



# Corporate Learners' Perceptions of Extended Reality Technology as a Learning Aid in the Workplace

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## ABSTRACT

Virtual and augmented reality have grown in popularity as learning tools in the workplace in recent years. This study looks at how corporate learners perceive the use of extended reality technology in the workplace. Corporate learners utilise a variety of learning technologies, and their opinions of these resources have an impact on their adoption and learning process. A mixed-methods study was conducted using an online survey and follow-up interviews with the financial services participants (N = 106). The study was guided by the second-generation activity theory and the technology acceptance model (TAM). Findings showed that learners valued immersive technology because it increased teammate involvement and knowledge. However, issues with technological accessibility and incorporation into corporate learning programmes were also raised. According to this study, immersive technology may help with workplace learning, but its advantages and challenges should be taken into account as well. Extended reality (XR) technology offers notable advantages in learning by elevating enjoyment and facilitating a smoother learning experience, which greatly impacts learners' attitudes. However, its implementation in education presents challenges, primarily due to the increased need for resources. Additionally, the learning curve associated with XR technology poses hurdles for both educators and learners. Limited accessibility to virtual reality gear further complicates matters, potentially hindering proficiency and accessibility for learners trying to navigate this technology.

## KEYWORDS

activity theory, augmented reality, education technology, extended reality technology, technology acceptance, virtual reality

## INTRODUCTION

The technological shift during the COVID-19 pandemic has left an ongoing impact on learning and in the workplace. It is necessary to look into technological innovation in how skills are taught in order to prepare the post-pandemic labour force as the demographic shift spreads the use of technology and

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alters behaviour. Immersive technology, sometimes referred to as extended reality technology, stands out among existing technologies. Extended reality incorporates immersive technologies like virtual reality, augmented reality, and mixed reality. Immersive technology predominantly refers to virtual reality and augmented reality, where virtual reality fully immerses users in a digital environment and augmented reality superimposes digital content on the real world. Extended reality is a more inclusive term that encompasses a variety of immersive experiences. In the workplace, there is a growing skill gap. Technology is creating more new jobs, and businesses are having trouble finding candidates with the proper skills to fill them (Van Roy et al., 2018). Businesses urgently need to drive corporate learning and enable employees to acquire necessary abilities quickly. Businesses are considering using remote training methods as remote and hybrid working trends increase (Donnelly & Johns, 2021; Hunter, 2019; Wang et al., 2021). However, most remote training can be expensive because it requires specialised software and content that has been carefully curated by experts.

Students who learn remotely may encounter a variety of issues. The early discomfort may have an effect on their attitude toward learning (Almarzooq et al., 2020). Students who learn remotely often do not receive prompt responses to their questions. This can harm the learning process when students are unable to establish relationships with their instructors and fellow course mates (Almarzooq et al., 2020; Mukhtar et al., 2020). Without prompt clarity, dropout rates could increase. In long-term courses, students might struggle to keep themselves motivated. Some courses have intricate designs and necessitate reading or research, so students must be more motivated to pay attention to the material (Jitpaisarnwattana et al., 2022). For the course to be completed, sustained engagement would be essential.

Immersive technology is being used more frequently by many industries, but the education sector is still not using it to its full potential. According to a poll by cloud AR/VR solution supplier Grid Raster, 91% of enterprises either now use or want to employ immersive technology (Vigliarolo, 2020). However, only 26% use it for employee training (Vigliarolo, 2020). This study aims to ascertain whether extended realities can raise student engagement.

The technology acceptance model (TAM) by Davis (1986) and second-generation activity theory are used in this study to determine the elements that affect the adoption of extended reality as a learning tool in the corporate setting. The study's goals are to determine whether learners view extended reality technologies as tools that can help with learning, to identify the crucial factors influencing the adoption of extended technology in corporate training, and to examine the advantages and difficulties of implementing extended reality tools at work.

The purposes of the study are to better understand how learners perceive extended reality technology (i.e., AR/VR) for learning in order to address interest in employing it in adult learning in the financial services sector, recognize the adoption-influencing factors and the difficulties in achieving a successful rollout, and address interest in employing extended reality technology (i.e., AR/VR) in adult learning in the financial services sector. It is important to understand how learners perceive this technology for learning and recognize the adoption-influencing factors and difficulties in achieving a successful rollout.

Our study differs from previous research in two significant areas. First, unlike most previous studies that predominantly concentrate on the application of these technologies in educational contexts, our research examines their utilisation within the workplace. Second, while the majority of research in this field focuses on STEM-related topics, our emphasis is on a relatively understudied industry: the financial services sector. Our research contributes significantly on both national and international levels. It substantially improves the professional development of the financial services industry on a national scale by providing beneficial insights and practises that can raise the industry's standards and performance. Internationally, our findings can serve as an example for other nations seeking to enhance their financial services by implementing some of the practices and strategies identified in our research. This cross-border applicability can facilitate the exchange of knowledge and advance the global financial services landscape.

## LITERATURE REVIEW

Modern workplace education has undergone a significant paradigm shift with the incorporation of immersive technology into the corporate learning environment. As organizations seek to improve employee training and development, extended reality technology offers a promising approach. Extended reality comprises a spectrum of immersive learning technologies, including virtual reality (VR), augmented reality (AR), and mixed reality (MR). Understanding how corporate learners perceive and utilise extended reality technology as a learning aid is crucial in the current environment. This section examines the existing corpus of knowledge regarding immersive technology and its applicability to workplace learning. In addition, the study's theoretical underpinnings, specifically the TAM and activity theory (AT), are examined. By elucidating the relevant literature and theoretical foundations, this review sets the stage for a comprehensive analysis of corporate learners' perceptions in relation to extended reality technology adoption in the corporate training context.

### Use of Immersive Technology in Education

Immersive technology can be used as a teaching and learning tool (Abd Majid & Mohd Shamsudin, 2019; Alfalah, 2018; Fussell & Truong, 2022; Gedera, 2014; Sural, 2018). It focuses on establishing a comfortable learning environment to duplicate mental processes and encourage a deeper understanding of the subject (Alalwan et al., 2020). This is accomplished by interaction with the learning resources. The research, however, does not address the extent to which extended reality technologies can be used for instruction and learning.

With immersive technology, online learners can study at their own pace and experience the virtual world without time restrictions. This might be in the form of previously recorded 360-degree videos of the area that facilitate understanding of the surroundings (Vallade et al., 2020). There is, however, little evidence that the degree of accessibility influences the spread of the technology. The platform's use for differentiated learning makes it possible for some learning components to be accessible only after mastering a particular subject. For instance, learning about the mechanics of equipment enables pupils to follow the steps one at a time. As a result, it is no longer necessary for each learner to have access to an expert. For instance, Kentucky Fried Chicken created a virtual reality game to teach its personnel how to prepare chicken and operate machinery (Illinois Institute of Technology, 2018). Numerous studies show that the step-by-step instruction offered in the virtual environment offers a fully supervised strategy that enhances employee onboarding without placing stress on labour (Al Janabi et al., 2020; J. Lee et al., 2019).

Kinesthetic learning may be aided by immersive technology. Different students learn in various ways. Some people enjoy doing things with their hands and will gain knowledge by taking part in practical exercises, role plays, and simulations (Craig et al., 2022; Giri et al., 2021). Additionally, students can document their experiences with digital items and impart their expertise to others by sharing them (Powell, 2021; Vallade et al., 2020). Students can study and practise surgical techniques while operating on virtual patients using the surgery simulator, for instance (Al Janabi et al., 2020; Fussell & Truong, 2022; Gsaxner et al., 2023; J. Lee et al., 2019).

Virtual reality and other immersive technologies provide a distraction-free environment that enables students to fully engage in vital learning. Learners who are more involved are more motivated and less prone to give up on technology (Fussell & Truong, 2022; H. T. Lee, 2021; J. Lee et al., 2019). Besides producing positive learning outcomes, augmented reality technology creates a lively environment that promotes interaction which is crucial for collaborative learning (Wan et al., 2018). Learners can appreciate various features of immersive technology which significantly improve the convergence of virtuality, reality, and mentality (Wu et al., 2021).

Immersive technology makes learning easier in physical and online classrooms (Abd Majid & Mohd Shamsudin, 2019; Kuhail et al., 2022; Sural, 2018). It helps students to prepare for an in-person session by studying and practising beforehand. In-person classes can use augmented reality

to provide students with a closer look at and interaction with the material (Alalwan et al., 2020). A study by Lawrence and Ahmed (2018) highlights the potential of immersive technologies in creating communities of practices that allow for a better learning experience.

