individual makes to accept or reject a particular innovation" (p. 626). In some models, adoption is the choice to accept an innovation and the extent to which that innovation is integrated into the appropriate context. Adopting these technologies in teaching and learning can encourage better learner engagement (Iglesias & Gálvez, 2008). It is said that Gen Z, who were born into the digital technology era, can easily use AR/VR technology.

Recent research has explored how immersive technology is actively being utilized as a tool to assist in various fields, such as manufacturing and healthcare. In the healthcare industry, these technologies have been used to cure patients in surgery (Noghabaei et al., 2020) and in telehealth, especially during the COVID-19 pandemic (Rutkowski, 2021). Furthermore, Akbari and Hopkins (2022) demonstrated the adoption of this combination of AR/VR technologies in operations and supply chain management. As AR/VR technology advances, it is also adopted in educational contexts and is attracting an increasing number of educators and learners (Zhang & Wang, 2021). For instance, in electromagnetism, to understand basic concepts, learners use AR technology to discover the effects of magnetic fields (Ibáñez et al., 2014). Moreover, according to Al-Ansi et al. (2023), AR/VR technology in education can have positive effects on both teachers and students through diversified experiences, cost saving, collaboration between students and teachers, and gamification in lessons.

DATA RESOURCES

The current study deliberately focused on assessing students' adoption of AR/VR technology and exploring how each factor affects multiple goals and AR/VR acceptance. The authors also show that there are other influences, such as barriers, on learners' adoption of AR/VR technologies.

To make sure of the consistency of the collected research, certain criteria were set for the research articles considered, namely:

- They were published within the last 20 years.
- They discuss AR/VR technology in education.
- The research results and consequences are provided comprehensively, and conclusions are clearly presented.

This study synthesized 116 previous research papers collected from different prestigious databases, including ScienceDirect, Taylor & Francis Online, Emerald Insight, and IEEE. Keywords such as "AR/VR adoption," "learner's experience," "barriers in using AR/VR," "AR/VR" used with "goals in learning," and "AR/VR technology" were chosen to find related research papers.

RESEARCH FRAMEWORK AND HYPOTHESIS

The presented theoretical model in the research is grounded in customer experience. The main aim is to elucidate how learner experience, multiple goals, and barriers influence the adoption of AR/VR technologies (see Figure 1). Particularly, the model emphasizes the pivotal role of experience in shaping human behavior, especially the adoption, as noted by Mandel and Johnson (1999). According to Zhang and Wang (2021), the integration of AR/VR technology holds promise in enriching students' learning behaviors. The relationship between learner goals and behavior is also investigated, with support from Wood et al. (2021), who assert that human actions are driven by specific goals. Thus, by incorporating the theory of multiple goals, the research underscores the importance of influencing learner goals through experience. In addition, the model is the integration of 4 constituent models (shown in Figures 2, 3, 4, 5).

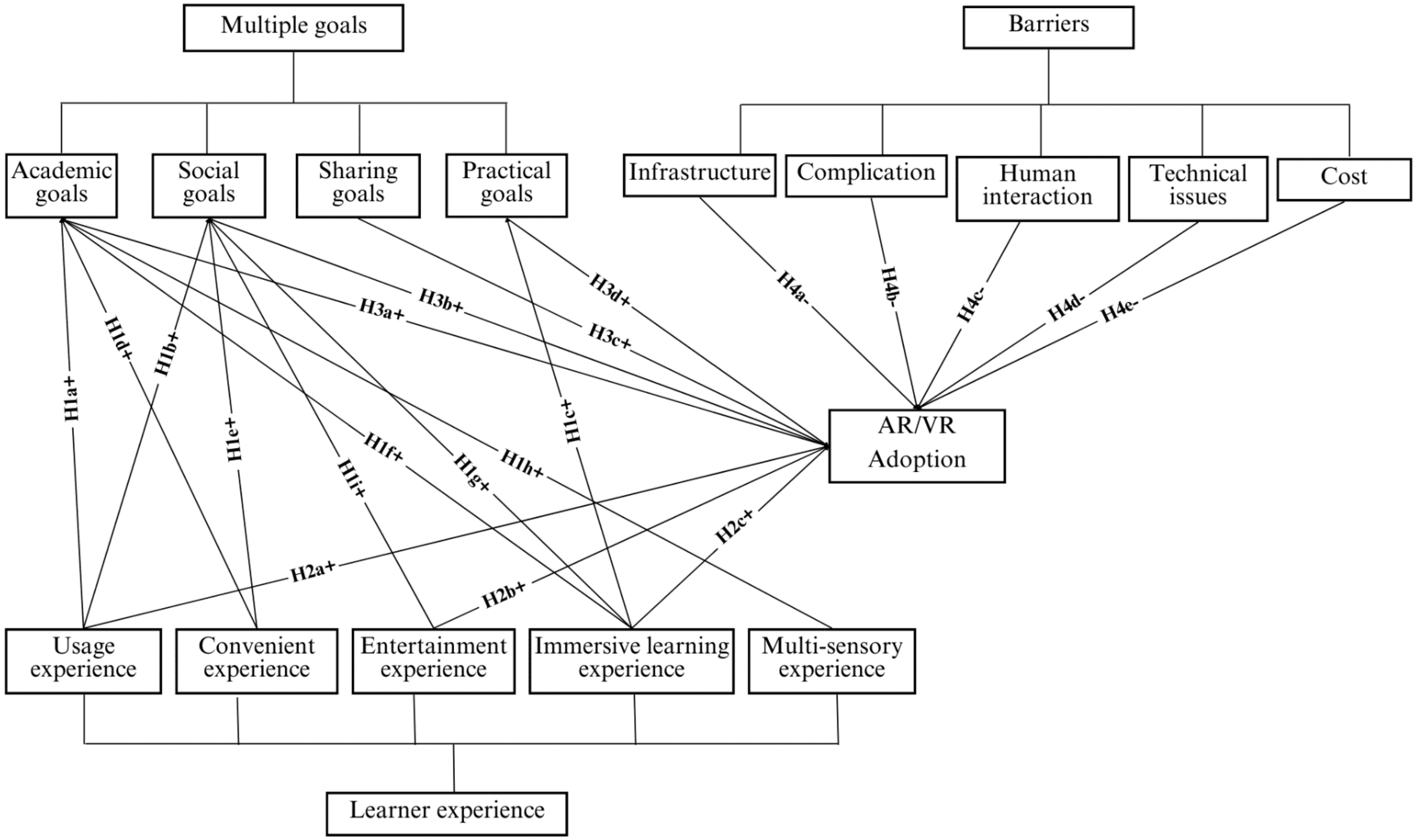

Figure 1. Proposed theoretical model

Learner experience affects multiple goals

As mentioned by Meyer and Schwager (2007), "customer experience is the internal and subjective response customers have to any direct or indirect contact with a company" (p. 2). As regards user experience, the "product" is "the experience that people procure during the interacting process with a product in a certain circumstance," while the "system" is the way people feel when using a system (R. Huang et al., 2015, p. 248). When it comes to "learner experience," this "is a notion derived from user experience in software engineering and is a kind of general experience" (R. Huang et al., 2019, p. 92). Just as the subject of a user experience is the user, the learner is the subject of the learning experience. Hence, the learner may be as crucial to learning and development as the user experience is to software firms (R. Huang et al., 2019). Also, according to R. Huang et al. (2019), learning outcomes are impacted by educational technology. Applying AR and VR gives students immersive digital experiences that are unmatched by traditional ways of teaching. Such opportunities foster deeper engagement with complex materials, moving beyond conventional lectures and textbooks (Al-Ansi et al., 2023). Therefore, more and more educational institutions such as Norwegian University (Garcia Estrada & Prasolova-Førland, 2022), Carolina State University (Williams et al., 2021), University of Dundee (Erolin et al., 2019), Pantheon Institute of Technology and Design (Istituto Pantheon Design & Technology, 2023), have been applying AR/VR to various subjects (anatomy education, design, etc.). Additionally, Drexel University, Emory University, New York University, Princeton University, Stanford University, and the University of Florida have established virtual learning platforms to improve student participation in educational activities (Papanastasiou et al., 2018).

In accordance with Vansteenkiste et al. (2010), the reasons students chase Performance-Approach objectives have a greater correlation to their learning experiences than the actual achievement of Performance-Approach goals. In the current study, the authors aim to analyze students' academic goals through AR/VR learning experiences, as discussed by the following researchers. MacDowell et al. (2022) highlighted the need for immersive learning experiences that resonate with educational objectives through a case study of the integration of AR/VR in K–12 and higher education. On the other hand, AR and VR can offer disabled students impactful classroom learning tools, including specialized content libraries and experiences designed for specific courses or learning objectives (Bailey et al., 2021). In terms of the impact of usage experience on academic goals, one study mentioned that the higher the students' usage experience, the higher the impact of AR/VR on their performance or engagement (Nesenbergs et al., 2020). In addition, AR videos enhance the learning experience and efficiency, particularly in process learning-related activities (Yip et al., 2019). Also, Vergara et al. (2017) suggested that the virtual tool has an optimistic influence on pupils' gaining knowledge and increasing motivation (H1a+). Regarding users' satisfaction, students using AR/VR found visual worlds enjoyable for 3D flying, social networking, and virtual field trips. These environments enable shared collaboration and instruction, allowing students and instructors to showcase their skills (Chow et al., 2007; De Lucia et al., 2009; Hew & Cheung, 2008) (H1b+). According to Steele et al. (2019), analyzing AR/VR immersive experiences may indicate the potential for creative and cognitive skills for learners, indicating that these experiences support learners' practical skills (H1c+). Yip et al. (2019) showed the convenient experience that augmented reality films promoted high levels of interaction between students and the learning materials (H1d+). Interactivity among students is vital to reaching social goals (H1e+), enabling learners to improve their learning processes and share activities. Social VR technologies offer university EFL learners physical and social affordances for intercultural language learning, providing a convenient experience and supporting social goals by enabling communication with interesting people worldwide at their convenience (Liaw, 2019). The application of AR/VR technologies during immersive learning experiences can improve students' information absorption and boost them to proactively engage in their own studies (Holly et al., 2021) (H1f+). AR/VR educational environments aspire to enhance conventional formal learning settings by incorporating personalized and flexible informal learning contexts, thereby enabling learners to actively engage in a multi-sensory experience (Mangina, 2017). Hence, when employed within an educational context, these tools have the potential to amplify motivation (Tilhou et al., 2020), analytical skills (Radianti et al., 2020), and self-assurance (Chen & Hsu, 2020). Specifically, due to its unrestricted temporal and spatial constraints, VR has the capacity to offer students an incredibly immersive and simulated environment replete with visual representations (Chang et al., 2020). Dickey (2005) mentioned that students enjoy virtual worlds because of the freedom they have to navigate in a 3D space, socialize, meet new people, and engage in virtual field trips and simulated experiences, effectively immersing themselves in the learning content and context. In contrast, AR may be able to satisfy learners' social goals because AR simulation plays a more supporting function in students' collaborative inquiry learning than traditional learning (Saltan & Arslan, 2016). Additionally, AR/VR learning content involves collaborative activities in which learners have to deal with problems through social interactions with the aim of fostering a sense of connection (Enyedy et al., 2012; Mateu et al., 2014). Hence, it can be seen that experiencing immersive learning through AR/VR enables students to achieve their social goals (H1g+). According to Yip et al. (2019), the AR application is immensely convenient for students because it allows them to revise lessons, thus improving learning efficiency. Hence, the convenience of AR/VR positively impacts the academic goals of students (H1h+). The impact of the entertainment experience of AR/VR on the social goals of students was demonstrated by Dick (2021). Particularly, AR/VR has been found to boost cognitive growth, classroom engagement, and memory recall for complicated topics, which can enhance students' overall learning outcomes (H1i+) (see Figure 2).

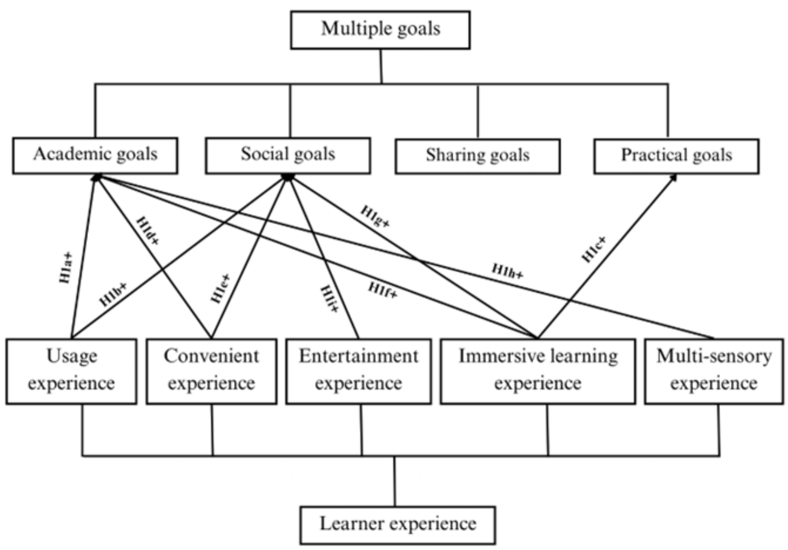

Figure 2. Learner experience affects multiple goals

Learner experience affects AR/VR adoption

Students believe that the use of immersive visualization through VR improves their comprehension and participation (Shen et al., 2022), which relates to the AR/VR adoption of learners when experiencing immersion (H2c+). Also, in the research of Shen et al. (2022), the adoption of learners toward AR/VR with entertainment experience (H2b+) and usage/benefits experience (H2a+) was shown through the way these types of technologies help offer students delight and motivation, decrease cognitive overload, and boost their skills (Figure 3).

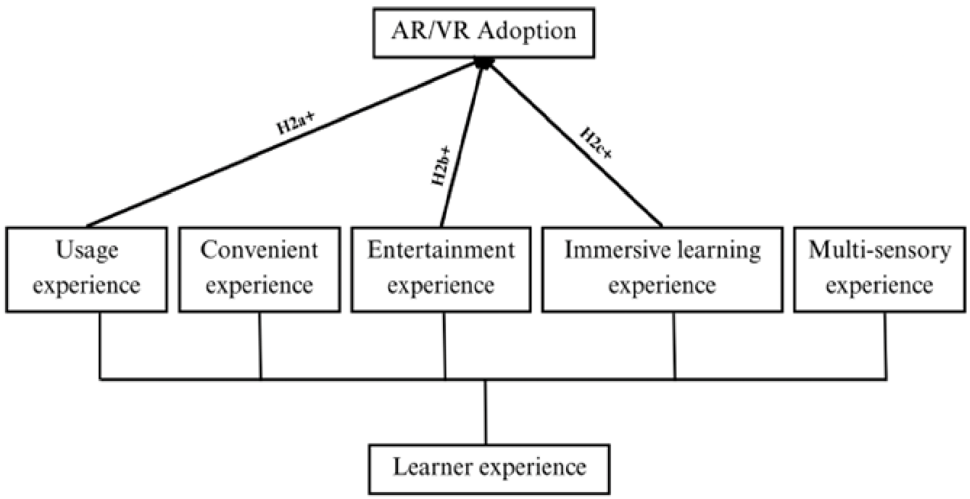

Figure 3. Learner experience affects AR/VR adoption

Multiple goals affect AR/VR adoption

According to Covington (2000), "all actions are given meaning, direction, and purpose by the goals that individuals seek out, and that the quality and intensity of behavior will change as these goals change" (p. 174). In another statement, Unsworth et al. (2014) specify that "goals are core motivational constructs that influence behavior" (p. 1064). Regarding the educational environment, goals can be defined as the mental images of intended results that guide behavior and motivation. Research has looked at students' academic performance objectives, or "achievement goals," as well as the kinds of goals sought in learning circumstances (Mansfield, 2009). In reality, however, people tend to set many goals in their lives. Whatever our individual worries, aspirations, or problems may be – regardless of age or stage of life – pursuing numerous goals is an unavoidable aspect of being human (Kung & Scholer, 2019). The viewpoint of having multiple goals prioritizes looking at the combined potential benefits for student learning of different goal orientations with the aim of gaining a more thorough and improved comprehension of the complicated phenomena of achievement, learning, and motivation (Ning, 2016).

The authors will show some details from previous research to explain the impact of multiple goals on AR/VR adoption. During the process of reaching academic goals, learners tend to share their personal stories of improvement, receiving and providing feedback, encouragement, and inspiration to others as they learn how to harness the power of technology to foster deeper thinking and academic development (Fisher & Baird, 2020) (H3a+). The action of exploiting technology for learning is an expression of AR/VR adoption. Visual worlds are used by students for social purposes, such as mingling and meeting new people and going on virtual field trips (Papanastasiou et al., 2018) (H3b+). On the road to participating in social and learning activities, students/learners utilized AR/VR. Matsika and Zhou (2021) mentioned that AR/VR is adopted because it can maximize learning and encourage collaborative and cooperative learning (sharing goals) (H3c+) and the development of new talents and cognitive skills in students (practical goals) (H3d+) as they progress through their academic careers toward their professional futures (social goals) (see Figure 4).