The aforementioned studies notwithstanding, research on the use of immersive technology in education and corporate learning remains scarce. The use of such technology is still in its infancy. Additional examination into the use of immersive technology in corporate training, particularly in soft skills and financial training, is needed.

## Theoretical Foundations

### *Technology Acceptance Model Theory (TAM)*

The technology acceptance model (TAM) was developed by Fred Davis (1986) to measure users' acceptance of new technologies. The model suggests that perceived usefulness (PU) and perceived ease of use (PEU) influence behavioral intention, which in turn affects user experience. This model has been widely used in research and could be credited for its transferability across different contexts in the technology space. It primarily aims to predict the adoption rate of new technology. The two core variables in the TAM – perceived usefulness and perceived ease of use – have been key determinants of user acceptance. These two variables create beliefs that a particular technology can be adopted with the least effort and that technology would enhance the performance of a certain task.

TAM has emerged as a critical theoretical paradigm for assessing the long-term adoption of learning technologies by learners, instructors, and other stakeholders. TAM's empirical research, reviews, and meta-analyses have been undertaken on various educational themes. For instance, TAM has been used to assess video conferencing tools as a medium for teaching virtual classes (Alfadda & Mahdi, 2021). TAM has also been used to evaluate learning management systems (Šumak et al., 2011). Other research highlights that it has been used for e-learning, and extensions of the TAM have been created to evaluate digital learning (Abd Majid & Mohd Shamsudin, 2019)

Despite the breadth of TAM research, a shortage of studies addresses concerns related to methodologies and applications in emerging educational technologies such as immersive technology. Given the novelty of immersive technology in non-STEM disciplines for corporate learning, this research will use the first TAM framework. The study will not address the social factors indicated in Technology Acceptance Model 2 (TAM2), Technology Acceptance Model 3 (TAM3), and Unified Theory of Acceptance and Use of Technology (UTAUT) since most corporate learners learn quickly, and adult learners are usually self-directed.

### *Activity Theory (AT)*

The implementation of any new system and its successful adoption are not solely dependent on the end user's acceptance. The activity theory (AT) seeks to uncover other factors influencing adoption rate. AT offers a well-suited framework for studying user perceptions of extended reality as a learning aid in the workplace for several compelling reasons.

First, it provides a holistic perspective, recognising that learning in the workplace with extended reality is a multifaceted endeavour. It takes into account not only the technology itself, but also the broader context, which includes interactions, objectives, tools, and the social dynamics of the workplace. Understanding the complexities of extended reality implementation in the workplace necessitates this comprehensive approach. A study by Wu et al. (2023) suggests that the use of extended reality given the rising interest in metaverse would require an educational framework that studies the design, pedagogy, technology, actors, and learning. Vygotsky advocates that the social context influences learning. Activity theory is not only a technique but also a significant theoretical framework for analysing human actions in the numerous aspects of individual activities and social interaction (Kuutti, 2019). The use of extended reality as a learning tool by employees in the workplace is embedded in the organisational culture, social interactions, and overarching goals. This framework

enables the investigation of how these contextual factors influence the perceptions and behaviours of users. Crawford and Hasan (2006) state that AT provides a holistic understanding of how people with sophisticated tools in complex, dynamic environments for learning and innovation do things together. A study by Thomas and Schneider (2018) highlights the challenges faced by instructors and supports the assertion that incorporating virtual worlds into pedagogy necessitates a shift in teachers' perceptions.

In addition, AT is inherently user-focused. It is concerned with comprehending how people interact with their environment and instruments. It enables researchers to delve into users' experiences, requirements, and challenges, which is crucial for understanding their perceptions of this technology in the context of extended reality in workplace learning. The use of AT in understanding human-computer interaction was introduced by Nardi (1996). AT has been used to explain how information and communication technologies are integrated in schools and classrooms throughout different levels of education (Issroff & Scanlon, 2002; Lim & Hang, 2003). It can also be applied to the acceptance of mobile learning and one-to-one technology (Baguma et al., 2019; Holen et al., 2017; Jitpaisarnwattana et al., 2022; Liaw et al., 2010; Liaw & Huang, 2016; Park & Jo, 2017). A study by Collis and Margaryan (2004) applied AT to corporate learning and examined computer-supported collaborative learning in the workplace. These studies seek to use AT to investigate users' acceptance of technology and their experiences with learning. Barhoumi's study adds that AT is helpful as a conceptual framework in technology-enhanced education to determine the suitability of a given technology for facilitating learning (2020). Activity theory has been well-established in technology-enhanced learning. However, there is a lack of research specifically on immersive technology.

Activity theory has been criticised for serving more as a framework for qualitative analysis than forecasting (Nardi, 1996). There is also a lack of measurement of what motivates the individuals involved in the performance of each activity. As time evolves, the theory has expanded to be more inclusive of other considerations and has been adapted to the current cultural context. The first-generation activity theory developed by Vygotsky studies AT on an individual level; it focuses on the user's action (Langemeyer & Roth, 2006). It was found that the other, broader scope of activities had an influence. Despite the limitations, AT promotes interdisciplinary research that incorporates multiple perspectives from diverse domains. This approach is invaluable for investigating intricate phenomena like extended reality in workplace learning, which requires insights from psychology, sociology, education, and technology.

Further items that have been uncovered by Leont'ev have shifted the unit of analysis to include object-oriented labour activity (Khayyat, 2016). The third-generation AT was introduced to consider collaboration across organisations (Sam, 2012). Since this study seeks only to examine the activity within an organisation, the second-generation AT will be used (Engestrom, 1999). Another study defined the conceptual framework that provides a technological approach to AT. In any given environment or community, rules encompass both explicit laws, ordinances, and customs that set boundaries for behavior, as well as the implicit social norms, standards, and interconnectedness among its members.-(Jonassen, 2002). Activity theory is adept at identifying internal conflicts and contradictions within a system of activities. It aids in identifying obstacles to effective extended reality usage and provides insight into user resistance or challenges.

This study examines only one context: workplace learning. Activity theory's predilection for in-depth qualitative research is especially advantageous when attempting to comprehend user perceptions and workplace behaviours. To obtain a comprehensive understanding, researchers may conduct interviews, observations, and artefact analysis.

Activity theory's capacity to consider the interaction between technology, individuals, and the workplace context, as well as its solid theoretical foundation, make it an ideal framework for investigating user perceptions of extended reality as a workplace learning aid.

The following research inquiries are investigated in this study:

1. How much do technologies for extended reality support on-the-job learning for corporate learners?
2. What variables affect the use of advanced technologies in corporate training?
3. What benefits and difficulties might learners expect when implementing technologies for extended reality?

## RESEARCH METHODOLOGY

The mixed-methods sequential explanatory design is used to integrate both theories. The research is divided into two stages. Variables from the technology acceptance model are adapted for quantitative analysis in the first phase. A qualitative study was conducted using the second-generation activity theory to better understand the learner's perspective on extended reality adoption. This phase expanded on the quantitative research conducted in the previous stage. It helped to understand the phenomenon and uncover new aspects of technology adoption. Given the lack of research on using extended reality for workplace learning, including both quantitative and qualitative features would allow for a more comprehensive knowledge of the problem by utilising the strengths of each technique. Depending just on quantitative research would not fully account for each participant's experience, and relying solely on qualitative research is inadequate to establish a broad conclusion.

Data was gathered in two ways: quantitatively through an online survey and qualitatively via interviews with participants working in the financial services sector in Singapore. Learners who participated in workshops or attempted e-learning courses with extended reality elements – either augmented or virtual – were asked to participate in this research.

Several factors influence research into the perceptions of using extended reality for workplace learning in Singapore's financial services sector. First, Singapore is a global financial centre renowned for innovation and technological progress, requiring continuous employee upskilling. Exploring how extended reality can enhance learning in this critical industry is particularly pertinent. Singapore's proactive attitude towards incorporating emergent technologies, coupled with government support and favourable policies, creates an ideal environment for extended reality integration research in a real-world setting. The Singaporean financial services industry employs a diverse workforce, providing insight into how individuals in different age groups, genders, and levels of technological proficiency perceive and interact with extended reality-based learning. In addition, the research has global significance because the challenges and requirements of the finance industry are universal. The findings have the potential to improve the competitiveness and economic growth of financial institutions outside of Singapore.