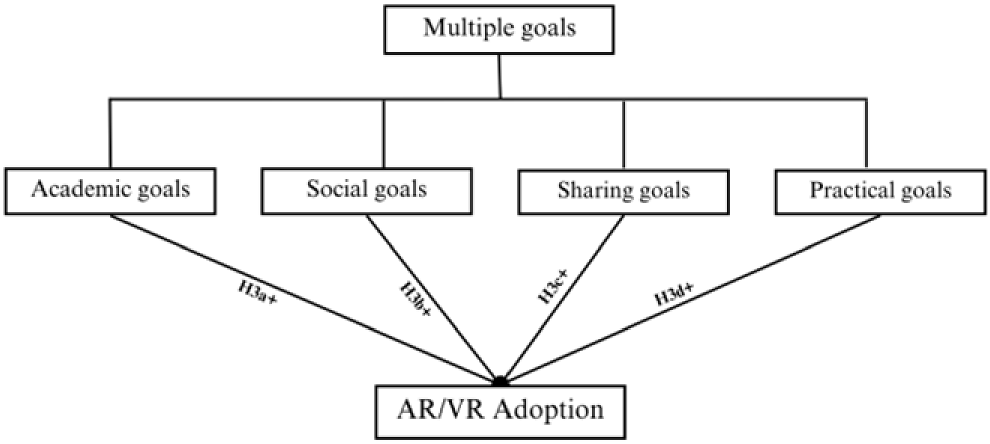

Figure 4. Multiple goals affect AR/VR adoption

Barriers

According to The American Heritage Dictionary (n.d.), a barrier is intangible and can impede people from doing something. In behavior research, barriers affect consumers' attempts to go against innovation until people know more about it (Ram & Sheth, 1989). Learning barriers or reasons for learning difficulties, which are somewhat prevalent in educational settings, can stem from numerous factors, ranging from psychological, economic, attitudinal, and personal to organizational (Khan, 2011).

In terms of the relationship between barriers and technology adoption, K et al. (2023) determined potential barriers to the adoption of digital technologies and highlighted the importance of prioritizing their removal for such technologies to be successfully adopted. In the field of education, previous studies mentioned the difficulty of using AR/VR technology in teaching and learning (Alkhattabi, 2017; Evans, 2019). The current study has thus identified the following barriers in previous research: infrastructure (Abrahams, 2010), complications (Evans, 2019), human interaction (Abrahams, 2010; Matsika & Zhou, 2021), technical issues (Evans, 2019; Matsika & Zhou, 2021), and cost (Evans, 2019), among others (Figure 5).

Infrastructure is the first barrier to AVR technology adoption, and lack of infrastructure causes difficulties in universities adopting AR/VR technology (Abrahams, 2010) (H4a-). Second, most VR interfaces are now designed according to gaming principles; therefore, they are not suitable for an educational context and are thus difficult to use: since the users cannot be gamers, they will not be familiar with gaming interfaces (Evans, 2019) (H4b-). Third, using AR/VR technology reduces face-to-face interaction and direct connections between teachers and learners, which can lead to the misinterpretation of lessons and negatively impact the relationship between teachers and learners (Abrahams, 2010; Matsika & Zhou, 2021) (H4c-). In addition, AVR technology negatively affects learners due to technical issues, such as its bad effects on learners' eyes, social and motor performance, encouragement (Matsika & Zhou, 2021), or headaches (Evans, 2019). AVR technology also encourages laziness in learning, and learners can regard it as a game and become addicted to technology (Matsika & Zhou, 2021) (H4d-). Last but not least, cost prevents people from adopting AR/VR technologies. To apply these technologies in the education system, schools and universities have to pay for both equipment and development costs (Evans, 2019) (H4e-). Organizations are still hesitant to implement experience design, which affects AR/VR adoption. As a result, there is an obstacle and no real experience for learners to adopt AR/VR adoption (Evans, 2019).

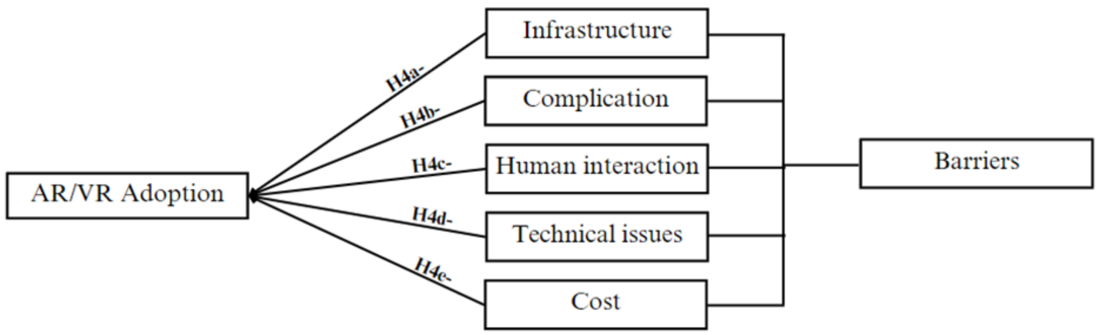

Figure 5. Barriers affecting AR/VR adoption

RESEARCH METHODOLOGY

Many articles, research papers, and magazines address the application of AR/VR, its advantages for learners and teachers, and obstacles to using it. However, research has not yet considered its adoption, learner experience, multiple goals, and barriers within education. The research gap between the current study and others is that this study is based on the theory of consumer behavior instead of TAM, UTAUT, or variations of these two models. TAM (Davis, 1989) has emerged as a highly influential framework for understanding technology acceptance (Charness & Boot, 2016). UTAUT was built upon the foundations of TAM and integrated elements from six other models (Momani, 2020). The TAM and UTAUT models, while widely used for studying technology acceptance (Cabero-Almenara et al., 2019; Chatti & Hadoussa, 2021; Matsika & Zhou, 2021), have certain weaknesses when it comes to capturing customer experience and behavior when purchasing, rejecting, or adopting technology (Hai & Kazmi, 2015). Given the introduction of new IT applications, the TAM model may not fully explain the behavior of individuals who are expected to either accept or reject the purchasing of such technologies (Abbasi et al., 2011). Similarly, UTAUT does not explicitly incorporate the influence of emotions on technology acceptance despite emotions being a significant factor that can impact users' behavior (Venkatesh et al., 2012).

Ajibade (2018) also argued that TAM is primarily conceptualized to focus on individual perceptions and purposes and is not intended to address technology usage in organizational contexts comprehensively, especially in universities. Particularly in AR/VR adoption, studies correlating to consumer behavior theory are almost nonexistent. The current research considers learners to be customers when they experience educational services, specifically AR/VR. For instance, students can be seen as customers because they pay for and use educational services (Aydin, 2014). Alternatively, other research regards educational institutions as businesses, with students serving as customers (Calma & Dickson-Deane, 2020). Furthermore, a business aims to meet customers' expectations by bringing them values and benefits (Burgess et al., 2018; Choi et al., 2016). Besides the research paper mentioning students as consumers, some studies refer to universities as firms that offer educational services (Kamvounias, 1999; Voon, 2008).

The current authors followed the scrupulously planned research process shown in Figure 6. After choosing the topic, a literature review was carried out before a draft model was created. The interviews with four lecturers helped the team to amend scales to develop and draw up the survey. After that, the authors obtained a significant sample size, converted data with SmartPLS-SEM 4.0.9.3, and analyzed and evaluated the data obtained. The sections below present the results and suggest solutions for universities.

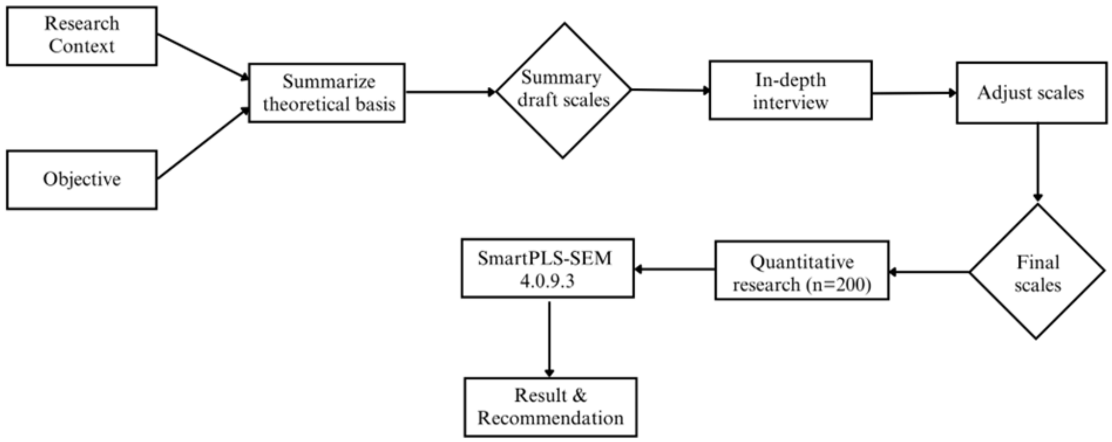

Figure 6. Capsule of the research process

DATA COLLECTION

In this research, the authors applied both quantitative and qualitative approaches. The quantitative method consisted of a questionnaire to gain data from participants about AR/VR adoption in learning. The respondents to this questionnaire are students whose universities have applied AR/VR technology in education, namely, Hanoi University of Science and Technology (Innovation Center, n.d.), Ho Chi Minh City University of Technology and Education (Truong, 2022), FPT University (FPT University, 2023), and Duy Tan University (Duy Tan University Media Center, 2018). It was beneficial for this study to survey students from such educational institutions to ensure the accuracy of results. In this survey, instead of asking about the ages of students, we prioritized questions about their academic years to assess the differences in perceptions across different cohorts regarding how AR/VR technology supports their learning. With a total of 12 paths affecting AR/VR, the adoption variable has the most paths of all the structures, and we applied the "10 times rules" in PLS-SEM, requiring at least 120 responses (Hair et al., 2011). In all, 214 participants responded to the survey; however, 14 responses were rejected as invalid. The resulting representative sample size of 200 is regarded as acceptable.

The qualitative method consisted of a discussion group interview carried out with professors at universities in Vietnam. The four participants were a lecturer at the Faculty of Business Administration from the Swinburne Vietnam Alliance Program with a DBA degree, a lecturer at the Faculty of Business Administration from the International School, Duy Tan University with a DBA degree, a lecturer at the Finance Department of the University of Economics, The University of Da Nang with an MBA degree, and a lecturer in the Faculty of Electrical and Electronic Engineering from Central Electric Power College with an MSc degree. The purposes of the discussion group interview in this research were to adjust the questionnaire used to make it more understandable for the survey participants and to agree on factors matching the Vietnamese context. In this research, the discussion group interview was performed at the workplace when the participants had free time.

SURVEY STRUCTURE

A questionnaire survey was carried out online and sent to students who had taken classes using AR/VR technology as a learning support device. The survey had five parts. The first part contained questions relating to participants' demographics, while the remaining parts contained questions relating to multiple goals, barriers, learner experiences, and AR/VR adoption. In total, 51 questions were posed in this questionnaire involving demographic information and variables (Appendix A).

Several studies have carried out surveys to gain a clear vision and objective evaluation of AR/VR adoption. The questions in Kluge et al.'s (2022) survey about the acceptance of extended reality were measured on an ordinal scale, namely, the Likert scale, which ranged from 1 to 5 points. Moreover, surveys administered by Wojciechowski and Cellary (2013), Shen et al. (2022), and Salem et al. (2020) used Likert scales to show agreement levels as well as satisfaction with and preferences for using AR/VR technology for learning. As a result, the survey used in the current research employed a 5-point Likert scale to gain different students' opinions about adopting AR/VR technology in learning. Measurement items were assessed along a scale from 1 to 5, from totally disagree to totally agree.

MEASUREMENT

In this research, the authors collected and developed scales to create a draft scale. We then conducted discussion group interviews with experts who are university lecturers to adjust the scales to suit the Vietnamese educational context. We then further adjusted the scales to create the official scales: learner experience scales (Appendix B), multiple goals scales (Appendix C), adoption AR/VR scales (Appendix D), and barriers scales (Appendix E). We combined these scales with quantitative research. Finally, these scales were tested through the reliability assessment method of partial least squares structural equation modeling (PLS-SEM) through the SmartPLS 4.0.9.3 tool.

DATA ANALYSIS

The research used PLS-SEM and SmartPLS 4.0.9.3 to analyze and evaluate structural and measurement models from the survey data. PLS-SEM has a large number of advantages for working with structural equation models (Hair, Sarstedt, et al., 2014). PLS-SEM effectively handles small sample sizes and intricate models (Cassel et al., 1999; Vinzi et al., 2010). In this research, to confirm convergent validity, the average variance extracted (AVE) had to be greater than 0.5 (Al-Maroof & Al-Emran, 2018; Hair et al., 2011). Moreover, to evaluate the reliability and determine the stability of the research results, Cronbach's alpha and composite reliability (CR) were used, with numbers greater than 0.7 being regarded as acceptable (Al-Maroof & Al-Emran, 2018; Hair, Gabriel, & Patel, 2014; Taber, 2018). In addition, the variance inflation factor (VIF) values did not exceed 5, so there is no indication of multicollinearity (Paul, 2006). The correlation between two latent variables was estimated by the heterotrait-monotrait ratio of correlations (HTMT). Since the HTMT is an estimator for the inter-construct correlation, it is necessary for the HTMT ratio to be less than 1 to demonstrate the discriminant validity (Henseler et al., 2015). Besides, the study examined the determination coefficients (R^2). An R^2 value between 0.33 and 0.67 suggests a moderate explanation, while an R^2 value of 0.67 or higher indicates a strong explanation (Hock & Ringle, 2010). To assess reliability estimates in the research model and the impact of the variables on AR/VR adoption, a bootstrap calculation was used (Byrne, 2013).

RESULTS

DISCUSSION GROUP INTERVIEW RESULTS

In this research, experts were interviewed to assess the factors and adjust the scales and words. Consensus was gained from all four participating experts. In the interviews, when asked to design the scale for this study for the first time, the lecturer from the Swinburne Vietnam Alliance Program recommended that each factor should be more than two scales. After completing scales, the lecturer from Central Electric Power College said that the meaning of the following statement in the IME2 scale – "I am often afforded the opportunity to design and prototype by using state-of-the-art tools" – was not clear, and the scale needed to be changed to "I can design and create realistic products by using state-of-the-art tools." The lecturer from the International School, Duy Tan University, thought it was necessary to adjust the IME3 statement "I can observe, analytically see possibilities, envision and express my own response to the problem" to ensure easy understanding. The new statement she proposed was, "I can observe and analyze the problems raised in learning effectively thanks to modern technology." On the other hand, as regards the COE1 statement, "I can review the multimedia information at home or anywhere else," the lecturer from the University of Economics - The University of Da Nang pointed out that the words "multimedia information" were confusing for respondents and should be readjusted to "multiple technology formats at home or anywhere else." After consideration, COE1 was changed to "I can review knowledge in a variety of technology formats at home or anywhere else."

The Demographic Profile of Respondents

The questionnaire was answered by 200 students from several universities in Vietnam. Most respondents were juniors (41.5%) and sophomores (33%), whereas the minority were seniors (20%) and freshmen (5.5%). Males (n=75) accounted for 37.5%; that is, three-fifths of the number of females (n=125; 62.5%). It could be concluded from the questionnaire that students in many majors have accompanied them for being inquired and evaluated. Sixty-six respondents (33%) were majoring in digital marketing, followed by international business and software engineering (39, 19.5%, and 26, 13%, respectively). The remaining majors had smaller ratios, including hotel management (9.5%), business administration (7%), others (3.5%), tourism and hospitality management (3%), graphic design (3%), finance (2%), English linguistics and literature (2%), multimedia (1.5%), AI (1%), construction economics (1%), and Japanese linguistics and literature (1%).

The Measurement Model Evaluation

The tables below demonstrate the construct reliability and validity of variables such as Learner Experience (Table 1), Multiple Goals (Table 2), AR/VR Adoption (Table 3), and Barriers (Table 4). All the outer loadings of items had values above 0.7, which showed convergent validity (Hair, Sarstedt, et al., 2014). Additionally, AVE readings of 0.5 or higher indicate that the indicators' reliability requirements were satisfied (Al-Maroof & Al-Emran, 2018). In terms of CR, most of the observed variables are in the range of 0.7 to 0.9. In terms of CR, most of the observed variables are in the range of 0.7 to 0.9, which proves that the CR is valid (Hair et al., 2021). Hair et al. (2021) also said that if CR is greater than 0.95, it is more likely that the observed variables will overlap; that is, they will have the same content. According to Table 3, the CR of AV/VR adoption is 0.954, so the overlap is considered negligible.