### Participants

Participants who attended the workshops or attempted e-learning modules containing extended reality activities were invited to participate in this research. This research used a non-probability sampling method, namely convenience sampling. This sampling method makes it easier for learners from various fields to participate. Participation in this study was solely on a voluntary basis. The sample size should be large enough to represent the population that has tried using extended reality in workplace learning. The 106 participants in the study all held client-facing positions in Singapore's financial services industry and possess at least a bachelor's degree. The distribution of participants consists of 50 females and 56 males. Further categorization is based on their prior exposure to extended reality technology: 18 females and 32 males had been exposed to extended reality technology, while 32 females and 24 males had no prior extended reality experience. This diverse demographic composition ensures a thorough examination of the adoption of extended reality technology in client-facing positions in the financial sector, taking into account participants' varying degrees of familiarity with extended reality technology.

The sample for the survey comprised 106 participants out of a population of 106 who had attempted courses that utilised extended reality. Of the 106 participants, 47% reported prior experience

using such technologies before the courses, and 53% had not utilised such technology before attempting the courses.

The sample for the interview comprised 32 participants out of a population of 106 who had attempted the survey. In-depth interviews were conducted with each participant to uncover an array of opinions. For qualitative research, data are extracted as much as possible to reach saturation. The selection of 32 participants from a cohort of 106 for in-depth interviews is based on methodological considerations. In accordance with the objectives of the study, this selection sought to maintain a concentrated and manageable sample for in-depth analysis. With 32 interviews, data saturation was reached, with no further insights to draw upon. With an emphasis on data quality over quantity, these 32 interviews yielded rich and nuanced insights.

## **Instrument**

### *Quantitative Phase*

The instrument used for this phase was a modification of the TAM questionnaire developed by Davis (1989). It was an extension of the original TAM with questions assessing attitudes towards usage and intention to use from Rigopoulos et al. (2008) and Van De Bogart & Wichadee (2015). The studies by Rigopoulos et al. (2008) and Van De Bogart & Wichadee (2015) are reliable, supported by their publication in peer-reviewed journals and stronger impact factors relative to comparative journals. Importantly, their work aligns with the research goals and objectives of the current study, making their research methods and measures highly relevant to the research context. Furthermore, their research is consistent with the TAM's principles and constructs, which strengthens the reliability for extending the TAM questionnaire. As these studies relate strongly to the current research, the questions have been adapted. There are two parts to the questionnaire. The first part aims to assess the general profile of the respondents, which solicits information on their age, gender, and experience using extended reality technology for learning. The second portion of the questionnaire requires the respondents to indicate their agreement with the statement presented. The survey is based on a 7-point Likert scale, ranging from strongly agree to strongly disagree. These are done with references from various research that confirmed the reliability and validity of the instrument. The questions curated were validated by other colleagues and pilot testing was done before the full execution. The variables were adopted from related studies, as shown in Table 1, that were conducted previously and adapted for this study. The reliability of this instrument was tested and verified through Cronbach's alpha. The reliability of the questionnaire was 0.95.

### *Qualitative Phase*

In this phase, a semi-structured interview was used to facilitate more communication opportunities to draw insights. The curated open-ended questions go beyond close-ended questions to facilitate understanding of the learner's thoughts and perceptions toward the use of extended reality technologies in learning. The validity and reliability of the qualitative approach are demonstrated through the processes set in place. The instrument consists of semi-structured questions revolving around the affordances and challenges facing the use of extended reality in learning.

## **Data Collection and Procedures**

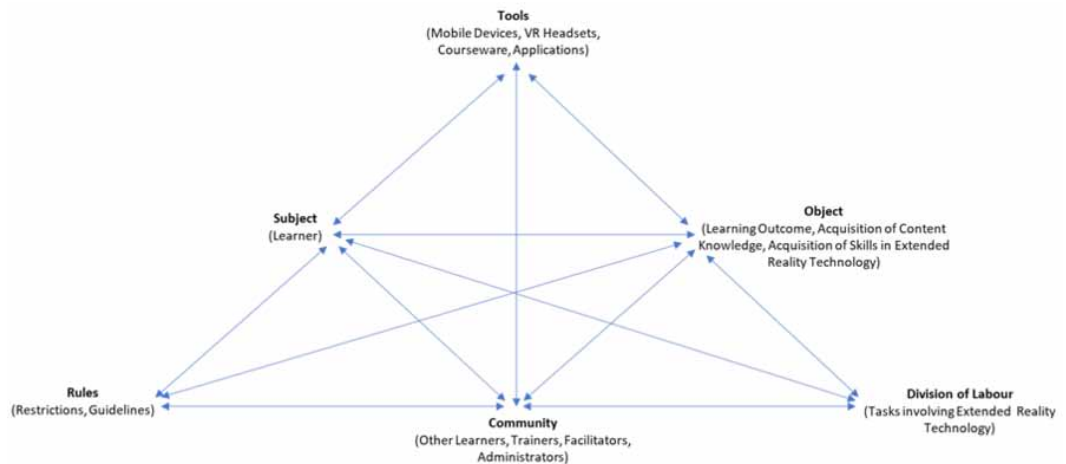
### *Quantitative Phase*

Upon attending the courses with extended reality elements, learners received an email with the online survey link inviting them to participate in this study. This ensured that the experiences were still vivid in their minds and that the view captured was the most reflective. Informed consent from the learner was sought before the respondent attempted the online questionnaire. Respondents were informed about the purpose of the study and critical information about it. They were also briefed on

Table 1. Details of the survey

Questions	
Perceived Usefulness	
PU1	Using extended reality technology in learning enables me to attain the learning outcome more quickly.
PU2	Using extended reality technology in learning would improve my job performance.
PU3	Using extended reality technology in learning would increase my productivity.
PU4	Using extended reality technology in learning would enhance my effectiveness on the job.
PU5	Using extended reality technology would make it easier to learn the items relating to the job.
PU6	I would find extended reality technology useful in learning.
Perceived Ease of Use	
PEU1	Learning to use extended reality technology would be easy for me.
PEU2	I would find the easy-to-get extended reality technology to do what I want it to do.
PEU3	My interaction with extended reality technology would be clear and understandable.
PEU4	I would find extended reality technology to be flexible to interact with.
PEU5	It would be easy for me to become skillful at using extended reality technology.
PEU6	I would find extended reality technology easy to use.
Attitude Towards Usage	
ATU1	I think extended reality technology makes learning easier.
ATU2	I have a generally favorable attitude towards using extended reality technology.
ATU3	Using extended reality technology brings a lot of enjoyment in learning.
Intention to Use	
ITU1	I think that using extended reality technology in learning is a good idea.
ITU2	I intend to use extended reality technology for learning in the future.
ITU3	I intend to sign up for courses that use extended reality technology.

Figure 1. Second-generation activity model (Engestrom, 1987) with items examined in the semi-structured interview





how this study would be conducted and how their data and information would be guarded with the strictest confidentiality.

### *Qualitative Phase*

Learners were randomly sampled from those who had completed the survey and were called for an interview. The interview was conducted over a web conference tool, Microsoft Teams. Interviews were recorded and transcribed via the Microsoft Teams toolkit. Consent was obtained before the interview to ensure that the information would be kept with the strictest confidentiality. Participants were briefed again on what extended realities are, and questions were answered before the commencement of the session to prevent misunderstandings about the technology.

## **Data Analysis**

### *Quantitative*

The data were first validated by checking for the completeness of the response. Those surveys that were incomplete were removed from this study. Cronbach's alpha was tabulated to assess the reliability of the data. The collected data obtained a Cronbach's alpha of 0.95, demonstrating sound internal consistency.

Descriptive statistics were used to analyse the data set and describe the data drawn. Microsoft Excel was used to tabulate the mean, median, mode, standard deviation, and skewness, providing an initial understanding of the learner's perception of the technology for learning. Standard deviation aims to gain insights into the data's variability level and helps to determine the degree of diversity from the learner's perspective. A correlation analysis was performed to understand the strength of the relationship between the variables tested. An independent T-test was conducted to compare the two groups of learners – those with prior experience with extended reality technology and those without such experience.

### *Qualitative*

Thematic content analysis was used in this research to identify and document the emerging categories and themes from the interviews. Thematic analysis was chosen as it is a technique for studying qualitative data that comprises searching over a data set to detect, evaluate, and report repeating patterns (Braun & Clarke, 2006). To avoid inconsistency and improper use of terminology, the second generation activity theory as the conceptual framework guided the analysis.

Upon the completion of the transcription, all the names of the participants were masked with pseudonyms to protect their identities. Inductive content analysis was employed, in which relevant categories were discovered by close inspection of the text and ongoing comparison with similar texts (Zhang & Wildemuth, 2009). The transcriptions were loaded into software called ATLAS.ti that is designed for qualitative analysis to open each pattern's coding. Responses that were intriguing and insightful were coded. The refined codes were grouped into more significant categories known as "themes." Following that, the integrity of the coding was double-checked

Table 2. Internal consistency of instrument

Category	Items	Cronbach's Alpha
Perceived Usefulness	6	0.95
Perceived Ease of Use	6	0.95
Attitude Towards Usage	3	0.95
Intention to Use	3	0.95

using the completed codebook as a reference. Frequency analysis of each type was further carried out and tabulated.