Table 1. Learner experience

Constructs	Items	Outer Loadings	VIF	Cronbach's Alpha	CR	AVE
Immersive experience (IME)	IME1	0.892	2.266	0.853	0.911	0.773
	IME2	0.830	1.832			
	IME3	0.913	2.593			
Entertainment experience (ENE)	ENE1	0.850	2.181	0.900	0.930	0.769
	ENE2	0.877	2.637			
	ENE3	0.876	2.612			
	ENE4	0.903	3.041			
Convenience experience (COE)	COE1	0.895	2.405	0.889	0.931	0.818
	COE2	0.910	2.725			
	COE3	0.908	2.656			
Multi-sensory experience (MSE)	MSE1	0.921	2.100	0.840	0.926	0.862
	MSE2	0.936	2.100			

Constructs	Items	Outer Loadings	VIF	Cronbach's Alpha	CR	AVE
Usage experience (USE)	USE1	0.922	3.005	0.900	0.938	0.834
	USE2	0.906	2.660			
	USE3	0.911	2.810			

Table 2. Multiple goals

Constructs	Items	Factor Loadings	VIF	Cronbach's Alpha	CR	AVE
Academic goals (ACG)	ACG1	0.775	1.460	0.708	0.834	0.627
	ACG2	0.787	1.507			
	ACG3	0.814	1.275			
Social goals (SOG)	SOG1	0.823	2.573	0.834	0.883	0.601
	SOG2	0.789	2.387			
	SOG3	0.700	1.408			
	SOG4	0.789	1.827			
	SOG5	0.770	1.547			
Practical goals (PRG)	PRG1	0.747	1.374	0.823	0.896	0.744
	PRG2	0.906	3.322			
	PRG3	0.924	3.513			
Sharing goals (SHG)	SHG1	0.945	2.285	0.857	0.933	0.874
	SHG2	0.925	2.285			

Table 3. Adoption AR/VR

Constructs	Items	Outer Loadings	VIF	Cronbach's Alpha	CR	AVE
Adoption AR/VR (AVRA)	AVRA1	0.834	2.943	0.950	0.954	0.691
	AVRA2	0.841	3.172			
	AVRA3	0.874	3.859			
	AVRA4	0.751	2.422			
	AVRA5	0.829	3.119			
	AVRA6	0.834	3.022			
	AVRA7	0.853	2.968			
	AVRA8	0.837	3.024			
	AVRA9	0.814	2.930			
	AVRA10	0.840	3.217			

Table 4. Barriers

Constructs	Items	Factor Loadings	VIF	Cronbach's Alpha	CR	AVE
Infrastructure barriers (INB)	INB1	0.883	2.111	0.913	0.916	0.657
	INB2	0.883	2.165			
	INB3	0.718	1.293			
Complication barriers (CMB)	CMB1	0.917	2.137	0.844	0.927	0.864
	CMB2	0.941	2.137			
Human interaction barriers (HIB)	HIB1	0.918	2.698	0.912	0.944	0.849
	HIB2	0.922	3.528			
	HIB3	0.924	3.361			
Technical issues barriers (TIB)	TIB1	0.918	2.272	0.856	0.932	0.873
	TIB2	0.950	2.272			
Cost barriers (COB)	COB1	0.922	3.223	0.925	0.944	0.849
	COB2	0.968	3.836			
	COB3	0.871	3.627			

The HTMT criterion is the geometric mean of the heterotrait-heteromethod correlations (i.e., correlations between different structural measures) divided by the mean of the monotrait-heteromethod correlations (i.e., correlations between questions measured within the same construct). In a qualified model, the HTMT must be below 1.0; if the HTMT value is below 0.90, a discriminant value has been established between a given pair of constructs (Henseler et al., 2015). According to Garson (2016), the discriminant value between two related variables is demonstrated when the HTMT criterion is less than 1.0. Table 5 presents the discriminant validity of pairs of structures according to the HTMT scale. Accordingly, it can be seen that most of the discriminant values of the model are no more than 1.0. With only the pair of structures INB–SOG having a value greater than 1.0 (1.058), the discriminant validity is considered to have not been established.

Table 5. Discriminant validity (HTMT Scale)

	ACG	AVRA	CMB	COB	COE	ENE	HIB	IME	INB	MSE	PRG	SHG	SOG	TIB	USE
ACG															
AVRA	0.735														
CMB	0.066	0.081													
COB	0.051	0.089	0.051												
COE	0.825	0.703	0.068	0.080											
ENE	0.826	0.768	0.032	0.051	0.888										
HIB	0.062	0.083	0.295	0.032	0.061	0.052									
IME	0.839	0.764	0.021	0.080	0.902	0.973	0.023								
INB	0.806	0.487	0.072	0.073	0.766	0.695	0.143	0.725							
MSE	0.796	0.648	0.109	0.053	0.832	0.846	0.071	0.854	0.572						
PRG	0.984	0.729	0.057	0.041	0.839	0.895	0.050	0.872	0.729	0.792					
SHG	0.779	0.686	0.017	0.039	0.833	0.823	0.031	0.896	0.730	0.759	0.898				
SOG	0.943	0.579	0.108	0.085	0.788	0.757	0.150	0.808	1.058	0.677	0.771	0.790			
TIB	0.139	0.094	0.059	0.068	0.153	0.135	0.083	0.172	0.163	0.124	0.170	0.165	0.152		
USE	0.803	0.803	0.092	0.038	0.880	0.904	0.016	0.911	0.626	0.872	0.847	0.846	0.683	0.156	

THE STRUCTURAL MODEL EVALUATION

Table 6 illustrates the R^2 value of the dependent variables. If the coefficient is in the range of 0.33 to 0.67, the model is explained at a moderate level. From the table, it can be seen that all dependent variables show a moderate level, namely, ACG (0.527), AVRA (0.623), PRG (0.540), and SOG (0.549). In general, the anticipated average R^2 value for the proposed structure model is acceptable (Figure 7).

Table 6. The R^2 value for coefficients of determination

Dependent variables	R Square	Level
ACG	0.527	Moderate
AVRA	0.623	Moderate
PRG	0.540	Moderate
SOG	0.549	Moderate

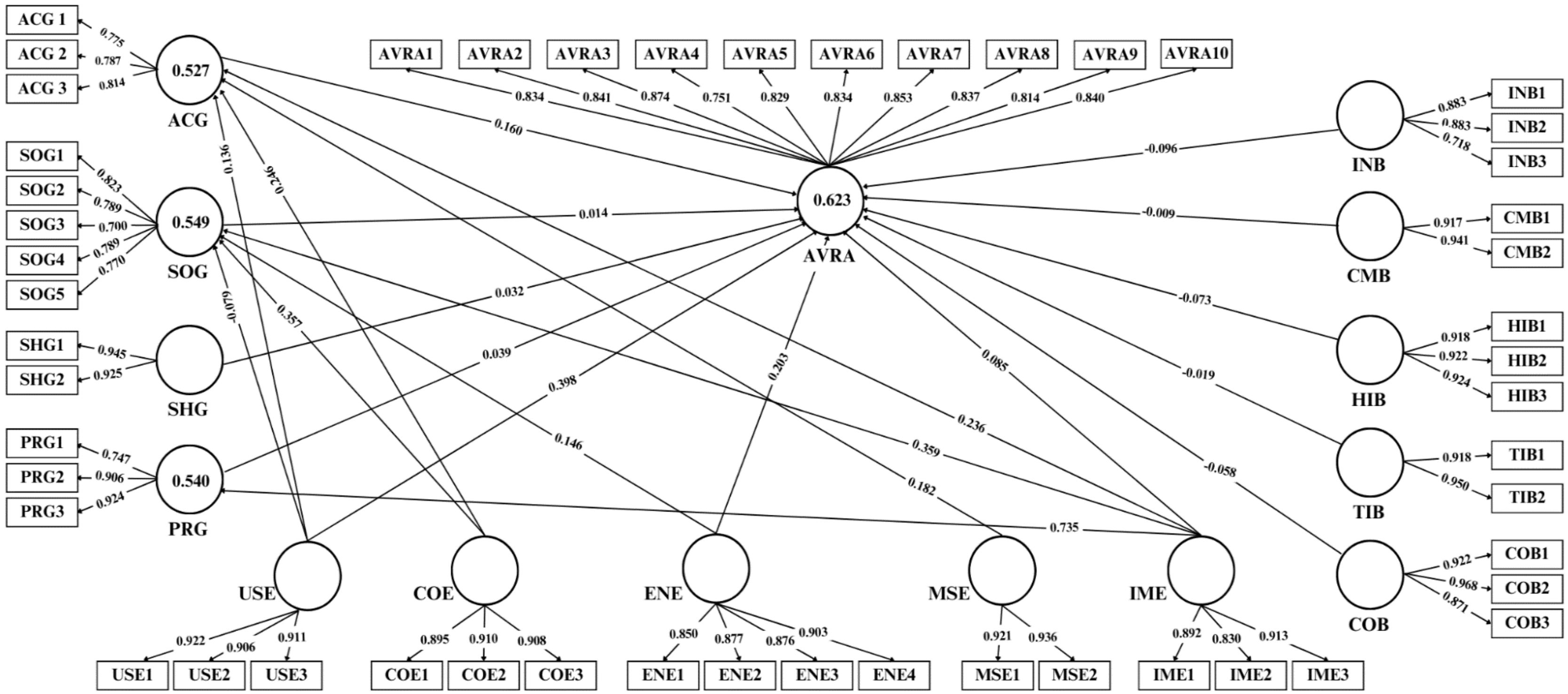

Figure 7. The structural model

Table 7 indicates the results of the proposed research model's hypothesis testing. Each H corresponds to each relationship of variables. Four observed variables (LE, MG, BR, AVRA) were mentioned to examine the proposed model. Overall, 10 out of 21 hypotheses were supported.