## RESULTS AND FINDINGS

This study aimed to delve into the following research questions:

1. To what extent do extended reality tools help corporate learners learn on the job?
2. What factors influence the adoption of extended technology in corporate training?
3. What are the affordances and challenges of adopting extended reality tools in their learning process?

### Quantitative

There are a total of 106 learners who attempted the courses with the use of extended reality technology. The learners' profiles and experiences with extended reality technology before the course are displayed in Table 3.

#### *Perceived Usefulness*

The population seems to strongly perceive ( $M = 5.96$ – $6.49$ ,  $SD = 0.61$ – $0.82$ ) the usefulness of extended reality technology in aiding learning efforts. There are strong indications that extended reality technology enables them to attain learning outcomes quickly ( $M = 6.49$ , Kurtosis = 1.39). The learners found learning easier with extended reality technology ( $M = 6.19$ ,  $SD = 0.79$ ), which is relatively helpful in learning ( $M = 6.38$ ,  $SD = 0.64$ ). However, regarding effectiveness on the job, the results reported are slightly lower ( $M = 5.96$ ,  $SD = 0.77$ ).

#### *Perceived Ease of Use*

Learners generally find extended reality technology easy to pick up ( $M = 6.35$ ,  $SD = 0.74$ ) and easy to use ( $M = 6.20$ ,  $SD = 0.81$ ). However, learners indicate lower flexibility in interacting with the technology ( $M = 5.61$ ,  $SD = 0.83$ ).

Table 3. Demographic profiles of learners and their experiences with extended reality technology before the course

Age Group	With Prior Experience	Without Prior Experience	Grand Total
<b>Female</b>	<b>32</b>	<b>18</b>	<b>50</b>
21-30	11	11	22
31-40	11	7	18
41-50	7	0	7
51-60	3	0	3
<b>Male</b>	<b>24</b>	<b>32</b>	<b>56</b>
21-30	6	21	27
31-40	12	9	21
41-50	6	1	7
51-60		1	1
<b>Grand Total</b>	<b>56</b>	<b>50</b>	<b>106</b>

### *Attitude Towards Usage*

The population has a strong positive attitude towards using extended reality technology for learning ( $M = 6.50\text{--}6.69$ ,  $SD = 0.60\text{--}0.66$ , Kurtosis =  $1.26\text{--}2.56$ ). The learners find that extended reality technology makes learning easier ( $M = 6.59$ ,  $SD = 0.60$ ), and they generally have a favourable attitude towards using it ( $M = 6.50$ ,  $SD = 0.64$ ). Learners also enjoy learning when using extended reality technology ( $M = 6.53$ ,  $SD = 0.66$ ).

### *Intention to Use*

There is a strong indication that the learners will be using the technology for learning ( $M = 6.51\text{--}6.63$ ,  $SD = 0.59\text{--}0.71$ ). Learners view the use of extended reality technology in learning positively ( $M = 6.63$ ,  $SD = 0.59$ ). There is a strong indication that they will be using the technology for learning in the future ( $M = 6.56$ ,  $SD = 0.63$ , Kurtosis =  $1.78$ ) and that they intend to sign up for courses that use such technology ( $M = 6.51$ ,  $SD = 0.71$ , Kurtosis =  $1.82$ ).

Overall, the learners perceive extended reality technology as a helpful learning aid. Higher scores are observed for perceived usefulness ( $M = 5.96\text{--}6.49$ ) than for perceived ease of use ( $M = 5.61\text{--}6.35$ ). Strong positive attitudes are observed regarding the use of extended reality technology, and there is a firm intention for future usage in learning. More details on the results can be found in Table 4. Results shown in Table 5 reveal that all variables are positively correlated. The results suggest that the learners' attitudes strongly influence their intention to use the technology. Enjoyment in learning and thinking it is a good idea to adopt extended reality technology in learning are strongly correlated,  $r(104) = .81$ ,  $p < .001$ . Having a favourable attitude is strongly correlated ( $r(104) = .82$ ,  $p < .001$ ) with the intention to use extended reality technology for learning.

### *Correlation*

Results shown in Table 5 revealed that all the questions are positively correlated. The results suggest that the learners' attitudes strongly influence their intention to use the technology. Enjoyment in learning and thinking it is a good idea to adopt extended reality technology in learning are strongly correlated,  $r(104) = .81$ ,  $p < .001$ . Having a favourable attitude is strongly correlated,  $r(104) = .82$ ,  $p < .001$  to the intention to use extended reality technology for learning.

### *Independent T-Tests*

It is evident that there is a statistically significant difference between the two groups of learners (with and without prior experience with extended reality), as determined by the outcomes of the independent t-tests. The p-values derived from the t-tests were all below 0.05, indicating that the differences observed are unlikely to have occurred by chance. Table 6 presents a concise overview of the key findings, emphasising the statistical significance of differences among the groups. This result is crucial for comprehending the manner in which previous experience influences the variables under investigation, and it indicates that prior experience significantly influences the context of this study.

The significant differences observed between the two groups highlight the importance of incorporating prior experience when implementing extended reality technology. This information is critical for the formulation of educational interventions or strategies that are specifically designed to meet the different needs of these distinct groups. For example, individuals lacking prior familiarity with extended reality technology might require a more comprehensive orientation of the tool.

### **Qualitative**

A total of 32 learners were interviewed. The purpose of the interviews was to uncover the affordances and challenges of the adoption of extended reality technology for learning. Based on the findings from the survey, the interview sought to delve deeper to understand the thoughts of the learners who

Table 4. Descriptive statistics

Questions	Mean	Standard Error	Median	Mode	Standard Deviation	Sample Variance	Kurtosis	Skewness	Range	Min	Max	Sum	Count
<b>Perceived Usefulness</b>													
PU1 Using extended reality technology in learning enables me to attain the learning outcome more quickly.	6.49	0.06	7.00	7.00	0.61	0.37	1.39	-1.01	3.00	4.00	7.00	688.00	106.00
PU2 Using extended reality technology in learning would improve my job performance.	6.05	0.07	6.00	6.00	0.75	0.56	0.50	-0.63	3.00	4.00	7.00	641.00	106.00
PU3 Using extended reality technology in learning would increase my productivity.	6.02	0.08	6.00	6.00	0.82	0.67	-0.08	-0.57	3.00	4.00	7.00	638.00	106.00
PU4 Using extended reality technology in learning would enhance my effectiveness on the job.	5.96	0.07	6.00	6.00	0.77	0.59	0.65	-0.71	3.00	4.00	7.00	632.00	106.00
PU5 Using extended reality technology would make it easier to learn the items relating to the job.	6.19	0.08	6.00	6.00	0.79	0.63	-0.07	-0.70	3.00	4.00	7.00	656.00	106.00
PU6 I would find extended reality technology useful in learning.	6.38	0.06	6.00	6.00	0.64	0.41	0.64	-0.75	3.00	4.00	7.00	676.00	106.00
<b>Perceived Ease of Use</b>													
PEU1 Learning to use extended reality technology would be easy for me.	6.35	0.07	6.50	7.00	0.74	0.55	-0.22	-0.81	3.00	4.00	7.00	673.00	106.00
PEU2 I would find the easy-to-get extended reality technology to do what I want it to do.	5.74	0.08	6.00	6.00	0.82	0.67	-0.68	0.00	3.00	4.00	7.00	608.00	106.00
PEU3 My interaction with extended reality technology would be clear and understandable.	5.92	0.07	6.00	6.00	0.76	0.57	-0.32	-0.26	3.00	4.00	7.00	627.00	106.00
PEU4 I would find extended reality technology to be flexible to interact with.	5.61	0.08	6.00	6.00	0.83	0.70	-0.54	-0.07	3.00	4.00	7.00	595.00	106.00
PEU5 It would be easy for me to become skilful at using extended reality technology.	5.75	0.09	6.00	6.00	0.89	0.80	-0.69	-0.23	3.00	4.00	7.00	610.00	106.00
PEU6 I would find extended reality technology easy to use.	6.20	0.08	6.00	7.00	0.81	0.66	-0.59	-0.60	3.00	4.00	7.00	657.00	106.00
<b>Attitude Towards Usage</b>													
ATU1 I think extended reality technology makes learning easier.	6.59	0.06	7.00	7.00	0.60	0.36	2.49	-1.46	3.00	4.00	7.00	699.00	106.00
ATU2 I have a generally favorable attitude towards using extended reality technology.	6.50	0.06	7.00	7.00	0.64	0.40	1.26	-1.13	3.00	4.00	7.00	689.00	106.00
ATU3 Using extended reality technology brings a lot of enjoyment in learning.	6.53	0.06	7.00	7.00	0.66	0.44	2.56	-1.49	3.00	4.00	7.00	692.00	106.00
<b>Intention to Use</b>													
ITU1 I think that using extended reality technology in learning is a good idea.	6.63	0.06	7.00	7.00	0.59	0.35	0.90	-1.38	2.00	5.00	7.00	703.00	106.00
ITU2 I intend to use extended reality technology for learning in the future.	6.56	0.06	7.00	7.00	0.63	0.40	1.78	-1.36	3.00	4.00	7.00	695.00	106.00
ITU3 I intend to sign up for courses that use extended reality technology.	6.51	0.07	7.00	7.00	0.71	0.50	1.82	-1.43	3.00	4.00	7.00	690.00	106.00

Table 5. Correlation analysis

	PU1	PU2	PU3	PU4	PU5	PU6	PEU1	PEU2	PEU3	PEU4	PEU5	PEU6	ATU1	ATU2	ATU3	ITU1	ITU2	ITU3
PU1	1.00																	
PU2	0.62	1.00																
PU3	0.64	0.79	1.00															
PU4	0.61	0.82	0.90	1.00														
PU5	0.70	0.74	0.82	0.81	1.00													
PU6	0.77	0.72	0.73	0.75	0.83	1.00												
PEU1	0.59	0.53	0.63	0.57	0.65	0.68	1.00											
PEU2	0.55	0.59	0.63	0.57	0.57	0.61	0.64	1.00										
PEU3	0.55	0.58	0.68	0.62	0.52	0.58	0.64	0.78	1.00									
PEU4	0.49	0.58	0.64	0.60	0.54	0.56	0.63	0.82	0.81	1.00								
PEU5	0.49	0.55	0.67	0.61	0.55	0.60	0.66	0.78	0.86	0.86	1.00							
PEU6	0.56	0.64	0.70	0.63	0.64	0.68	0.82	0.75	0.77	0.76	0.81	1.00						
ATU1	0.69	0.55	0.64	0.63	0.68	0.73	0.73	0.52	0.58	0.52	0.54	0.70	1.00					
ATU2	0.64	0.59	0.66	0.66	0.66	0.75	0.65	0.51	0.54	0.51	0.54	0.66	0.84	1.00				
ATU3	0.65	0.60	0.63	0.66	0.62	0.74	0.66	0.52	0.56	0.54	0.54	0.64	0.86	0.92	1.00			
ITU1	0.54	0.49	0.57	0.56	0.56	0.60	0.71	0.49	0.55	0.54	0.53	0.63	0.76	0.77	0.81	1.00		
ITU2	0.55	0.55	0.62	0.67	0.62	0.68	0.65	0.49	0.56	0.50	0.53	0.62	0.75	0.82	0.76	0.83	1.00	
ITU3	0.55	0.53	0.59	0.63	0.64	0.67	0.69	0.45	0.51	0.48	0.49	0.57	0.74	0.78	0.78	0.89	0.91	1.00

**Table 6. Independent T-test results**

	No Prior Experience with Extended Reality Technology			Possess Experience with Extended Reality Technology			Independent T-Test
	Mean	SD	N	Mean	SD	N	(p-value)
Using extended reality technology in learning enables me to attain the learning outcome more quickly.	6.27	0.63	56	6.68	0.51	50	0.000588368
Using extended reality technology in learning would improve my job performance.	5.77	0.74	56	6.26	0.68	50	0.000798192
Using extended reality technology in learning would increase my productivity.	5.69	0.79	56	6.27	0.74	50	0.000232772
Using extended reality technology in learning would enhance my effectiveness on the job.	5.66	0.78	56	6.20	0.66	50	0.000311331
Using extended reality technology would make it easier to learn the items relating to the job.	5.84	0.80	56	6.49	0.65	50	0.000026375
I would find extended reality technology useful in learning.	6.12	0.65	56	6.60	0.53	50	0.000147885
Learning to use extended reality technology would be easy for me.	5.98	0.79	56	6.68	0.51	50	0.000001471
I would find the easy-to-get extended reality technology to do what I want it to do.	5.28	0.64	56	6.15	0.76	50	0.000000003
My interaction with extended reality technology would be clear and understandable.	5.56	0.68	56	6.22	0.69	50	0.000003694
I would find extended reality technology to be flexible to interact with.	5.15	0.72	56	6.04	0.70	50	0.000000005
It would be easy for me to become skillful at using extended reality technology.	5.28	0.79	56	6.17	0.76	50	0.000000069
I would find extended reality technology easy to use.	5.75	0.77	56	6.61	0.60	50	0.000000013
I think extended reality technology makes learning easier.	6.37	0.65	56	6.78	0.45	50	0.000636620
I have a generally favorable attitude towards using extended reality technology.	6.28	0.69	56	6.68	0.51	50	0.001886777
Using extended reality technology brings a lot of enjoyment in learning.	6.30	0.69	56	6.71	0.56	50	0.001635810
I think that using extended reality technology in learning is a good idea.	6.41	0.66	56	6.83	0.42	50	0.000464585
I intend to use extended reality technology for learning in the future.	6.31	0.72	56	6.77	0.42	50	0.000453360
I intend to sign up for courses that use extended reality technology.	6.25	0.78	56	6.72	0.53	50	0.001240294

provided the ratings. The results of the interviews were sought for different themes for reporting. The second-generation activity theory was used as a framework to guide the semi-structured interview, as shown in Figure 1.

### *Demographics of Learners Have an Impact on the Adoption of This Technology*

When asked whether learner profiles influence adoption rates, respondents assumed that learner age and tech literacy were positively associated. “Younger learners may take up technology a lot quicker than older learners,” said one student. Another person mentioned that millennials are more technologically savvy than older people. Another respondent added, “Young people have had greater exposure to such technology and will be able to catch up on it more quickly.” One respondent has

also mentioned the behavioural differences in technology adoption: “Younger individuals are more tech-savvy, and they are exposed to such technologies at a much younger age, allowing them to embrace them more quickly.”

Based on the learners’ profiles, it was observed that those with prior experience in extended reality technology tend to be more open to courses curated with similar technology. Previous experience with the technology allows learners to better adjust to the steep learning curve when dealing with immersive technology. One respondent highlighted that “shopping applications that use such technology have helped me to appreciate the use of the technology better, especially in learning... that probes me to sign up for the course.”

According to the responses, men are more eager to learn and use extended reality technologies than women. Most males said they would be willing to experiment with new technology. This may be related to their attitude towards new technologies. “There is no problem exploring new technologies,” one male respondent said. When technology is enjoyable and valuable, people are more likely to use it. A respondent added, “We have to keep up with the times; therefore, testing new technologies may be interesting.” Another respondent stated that the utility that the new technology offers to work is the factor that promotes its usage and added that “exploring new experiences might perhaps introduce new and better methods of working.” It might be an opportunity to become more familiar with new technologies. One student noted, “It is fantastic to have the exposure and opportunity to test out.” At the same time, another added that “the technology sounds intriguing and certainly worth giving a try initially.”

### *Structuring Activities Using Extended Reality Technology Enhances Learning*

Respondents noted that the directions given were straightforward to follow. This corresponds to the findings of the survey. Some respondents remarked how beneficial the instructions were to their extended reality technology learning experience. According to one student, “the clear explanation and training help us understand how to utilise the programmes.” Some respondents said the facilitators who provided support and assistance assisted them in using the tools. “There are many facilitators to assist us with the headset and the apps,” one student said. “Without the facilitators, it would be difficult for us to find out how to utilise the VR gear for the first time,” said another. As one learner pointed out, “They showed the usage to us, and it was simple to follow through,” confirming the facilitator’s role is necessary to onboard learners with the tools.

Three students said that well-structured exercises using extended reality technologies improve their learning experience. This might be credited to the increased visualisation, as one stated, “The AR activities allow us to grasp and perceive the material better.” Another remarked that the capacity to practise enables the articulation of concepts conceived: “The simulations in the VR world help us to apply the concepts that were taught previously.” Another learner said that “the tasks after each section help to reinforce learning.”