Table 7. Hypothesis testing results

H	Relationship	β	Mean	SD	T values	P values	Decision
H1a	USE → ACG	0.136	0.127	0.135	1.009	0.313	Not Supported
H1b	USE → SOG	-0.079	-0.082	0.095	0.832	0.405	Not Supported
H1c	IME → PRG	0.735	0.734	0.041	18.068	0.000	Supported
H1d	COE → ACG	0.246	0.248	0.107	2.290	0.022	Supported
H1e	COE → SOG	0.357	0.353	0.085	4.181	0.000	Supported
H1f	IME → ACG	0.236	0.252	0.110	2.141	0.033	Supported
H1g	IME → SOG	0.359	0.357	0.102	3.523	0.000	Supported
H1h	MSE → ACG	0.182	0.178	0.130	1.396	0.163	Not Supported
H1i	ENE → SOG	0.146	0.155	0.103	1.412	0.158	Not Supported
H2a	USE → AVRA	0.398	0.394	0.106	3.768	0.000	Supported
H2b	ENE → AVRA	0.203	0.206	0.094	2.166	0.031	Supported
H2c	IME → AVRA	0.085	0.086	0.109	0.775	0.438	Not Supported
H3a	ACG → AVRA	0.160	0.165	0.176	0.908	0.003	Supported
H3b	SOG → AVRA	0.014	0.016	0.148	0.096	0.001	Support
H3c	SHG → AVRA	0.032	0.030	0.089	0.363	0.717	Not Support
H3d	PRG → AVRA	0.039	0.030	0.104	0.372	0.000	Support
H4a	COB → AVRA	-0.058	-0.054	0.054	1.069	0.285	Not Support
H4b	INB → AVRA	-0.096	-0.092	0.083	1.148	0.251	Not Support
H4c	TIB → AVRA	-0.019	-0.016	0.044	0.437	0.662	Not Support
H4d	CMB → AVRA	-0.009	-0.012	0.043	0.206	0.837	Not Support
H4e	HIB → AVRA	-0.073	-0.070	0.048	1.534	0.125	Not Support

CONCLUSION

IMPLICATIONS

By taking customer behavior theory as the foundation and building a proposed model of the impact of learner experience on multiple goals and AR/VR adoption, this study examined the following hypotheses: H1, H2, H3, and H4 (shown in Figure 5). In terms of the relationship between learner experience (LE) and multiple goals (MG), the outcomes indicated that convenience experience (COE) has a great effect on academic goals (ACG). In contrast, multi-sensory experience (MSE) and usage experience (USE) did not affect that variable. Similarly, while convenience experience (COE) had a beneficial effect on social goals (SOG), entertainment experience (ENE) and usage experience (USE) had no effect on social goals (SOG). This result is consistent with earlier studies (Yip et al., 2019) and means that students may attain their academic and social goals by experiencing the benefits of AR/VR. When applying AR/VR in the learning environment, learners can easily study anytime, anywhere, and interact more actively with videos or graphics related to the subject. Moreover, the integration of AR/VR into the learning process helps students meet their social goals, such as pleasing their parents, aiding friends, or better-grasping knowledge.

AR/VR creates a virtual world that can support students who are afraid of communicating with their peers or teachers. They can, therefore, be more proactive in building good relationships with friends and even support each other in learning. Moreover, AR/VR can visualize abstract knowledge and easily explain the relationship between the content of the lessons and its practical use so students can grasp that knowledge more effectively.

Importantly, the application of AR/VR enables learners to assimilate knowledge more deeply; thus, they will gain higher scores and gratify their parents. It can be seen that immersive experience (IME) remarkably impacts academic goals (ACG), social goals (SOG), and practical goals (PRG). This influence was also discussed by Steele et al. (2019) and Saltan and Arslan (2016), and it shows that participating in AR/VR experiences not only helps students improve their scores and gain knowledge but also helps them meet social goals. Social goals here can be understood in the sense that through AR/VR, learners can absorb lessons more quickly and readily. Particularly, by building up a communal virtual space, a larger social presence has the potential to stimulate more profound cognitive processing and yield enhanced educational achievements (Mayer, 2014).

Moreover, AR/VR enhances online classrooms, fostering interactive engagement and simulating face-to-face interactions that improve collaborative learning (Okorie, 2023). The AR/VR tool makes this connection between knowledge and actual work more intuitive and specific. Moreover, while students are soaking up knowledge, AR/VR can become a means for them to bridge the theoretical and practical divide. In the Vietnamese learning environment, students may have trouble applying what they have learned to their work. Many universities are also struggling to discover methods to assist students in becoming acquainted with practical learning activities rather than simply sitting motionless and absorbing theoretical knowledge. One current idea is to include AR/VR in education and learning to improve the capacity to apply gained information to real life and work. As a result, colleges and universities usually urge learners to practice, behave as company employees, and conduct work like full-time workers throughout training activities. Doing so facilitates students' application of theory in practice.

Mentioning the impact of the learner experience (LE) on AR/VR adoption (AVRA), the results indicate that usage experience (USE) significantly impacts the adoption of university students of AR/VR (AVRA). Entertainment experience (ENE) also influences learner AR/VR adoption. These two effects were discussed by Shen et al. (2022). Looking at the outcomes, the way HEIs focus on improving students' contentment, motivation, academic accomplishment, and critical thinking abilities will help increase student adoption of AR/VR. Furthermore, the unveiling of exciting entertainment experiences to increase students' interest in and enthusiasm for what they are learning is also represented in the findings of this study, which supports the widespread adoption of AR/VR among students in higher education. In Vietnam, students frequently struggle to retain their passion for and curiosity about learning. Accordingly, HEIs always provide opportunities for students to use technology (including AR/VR) to encourage and advance learning more effectively and vividly. Otherwise, immersive experience (IME) rejects the effect of AR/VR adoption (AVRA), assuming that the goals have been achieved: academic goals (ACG), social goals (SOG), and practical goals (PRG)). With regard to a student approving the usage of AR/VR, the IME must fulfill the student's above-defined goals.

When it comes to the impact of multiple goals (MG) on AR/VR adoption (AVRA), the data reveal that academic goals (ACG) have a significant impact on learners' adoption of AR/VR (AVRA). The social goals (SOG) and practical goals (PRG) have the same impact on AR/VR adoption (AVRA). On the other hand, sharing goals (SHG) has no favorable effect on AVRA. This finding reinforces previous investigations (Fisher & Baird, 2020; Matsika & Zhou, 2021; Papanastasiou et al., 2018). In detail, when students are motivated and encouraged to participate to improve academic achievement and recognition, they are more likely to accept the use of AR/VR. Students must consider employing a tool that can aid in the process of reaching the stated aim as well as their goal of learning information and gaining scores. When technology helps students achieve their social goals (the third level of Maslow's hierarchy of needs), they are more likely to accept its usage in their learning. A topic that currently requires attention in Vietnam and throughout the world is that students graduate but cannot find work. Therefore, learners will welcome any tool that will assist them in meeting the realities of seeking work. In reality, the usage of AR/VR in education has grown in recent years, providing a variety of choices for using technology to improve learning (Tan et al., 2022). In the learning process, students also contemplate the issue of putting what they have learned into practice; that is, they want to learn with practice. Through traditional teaching methodologies, AR/VR exposes students to non-reproducible real-world simulations, allowing them to better connect with difficult topics that go beyond courses and textbooks (Sun et al., 2023). As a result, using AR/VR to eliminate the divide between theory and practice is a factor in the increasing adoption of AR/VR among university students.

As regards the barriers that prevent learners from adopting AR/VR, the results show that all the barriers, namely, complication barrier (CMB), cost barrier (COB), human interaction barrier (HIB), infrastructure barrier (INB), and technical issues barrier (TIB), are rejected. Thus, the barriers do not support learners' adoption of AR/VR, and it is critical to overcome these hurdles in the academic setting in order to boost that adoption.

LIMITATIONS

The research was conducted to evaluate the influence of learner experience on multiple goals and AR/VR adoption in universities in Vietnam. During the research, the authors met some limitations.

Firstly, the relatively small sample size of 200 participants is not representative of the entire population of educators and students in Vietnam. With a small sample size taken from a specific country, the survey subjects are quite restricted. Therefore, the results of the study will not represent other nations in the world. If the sample size can be extended, the study will generate more accurate results that incorporate a future perspective and are generalizable globally, thus becoming more comprehensive and applicable.

Secondly, this study was approached from a rather new direction. That is, instead of using the TAM or UTAUT models, the authors looked at the influence of learner experience on multiple goals and barriers to using AR/VR and AR/VR adoption. The scarcity of related research also created significant difficulties for the authors in completing the research paper.