### *Extended Reality Content Curation*

Respondents believe the information generated using extended reality technologies to be very interesting. Several individuals said the information was realistic and highly relevant to the work function. One student said, “The VR mimics actual case situations that occur while seeing customers,” and another remarked, “It helps us to rehearse the different replies that we could receive from clients.” One responder noted that “the situations are realistic,” and another specified that “AR enables us to see the diverse severity of different critical illnesses and helps to obtain a better understanding.” Visualization provides for improved learning, as one stated that “the AR and VR activities bring the wordy contents to life and enable us to understand how it works better.”

According to the responses, having readily available tools helps individuals navigate smoothly. Several remarked that accessing contents on their device allows them to gain familiarity: “It is handy to access material on our iPads” and “contents can load quickly, and it is simpler to browse using

our own smart devices.” Another student added that the convenience enables him to “have access to the required information and may download contact cards and training materials on the device.” Another commented: “It gives amazing convenience since we can access it from both our phone and iPad.” These findings indicate that learners prefer to bring their own devices to class and utilise the technology they can easily access from their own devices.

### *Peer Learning Encourages Further Involvement*

The new technology facilitates peer-to-peer learning since users can collectively study and adapt. Collaborative learning experiences enable users to collaborate in an augmented environment while practising different scenarios for explaining key terminology to customers. “We get to stroll through different simulations and role-play them with our buddy,” one responder said. The interactive group activities facilitate the collaborative completion of learning assignments. “We can observe other teams’ creations and learn how to improve on our own,” one student said. Extended reality technology enables students to share their experiences while encouraging social engagement and fostering community. One learner mentioned that “we get to look at the applications together and explore together....this alleviates the worry of learning alone.” Another student said, “The course is entertaining. There are many conversations throughout the events.” Immersive technology enables peer learning via peer assessment and feedback. Students may use the application to assess and critique each other’s work. Another student remarked, “The app enables us to share our AR creations and comment on posts.” This increases interaction with technology. “Seeing the remarks and praises has inspired me and helped me build confidence using the app,” one student said. Perhaps this component creates an acceleration in learning, as one learner noted that “other colleagues that learn quicker can assist in bringing us up to speed.” “Learning to utilise the software in a group environment assists us in taking up the usage of the technology quicker,” said another.

### *Challenges Facing the Adoption of Extended Reality Technology*

According to several responses, there is a need for additional facilitators to assist in the usage of the new apps and VR gear. More personnel are required for the session. One responder said, “More facilitators are needed for this training.” There are a variety of roles played by the facilitator. For instance, “There are more facilitators to assist us in using the software,” and “The facilitators help us with VR headsets” were stated. This may have contributed to the sense of support for learning new technologies. One responder commented, “There is assistance since there are more facilitators.” In addition to the increase in personnel, the training requires more time. According to one reply, “Much effort is given to providing explicit instruction on the usage of the devices.”

According to the responses, the requirement to download several applications and access multiple platforms might impede adoption. One student said, “The activities are conducted outside the learning management system, and we must download the software, which is rather cumbersome.” This might not be very clear to the students. “Downloading multiple pieces of software is time-consuming and complicated,” said one participant. Another student commented, “It is difficult to access many platforms since we must move between apps.” All respondents said that they do not own a VR headset, which may discourage them from engaging in activities that require one. “It may be rather inconvenient to constantly require a VR headset to access material, given that few of us possess VR headsets,” noted one participant. It also suggests that adopting training materials that are only accessible through headsets could be restrictive. One participant said, “The virtual reality content is only accessible on Oculus, which I do not own...(and) it might be difficult to rent for educational purposes.” In addition, obtaining the VR headgear may present logistical difficulties. One participant noted, “Because I do not possess a VR headset, we will need to go to the venue to use one.”



## DISCUSSION AND IMPLICATIONS

The sample size of our study conducted within Singapore's financial services sector was 106 individuals. Although this sample may not represent the entire sector, it corresponds with typical corporate education class sizes, which are often limited to around 45 participants per class. Consequently, our findings provide valuable insight into the potential of extended reality technology for corporate education in this context. The limitations of the sample size necessitate more extensive research in the future. This research marks the initial stage in determining the applicability of extended reality technology in corporate learning.

### Age and Gender Have an Impact on the Adoption of Immersive Technology

The data showed that more younger males have used the technology than any other demographic. Immersive technology courses attract younger students. According to the data, the class's optionality may entice technology enthusiasts to enroll. This may be because they are comfortable with digital platforms and can learn new technology faster as digital natives. This supports past studies indicating younger students are digital natives and better at adapting to new technologies than older digital migrants (Kesharwani, 2020). When trying new technology, younger learners are less averse.

Given this insight, corporate learning designers can rethink how to introduce technology to diverse groups to suit their learning needs, such as by dividing people by age and gender to teach them how to use augmented and virtual reality equipment. The possibility of matching digital natives with immigrants can result in more widespread adoption. Individuals can be taught differently based on their extended reality technology proficiency. Instructional designers may use similar applications when selecting information to capitalise on learners' immersive digital experiences.

The results help explain how different learner profile assessments of extended reality technology's ease of use will lead to the intended learning outcome. This outcome may be limited by the small sample size and the straightforward sampling procedure, which may have induced bias. Participants may have been inclined to like new technologies as suggested by another study (H. T. Lee, 2021). Further research is needed to determine how age and gender affect extended reality technology adoption. Having a population that is not recruited via convenience sampling can be an option.

### Extended Reality Technology Impacts Learning

According to the findings of the study, using extended reality technology for educational purposes has a greater impact than using it for work-related tasks. The ability to learn new things pertinent to one's occupation correlates with higher scores than the ability to apply these new skills on the job effectively. This supports the notion that, under the proper conditions, extended reality technologies can facilitate learning. This relates to other studies that concur that extended reality aids in learning (Fussell & Truong, 2022; Kuhail et al., 2022). It has been demonstrated that the meticulous selection of content for use in extended reality technology plays a crucial role in how users evaluate the efficacy of such technology. The perceived usefulness of the technology is enhanced when it is associated with learning outcomes influenced by well-structured content. Utilising available technology effectively will have a positive effect not only on the learners' perspectives but also on their learning outcomes. It has been demonstrated that organising content so students have easy access to information increases their engagement with the subject matter. This study expands on previously established elements and reveals new insights into how those elements may influence an individual's perception of the technology's utility. In this scenario, the information may be downloaded onto the user's mobile device. Access to information is no longer limited to a single type of device; information may be assimilated and shared across a variety of devices. Examining the extent to which perceived expediency influences learners' perceptions of the learning utility of technology is beyond the scope of this research, as it is outside the investigation's jurisdiction. Examining the amount of perceived convenience that would affect the learners' perceived utility of the technology in learning is not within the purview of this research.

since it is beyond the scope of the investigation. Augmented reality and virtual reality were utilised in this study. However, there are no studies regarding the learner's preference for the extended reality technologies employed in the learning process. Future research may be able to identify the types of technology that learners prefer, which has the potential to increase motivation and influence adoption rates. When developing a curriculum, instructional design may take into account the various forms of extended reality technologies available to achieve the best possible learning outcomes for students. Diverse applications of immersive technology may facilitate learning.

### **Sense of Enjoyment and Ease of Learning Can Influence Learners' Attitudes**

The results suggest that extended reality technology makes learning more accessible and brings much enjoyment, which ultimately leads to a favourable attitude. Therefore, the study demonstrates a correlation between enjoyment and favourable attitudes. This result is in line with several prior studies that show the level of enjoyment would have a positive correlation to users' attitudes towards the technology (Alfadda & Mahdi, 2021; Granić & Marangunić, 2019; J. Lee et al., 2019; Marikyan, 2022; Pletz, 2021). Unlike research that mainly focused on the gamification of learning (Sailer & Homner, 2020), these results are based purely on immersive technology. The scope of the study mainly focused on extended reality technology and did not touch on the instructional design or gamification of content that could influence learning outcomes and engagement (Zainuddin et al., 2020). Hence, future research can be done to explore the gamification of content in immersive technology to provide optimal engagement.

The data demonstrates a correlation between the learners' attitudes and their intention to use technology for future learning. This is aligned with prior research that highlights the positive correlation between a user's attitude and their intentions to use (Abd Majid & Mohd Shamsudin, 2019; Lai, 2017; Pletz, 2021; Saadé & Bahli, 2005; Šumak et al., 2011). The factor influencing learners' attitudes toward immersive technology can be their interactions with other learners. This finding is in contrast to previous research highlighting limited social interaction while learning (Kuhail et al., 2022). There were several mentions of social learning that take place while users are experimenting with extended reality technology. Social learning in technology seems to yield a positive outcome when technology is novel or challenging to learn (Vélez & Gweon, 2021). This contributes to new insights into community learning when introducing new technology. However, the study has limited data demonstrating the extent of social learning when learning new technology. Future studies can be conducted to determine the extent to which social learning can be helpful, and possible discoveries can be made by educators on the optimal learning design that could accelerate learning with immersive technology.

The data also suggest that males' open attitude towards new experiences positively correlates with taking courses that utilise new technology. The results build on existing knowledge of the factors listed by Fussell & Truong (2022) and Pletz (2021) that influence the adoption of new technology in learning. However, the sample size is too small to generalise. Avenues for future studies can uncover gender differences in attitudes toward new technology experiences.

### **Factors Contributing to Learners' Engagement**

The survey findings showed that learners do take pleasure in using extended reality technology for learning purposes. The findings from the interviews indicate that this may be due to the participant's interest in the technology, the simplicity of the learning process, the convenience of gaining access to the tools, and the opportunity to collaborate with other students in the classroom. The qualitative data offered new perspectives on how learners engaged with the materials and what they thought of the tools. However, opinions on the circumstances contributing to their participation here are not unanimously agreed upon. Due to a paucity of data, the findings cannot definitively indicate which variables most significantly impact involvement. It is possible to conduct more studies to determine the aspects contributing to an individual's involvement with technology.

## Challenges

More resources are required for rolling out extended reality technology in learning. The findings imply that immersive technology in education results in a more significant requirement for extensive personnel, which is contrary to other studies. Instead of decreasing the amount of labour, there is a need for a larger workforce to assist with the facilitation and technical support of using the tool. Previous studies have concentrated on the amount of time that can be saved for instructional purposes; nevertheless, these findings reveal that other types of tasks need to be considered. Although the use of immersive technology will make it possible to minimise time spent teaching, it will also necessitate more time for facilitators to assist with the tools and more time to be spent instructing learners on how to use extended reality technology. The use of the second-generation activity theory in this investigation has made it possible to gain a comprehensive view of the necessary time resources. The sample size is restricted to specific learners in the banking and financial industry; in other sectors, learning may take place differently. Consequently, the findings cannot be extrapolated to all instances of corporate learning. Additional studies across other industries are needed to determine the amount of time and resources required from various stakeholders.

For long-term resource management and cost savings, organisations can consider investing in training programmes for educators and facilitators to become proficient with extended reality technology or to consider contracting dedicated technical support during the interim period. This would also allow the existing team to learn the technology. This further reinforces collaborative efforts to better support learners and manage lean personnel resources. Further, the provision of user-friendly extended reality content creation tools may help to reduce the time and effort required for content creation. An exploration of code-free authoring solutions can aid in the uptake and scalability of instructional design.

### *Expected Learning Curve for Extended Reality Technology*

The findings seem to indicate that there is a significant learning curve for corporate learners to traverse before they can become proficient in the use of extended reality technology. The research sheds light on the participants' perspectives on mastering the technology's most challenging aspects. To confirm whether a learner's spatial aptitude might affect the adoption of immersive technology, conducting more research with a broader population would be necessary.

To promote the adoption of extended reality, it is imperative to establish comprehensive training programmes to instruct learners. These programmes ought to progress from rudimentary extended reality principles to more intricate applications. Concurrently, it is imperative to prioritise user-friendly interfaces that facilitate effortless adaptation for learners. It is important to consistently collect user feedback to detect and resolve issues with extended reality learning materials and tools. In addition, research on the influence of spatial aptitude on extended reality adoption is required to effectively customise training methods. Combined, these measures ensure an extended reality educational experience that is more inclusive and facilitates a more seamless learning trajectory.

### *Inaccessibility of Tools*

The limited access to VR gear suggests that learners are not proficient with the technology and may struggle to obtain VR units. The cost of VR headsets and the necessity to develop mechanisms to distribute them affect scalability.

In response to the problem of instrument inaccessibility, a variety of approaches may be implemented. The implementation of virtual reality device loan programmes can facilitate learners' access by permitting them to borrow headgear. By engaging in negotiations with manufacturers of virtual reality headsets and pursuing grants, it is possible to secure discounts or subsidies, thereby reducing the cost of the technology. By investigating cloud-based extended reality solutions that are compatible with common devices like personal computers, tablets, and smartphones, the need for expensive headgear may be diminished. The implementation of communal extended reality facilities,

such as centres or laboratories, can also enable learners to employ the technology without requiring individual headgear. Moreover, the promotion of extended reality experiences that are accessible via smartphones and other widely available devices serves to augment accessibility and expand the scope of extended reality technology within the realm of education.

## **CONCLUSION**

Based on this study, extended reality technology is widely regarded as a workplace learning tool. The population sees that extended reality technology helps individuals learn faster and increase work performance. Learners can use the technology to complete activities because of the intuitive interface. The population strongly supports adopting extended reality technology for learning, scoring higher on perceived usefulness than perceived ease of use. The learners enjoy using extended reality technology because it makes learning easier. There is considerable evidence that learners will utilise technology for learning in the future and will sign up for courses that incorporate it. Overall, learners found extended reality technology beneficial.

This study found that the sense of enjoyment and ease of learning influence learners' attitudes towards extended reality technology. Similar to past research, it demonstrated an association between learners' attitudes and their desire to use technology for future learning. Factors that contributed to learners' engagement include their interactions with other learners and their open attitude towards new experiences. Future research should explore the gamification of content in immersive technology to provide the most optimal engagement. The findings of the survey showed that learners take pleasure in using extended reality technology for learning purposes due to the simplicity of the learning process, the convenience of gaining access to the tools, and the opportunity to collaborate with other students.

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## **CONFLICT OF INTEREST**

The authors of this publication declare there is no conflict of interest.

## REFERENCES

- Abd Majid, F., & Mohd Shamsudin, N. (2019). Identifying factors affecting acceptance of virtual reality in classrooms based on the Technology Acceptance Model (TAM). *Asian Journal of University Education*, 15(2), 52–60. doi:10.24191/ajue.v15i2.7556
- Al Janabi, H. F., Aydin, A., Palaneer, S., Macchione, N., Al-Jabir, A., Khan, M. S., Dasgupta, P., & Ahmed, K. (2020). Effectiveness of the HoloLens mixed-reality headset in minimally invasive surgery: A simulation-based feasibility study. *Surgical Endoscopy*, 34(3), 1143–1149. doi:10.1007/s00464-019-06862-3 PMID:31214807
- Alalwan, N., Cheng, L., Al-Samarraie, H., Yousef, R., Ibrahim Alzahrani, A., & Sarsam, S. M. (2020). Challenges and prospects of virtual reality and augmented reality utilization among primary school teachers: A developing country perspective. *Studies in Educational Evaluation*, 66, 100876. doi:10.1016/j.stueduc.2020.100876
- Alfadda, H. A., & Mahdi, H. S. (2021). Measuring students' use of Zoom application in language course based on the technology acceptance model (TAM). *Journal of Psycholinguistic Research*, 50(4), 883–900. doi:10.1007/s10936-020-09752-1 PMID:33398606
- Alfalah, S. F. M. (2018). Perceptions toward adopting virtual reality as a teaching aid in information technology. *Education and Information Technologies*, 23(6), 2633–2653. doi:10.1007/s10639-018-9734-2
- Almarzooq, Z. I., Lopes, M., & Kochar, A. (2020). Virtual learning during the COVID-19 pandemic: A disruptive technology in graduate medical education. *Journal of the American College of Cardiology*, 75(20), 2635–2638. doi:10.1016/j.jacc.2020.04.015 PMID:32304797
- Baguma, R., Bagarukayo, E., Namubiru, P., Brown, C., & Mayisela, T. (2019). Using WhatsApp in teaching to develop higher order thinking skills - A literature review using the activity theory lens. [IJEDICT]. *International Journal of Education and Development Using Information and Communication Technology*, 15(2), 98–116.
- Barhoumi, C. (2020). The effectiveness of WhatsApp mobile learning activities guided by activity theory on students' edKnowledge management. *Contemporary Educational Technology*, 6(3), 221–238. doi:10.30935/cedtech/6151
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. doi:10.1191/1478088706qp063oa
- Collis, B., & Margaryan, A. (2004). Applying activity theory to computer-supported collaborative learning and work-based activities in corporate settings. *Educational Technology Research and Development*, 52(4), 38–52. doi:10.1007/BF02504717
- Craig, C. M., Stafford, J., Egorova, A., McCabe, C., & Matthews, M. (2022). Can we use the Oculus Quest VR headset and controllers to reliably assess balance stability? *Diagnostics (Basel)*, 12(6), 1409. doi:10.3390/diagnostics12061409 PMID:35741219
- Crawford, K. & Hasan, H. M. (2006). *Demonstrations of the Activity Theory Framework for Research in IS Recommended Citation*.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *Management Information Systems Quarterly*, 13(3), 319–340. doi:10.2307/249008
- Donnelly, R., & Johns, J. (2021). Recontextualising remote working and its HRM in the digital economy: An integrated framework for theory and practice. *International Journal of Human Resource Management*, 32(1), 84–105. doi:10.1080/09585192.2020.1737834
- Engestrom, Y. (1999). Innovative learning in work teams: Analysing cycles of knowledge creation in work teams. In Y. Engestrom, R. Miettinen, & R. Punamaki (Eds.), *Perspectives on Activity Theory*. Cambridge University Press. doi:10.1017/CBO9780511812774.025
- Fussell, S. G., & Truong, D. (2022). Using virtual reality for dynamic learning: An extended technology acceptance model. *Virtual Reality (Waltham Cross)*, 26(1), 249–267. doi:10.1007/s10055-021-00554-x PMID:34276237
- Gedera, D. S. P. (2014). Students' experiences of learning in a virtual classroom: An activity theory perspective. [IJEDICT]. *International Journal of Education and Development Using Information and Communication Technology*, 10(4), 93–101. <https://www.learntechlib.org/p/150708/>