Thirdly, this study had limited access to interviewees. Since the number of educational organizations in Vietnam adopting AR/VR technology in teaching is still limited, contacting and scheduling interviews with respondents was challenging, and respondents were difficult to access. Some were busy with their teaching schedules and did not have time to participate; hence, the number of interviewees is not large. However, some lecturers at the named universities did participate.

Last but not least, although AR and VR technologies are similar and considered packages with similar approaches, each has different features and functions. Thus, applying AR and VR in specific circumstances may be the authors' next research direction.

RECOMMENDATIONS

The result of this research stimulates universities in Vietnam when implementing AR/VR in training activities from the aspect of enhancing the experience and goal of using new technology for learners. While UTAUT/TAM models only emphasize the pre-use factors and how users will apply a technology, this research approach focuses on after-use elements. Thus, it can make recommendations for applying AR/VR preventively and using it in the long term. Additionally, the research elaborates on whether, after using AR/VR, the technology can satisfy the needs they set out. Vietnamese higher education systems can use this article to learn how to apply AR/VR.

Based on the above results, learning experience (LE), especially usage experience (USE) and entertainment experience (ENE) have a significant impact on learners' AR/VR adoption (AVRA). Concerning usage experience (USE), it is indispensable for educational institutions to create more and more opportunities for learners to approach AR/VR during their learning process. Notably, universities in Vietnam should give students trial experiences of AR/VR in several subjects corresponding to different majors to evaluate its effectiveness. During the experimental process, it is necessary to gather continuous feedback on each class's satisfaction and frequently improve the usability and effectiveness of AR/VR applications in the educational context. Regarding the appraisal of effectiveness, the higher education system can also compare the learning results of classes using AR/VR with those in which it has been applied. Regarding entertainment experience (ENE), during sessions using AR/VR, lecturers should organize discussion and debate activities to assess the level of critical thinking before and after applying this technology. Vietnamese universities should also organize feedback from lecturers who teach classes using AR/VR to compare student interactions before and after using AR/VR. They should also survey students to see if they are able to review or remember the lessons better than before.

Multiple goals, particularly academic goals (ACG), social goals (SOG), and practical goals (PRG), greatly influence the AR/VR Adoption (AVRA) of students. Regarding academic goals, HEIs in Vietnam can develop AR/VR content aligned with curriculum objectives or student evaluation and grades to support specific learning outcomes and engage students in active learning. In terms of social goals, universities can implement collaborative AR/VR experiences that enable students to work together in virtual environments, fostering teamwork, communication, and problem-solving skills (in order to carry out the teamwork activities, learners need to use AR/VR). Aside from that, they can facilitate shared virtual spaces where students can engage in group discussions, peer feedback, and collaborative projects. Moreover, HEIs can use AR/VR to simulate real-world scenarios relevant to vocational training, field trips, technical skills development, or hands-on experiences. Particularly, AR simulations or training modules should be created, allowing students to practice practical skills safely and in a controlled environment. With VR, universities can simulate businesses: instead of having students physically attend businesses, they need to access VR applications.

Moreover, learning experience (LE), chiefly convenient experience (COE), and immersive experience (IME) have significant influences on multiple goals, namely, academic goals (ACG) and social goals (SOG). Thus, convenient experience (COE) and immersive experience (IME) should receive considerable attention. Universities in Vietnam should convert all materials to AR/VR platforms that can provide AR/VR experiences that can be accessed remotely, allowing students to engage in learning activities at their convenience. They must also ensure that AR/VR content is easily accessible on various devices, such as smartphones or affordable VR headsets, to promote inclusivity and convenience. As a priority, Vietnamese education organizations should ensure that AR/VR applications are intuitive and easy to navigate and provide clear instructions for learners. Regarding immersive experience (IME), Vietnamese universities can enable students to assume different roles and engage in simulations that mirror real-world scenarios or role-play as employees in real businesses. Exceptionally, they can provide immersive experiences where students can make decisions, solve problems, and experience the consequences of their actions. The syllabus designs for assignments should add their practice using AR/VR as a crucial criterion to evaluate their grades and learning outcomes; scoring will be based on their actions during the practical progress. In addition, they can design interactive activities that engage multiple senses simultaneously, enhancing memory retention and understanding. Vietnamese universities can immediately incorporate visual, auditory, and haptic feedback during their immersive role-playing to point out their failures or highlight their strengths with the aim of providing a richer, more immersive learning experience.

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DATA OF STATEMENT

This review's data is available in the public domain and is not sensitive in any way. Therefore, the information is open to the public and is not private.

CONFLICTS OF INTEREST

The authors say they have no competing interests. The authors further affirm that they have no known financial conflicts of interest or personal ties that might have appeared to affect the work presented in this paper.

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APPENDIX A. RESEARCH SURVEY

Our survey form was created with the purpose to study the relationship between learner experience, adoption, multiple learning goals, and barriers to using AR/VR technology in education. To answer the following survey, we hope you will answer based on your understanding of AR/VR technology in practice.

We promise that the data you provide will be kept confidential and only used for scientific research and not for business purposes.

Thank you for participating in our survey.

PART 1: General information: Choose your answer.

A. Currently, you are:
   - Freshman
   - Sophomore
   - Junior
   - Senior
   - Other

B. Your gender:
   - Male
   - Female
   - Other

C. Your major:
   - Software Engineering
   - Information Assurance
   - Safety Information
   - Artificial Intelligence
   - Graphic Design
   - Digital Marketing
   - International Business
   - Business Administration
   - Other

PART 2: Let us know how much you express your own views on the statements below. The specific levels are:

1. Totally disagree
2. Disagree
3. Neutral comment
4. Agree
5. Totally agree

Your experience with AR/VR technology		Totally disagree	Disagree	Neutral comment	Agree	Totally agree
Immersive experience	This experience can spark both interest and generate learning outcomes for me.	1	2	3	4	5
	I can design and create realistic products by using state-of-the-art tools.	1	2	3	4	5
	I can observe and analyze the problems raised in learning effectively, thanks to modern technology.	1	2	3	4	5
Entertainment experience	I can enhance levels of participation and engagement in learning subjects, and thence to a better learning acquisition.	1	2	3	4	5
	AR/VR can help me recall what I had learnt in my lesson and that it was useful for revision.	1	2	3	4	5
	I perceive that my friends would be receptive towards the learning program, find this experience useful for learning, and want to use the AR/VR system.	1	2	3	4	5
	I feel interested and understand lessons better.	1	2	3	4	5
Convenience experience	I can review knowledge in a variety of technology formats at home or anywhere else.	1	2	3	4	5

Your experience with AR/VR technology		Totally disagree	Disagree	Neutral comment	Agree	Totally agree
	I can zoom in and out to see the graphics or videos and these interactions cannot be operated in traditional videos.	1	2	3	4	5
	I only need to move my device slightly to trigger the next activity after completing my previous learning task.	1	2	3	4	5
Multi-sensory experience	I can touch and feel virtual objects through increasing the degree of presence in a virtual environment.	1	2	3	4	5
	I can gain "touch" experience through the sensation of forces, vibration or motion.	1	2	3	4	5
Usage experience	I have an increase in my motivation, satisfaction, and engagement with learning environments that are enriched with AR/VR applications.	1	2	3	4	5
	I can improve my academic achievement.	1	2	3	4	5
	AR/VR applications may support me in improving higher order thinking skills such as problem solving, critical or creative thinking.	1	2	3	4	5

Your goals of using AR/VR technology in learning		Totally disagree	Disagree	Neutral comment	Agree	Totally agree
Academic goals	I want to get good marks during the learning process.	1	2	3	4	5
	I am interested in many things and want to understand them.	1	2	3	4	5
	Applying AR/VR helped me to understand lessons and improve my score.	1	2	3	4	5
Social goals	I want to learn well so that I will not be left behind compared to my friends.	1	2	3	4	5
	I want to do well because my parents expect me to try my utmost.	1	2	3	4	5
	I want to get high marks so my parents will be proud of me.	1	2	3	4	5
	I want to do well so that I can help my teammates.	1	2	3	4	5
	I believe understanding lessons is much more important than achieving a good score.	1	2	3	4	5
Practical goals	I want to apply theory into practice.	1	2	3	4	5
	Applying AR/VR helps me to improve my practical skills.	1	2	3	4	5
	Applying AR/AR fulfills the gap between theory and practice.	1	2	3	4	5
Sharing goals	AR/VR platforms allow me to share my learning content.	1	2	3	4	5

Your goals of using AR/VR technology in learning		**Totally disagree**	**Disagree**	**Neutral comment**	**Agree**	**Totally agree**
	I can connect others to work together and achieve shared learning goals.	1	2	3	4	5

You accept AR/VR technology in learning because:	**Totally disagree**	**Disagree**	**Neutral comment**	**Agree**	**Totally agree**
The use of such a system improves learning in the classroom.	1	2	3	4	5
AR/VR applications enable me to accomplish tasks more quickly.	1	2	3	4	5
Using AR/VR applications enhances my learning effectiveness.	1	2	3	4	5
Learning to use/operate AR/VR applications would be easy for me.	1	2	3	4	5
Using AR/VR applications in learning is very entertaining and allows learning by playing.	1	2	3	4	5
AR/VR applications can benefit me for money spent.	1	2	3	4	5
I like learning with AR/VR applications.	1	2	3	4	5
My general opinion regarding AR/VR applications is positive.	1	2	3	4	5
I intend to use AR/VR applications for my studies in the future.	1	2	3	4	5
I plan to use AR/VR applications frequently.	1	2	3	4	5

You think the barriers that prevent you from accepting the use of AR/VR in learning would be:		**Totally disagree**	**Disagree**	**Neutral comment**	**Agree**	**Totally agree**
Cost barriers	To use AR/VR, we do not only have an equipment cost to bear but also a development cost.	1	2	3	4	5
	The cost of VR systems will prevent people from engaging with VR at any level.	1	2	3	4	5
	The application of AR/VR in education can lead to increased tuition costs and fees.	1	2	3	4	5
Infrastructure barriers	The lack of devices in classrooms sets limits for the practicality of the tasks.	1	2	3	4	5
	Technology sometimes has glitches and does not always work.	1	2	3	4	5
	I would prefer that the microphone/sound system would be in better condition so it would be easier and more fluent to understand the lecture in total.	1	2	3	4	5
Technical issue barriers	The scene/ illumination of AR/VR is different compared to reality.	1	2	3	4	5
	Having a problem with technology in the classroom, poor technical support is a huge missing.	1	2	3	4	5

You think the barriers that prevent you from accepting the use of AR/VR in learning would be:		**Totally disagree**	**Disagree**	**Neutral comment**	**Agree**	**Totally agree**
Technical issue barriers	I need some time for adoption in a VR environment.	1	2	3	4	5
	Usage of complex AR simulations for students, who are not familiar with this complex technology leading to confusion and astoundment.	1	2	3	4	5
Human interaction barriers	Lack of face-to-face and verbal cues can lead to misunderstandings.	1	2	3	4	5
	Building rapport with others is difficult.	1	2	3	4	5
	Students feel socially isolated from their peers.	1	2	3	4	5

The survey seems a bit long, doesn't it? We really appreciate you taking some time to fill out this survey! Wishing you much success on your upcoming journey!
If you have any comments, please feel free to tell us to improve!

APPENDIX B. LEARNER EXPERIENCE (LE) SCALES

Constructs	Codes	Measurement items	Source
Immersive experience (IME)	IME1	This experience can spark both interest and generate learning outcomes for me.	Parong and Mayer (2018); Steele et al. (2019)
	IME2	I can design and create realistic products by using state-of-the-art tools.	
	IME3	I can observe and analyze the problems raised in learning effectively, thanks to modern technology.	
Entertainment experience (ENE)	ENE1	I can enhance levels of participation and engagement in learning subjects, and thence to a better learning acquisition.	Pellas and Mystakidis (2020), Liu et al. (2007)
	ENE2	AR/VR can help me recall what I had learnt in my lesson and that it was useful for revision.	
	ENE3	I perceive that my friends would be receptive towards the learning program, find this experience useful for learning and want to use the AR/VR system.	
	ENE4	I feel interested and understand lessons better.	
Convenience experience (COE)	COE1	I can review knowledge in a variety of technology formats at home or anywhere else.	Yip et al. (2019)
	COE2	I can zoom in and out to see the graphics or videos and these interactions cannot be operated in traditional videos.	
	COE3	I only need to move my device slightly to trigger the next activity after completing my previous learning task.	
Multi-sensory experience (MSE)	MSE1	I can touch and feel virtual objects through increasing the degree of presence in a virtual environment.	Sanfilippo et al. (2022)
	MSE2	I can gain "touch" experience through the sensation of forces, vibration, or motion.	
Usage experience (USE)	USE1	I have an increase in my motivation, satisfaction, and engagement with learning environments that are enriched with AR/VR applications.	Saltan and Arslan (2016)
	USE2	I can improve my academic achievement.	
	USE3	AR/VR applications may support me in improving higher-order thinking skills, such as problem solving, and critical or creative thinking.	

APPENDIX C. MULTIPLE GOALS (MG) SCALES

Constructs	Codes	Measurement items	Source
Academic goals (ACG)	ACG1	I want to get good marks during the learning process.	Mansfield (2009), Dyulicheva et al. (2021)
	ACG2	I am interested in many things and want to understand them.	
	ACG3	Applying AR/VR helps me to understand lessons and improve my score.	
Social goals (SOG)	SOG1	I want to learn well so that I will not be left behind compared to my friends.	Mansfield (2009), Ferguson (2002)
	SOG2	I want to do well because my parents expect me to try my utmost.	
	SOG3	I want to get high marks so my parents will be proud of me.	
	SOG4	I want to do well so that I can help my teammates.	
	SOG5	I believe understanding lessons is much more important than achieving a good score.	
Practical goals (PRG)	PRG1	I want to apply theory into practice.	Lee and Sim, (2019), Dyulicheva et al. (2021), Gasmi and Benlamri (2022)
	PRG2	Applying AR/VR helps me to improve my practical skills.	
	PRG3	Applying AR/AR fulfills the gap between theory and practice.	
Sharing goals (SHG)	SHG1	AR/VR platforms allow me to share my learning contents.	Puggioni et al. (2021)
	SHG2	I can connect others to work together and achieve shared learning goals.	

APPENDIX D. ADOPTION AR/VR (AVRA) SCALES

Constructs	Codes	Measurement items	Source
Adoption AR/VR (AVRA)	AVRA1	The use of such a system improves learning in the classroom.	Wojciechowski and Cellary (2013), Shen et al. (2022)
	AVRA2	AR/VR applications enable me to accomplish tasks more quickly.	
	AVRA3	Using AR/VR applications enhances my learning effectiveness.	
	AVRA4	Learning to use/operate AR/VR applications would be easy for me.	
	AVRA5	Using AR/VR applications in learning is very entertaining that allows learning by playing.	
	AVRA6	AR/VR applications can benefit me for money spent.	
	AVRA7	I like learning with AR/VR applications.	
	AVRA 8	My general opinion regarding AR/VR applications is positive.	
	AVRA9	I intend to use AR/VR applications for my studies in the future.	
	AVRA10	I plan to use AR/VR applications frequently.	

APPENDIX E. BARRIERS (BR) SCALES

Constructs	Codes	Measurement items	Source
Cost barriers (COB)	COB1	To use AR/VR, we do not only have an equipment cost to bear but also a development cost.	Evans (2019), Kazanidis and Pellas (2019)
Cost barriers (COB)	COB2	The cost of VR systems will prevent people from engaging with VR at any level.	Evans (2019), Kazanidis and Pellas (2019)
Cost barriers (COB)	COB3	The application of AR/VR in education can lead to increased tuition costs and fees.	Evans (2019), Kazanidis and Pellas (2019)
Infrastructure barriers (INB)	INB1	The lack of devices in classrooms sets limits for the practicality of the tasks.	Häkkilä et al. (2018), Dinç (2019), Karagözler and Karagözler (2021)
Infrastructure barriers (INB)	INB2	Technology sometimes has glitches and does not always work.	Häkkilä et al. (2018), Dinç (2019), Karagözler and Karagözler (2021)
Infrastructure barriers (INB)	INB3	I would prefer that the microphone/sound system would be in a better condition so it would be easier and more fluent to understand the lecture in total.	Häkkilä et al. (2018), Dinç (2019), Karagözler and Karagözler (2021)
Technical issue barriers (TIB)	TIB1	The scene/ illumination of AR/VR is different compared to reality.	Dyulicheva et al. (2021), Dinç (2019)
Technical issue barriers (TIB)	TIB2	Having a problem with technology in the classroom, poor technical support is a huge missing	Dyulicheva et al. (2021), Dinç (2019)
Complication barriers (CMB)	CMB1	I need some time for adoption in a VR environment.	Dyulicheva et al. (2021), Nesenbergs et al. (2020)
Complication barriers (CMB)	CMB2	Usage of complex AR simulations for students who are not familiar with this complex technology, leading to confusion and astoundment	Dyulicheva et al. (2021), Nesenbergs et al. (2020)
Human interaction barriers (HIB)	HIB1	Lack of face-to-face and verbal cues can lead to misunderstandings.	Abrahams (2010), Maqsoom et al. (2023)
Human interaction barriers (HIB)	HIB2	Building rapport with others is difficult.	Abrahams (2010), Maqsoom et al. (2023)
Human interaction barriers (HIB)	HIB3	Students feel socially isolated from their peers.	Abrahams (2010), Maqsoom et al. (2023)

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