- Giri, G. S., Maddahi, Y., & Zareinia, K. (2021). An application-based review of haptics technology. *Robotics (Basel, Switzerland)*, 10(1), 29. doi:10.3390/robotics10010029
- Granić, A., & Marangunić, N. (2019). Technology acceptance model in educational context: A systematic literature review. *British Journal of Educational Technology*, 50(5), 2572–2593. doi:10.1111/bjet.12864
- Gsaxner, C., Li, J., Pepe, A., Jin, Y., Kleesiek, J., Schmalstieg, D., & Egger, J. (2023). The HoloLens in medicine: A systematic review and taxonomy. *Medical Image Analysis*, 85, 102757–102757. doi:10.1016/j.media.2023.102757 PMID:36706637
- Holen, J. B., Hung, W., & Gourneau, B. (2017). Does one-to-one technology really work: An evaluation through the lens of activity theory. *Computers in the Schools*, 34(1–2), 24–44. doi:10.1080/07380569.2017.1281698
- Hunter, P. (2019). Remote working in research: An increasing usage of flexible work arrangements can improve productivity and creativity. *EMBO Reports*, 20(1), e47435. doi:10.15252/embr.201847435 PMID:30530631
- Illinois Institute of Technology. (2018). Virtual Reality In Industry.
- Issroff, K., & Scanlon, E. (2002). Using technology in higher education: An activity theory perspective. *Journal of Computer Assisted Learning*, 18(1), 77–83. doi:10.1046/j.0266-4909.2001.00213.x
- Jitpaisarnwattana, N., Darasawang, P., & Reinders, H. (2022). Understanding affordances and limitations in a language MOOC from an activity theory perspective. *Research and Practice in Technology Enhanced Learning*, 17(1), 9. doi:10.1186/s41039-022-00186-y
- Jonassen, D. H. (2002). Learning as activity. *Educational Technology*, 42(2), 45–51. <https://www.jstor.org/stable/44428736>
- Kesharwani, A. (2020). Do (how) digital natives adopt a new technology differently than digital immigrants? A longitudinal study. *Information & Management*, 57(2), 103170. doi:10.1016/j.im.2019.103170
- Khayyat, M. (2016, December). *A proposed model for the fourth generation of activity theory to be applied on the smart city research arena* [Conference paper]. Thirty Seventh International Conference on Information Systems, Dublin, Ireland. [https://www.researchgate.net/profile/Mashael\\_Khayyat/publication/311677620\\_A\\_proposed\\_model\\_for\\_the\\_fourth\\_generation\\_of\\_Activity\\_Theory\\_to\\_be\\_applied\\_on\\_the\\_Smart\\_City\\_Research\\_Arena/links/5853ef3108ae95fd8e1ff46b/A-proposed-model-for-the-fourth-generati](https://www.researchgate.net/profile/Mashael_Khayyat/publication/311677620_A_proposed_model_for_the_fourth_generation_of_Activity_Theory_to_be_applied_on_the_Smart_City_Research_Arena/links/5853ef3108ae95fd8e1ff46b/A-proposed-model-for-the-fourth-generati)
- Kuhail, M. A., Elsayary, A., Farooq, S., & Alghamdi, A. (2022). Exploring immersive learning experiences: A survey. *Informatics (MDPI)*, 9(4), 75. doi:10.3390/informatics9040075
- Kuutti, K. (2019). *Activity theory as a potential framework for human-computer interaction Research*. Context and Consciousness. doi:10.7551/mitpress/2137.003.0006
- Lai, P. (2017). The literature review of technology adoption models and theories for the novelty technology. *Journal of Information Systems and Technology Management*, 14(1), 21–38. doi:10.4301/S1807-17752017000100002
- Langemeyer, I., & Roth, W.-M. (2006). Is cultural-historical activity theory threatened to fall short of its own principles and possibilities as a dialectical social science? *Outlines. Critical Practice Studies*, 8(2), 20–42. doi:10.7146/ocps.v8i2.2090
- Lawrence, G., & Ahmed, F. (2018). Pedagogical insights into hyper-immersive virtual world language learning environments. [IJCALLT]. *International Journal of Computer-Assisted Language Learning and Teaching*, 8(1), 1–14. doi:10.4018/IJCALLT.2018010101
- Lee, H. T. (2021). *Extending the technology acceptance model (TAM) to understand the perceived security and trust of users ' acceptance towards cryptocurrencies*. NIH.
- Lee, J., Kim, J., & Choi, J. Y. (2019). The adoption of virtual reality devices: The technology acceptance model integrating enjoyment, social interaction, and strength of the social ties. *Telematics and Informatics*, 39, 37–48. doi:10.1016/j.tele.2018.12.006
- Liaw, S. S., Hatala, M., & Huang, H. M. (2010). Investigating acceptance toward mobile learning to assist individual knowledge management: Based on activity theory approach. *Computers & Education*, 54(2), 446–454. doi:10.1016/j.compedu.2009.08.029

- Liaw, S. S., & Huang, H. M. (2016). Investigating learner attitudes toward e-books as learning tools: Based on the activity theory approach. *Interactive Learning Environments*, 24(3), 625–643. doi:10.1080/10494820.2014.915416
- Lim, C. P., & Hang, D. (2003). An activity theory approach to research of ICT integration in Singapore schools. *Computers & Education*, 41(1), 49–63. doi:10.1016/S0360-1315(03)00015-0
- Marikyan. (2022). *Technology acceptance model (TAM): How to cite technology acceptance model: A review introduction*. TheoryHub. <http://open.ncl.ac.uk>
- Mukhtar, K., Javed, K., Arooj, M., & Sethi, A. (2020). Advantages, limitations, and recommendations for online learning during COVID-19 pandemic era. *Pakistan Journal of Medical Sciences*, 36(COVID19-S4), S27–S31. doi:10.12669/pjms.36.COVID19-S4.2785 PMID:32582310
- Nardi, B. A. (1996). Activity theory and human-computer interaction. *Context and Consciousness: Activity Theory and Human-Computer Interaction*, 436, 7–16.
- Park, Y., & Jo, I. H. (2017). Using log variables in a learning management system to evaluate learning activity using the lens of activity theory. *Assessment & Evaluation in Higher Education*, 42(4), 531–547. doi:10.1080/02602938.2016.1158236
- Pletz, C. (2021). Which factors promote and inhibit the technology acceptance of immersive virtual reality technology in teaching-learning contexts? Results of an expert survey. *International Journal of Emerging Technologies in Learning*, 16(13), 248–272. doi:10.3991/ijet.v16i13.20521
- Powell, A. (2021). When pigs do fly: An uplifting experience. *Architectural Design*, 91(6), 38–45. doi:10.1002/ad.2751
- Rigopoulos, G., Psarras, J., & Askounis, D. (2008). A TAM model to evaluate user's attitudes towards the adoption of decision support systems. *Journal of Applied Sciences*, 8(5), 899–902. doi:10.3923/jas.2008.899.902
- Saadé, R., & Bahli, B. (2005). The impact of cognitive absorption on perceived usefulness and perceived ease of use in online learning: An extension of the technology acceptance model. *Information & Management*, 42(2), 317–327. doi:10.1016/j.im.2003.12.013
- Sailer, M., & Homner, L. (2020). The gamification of learning: A meta-analysis. *Educational Psychology Review*, 32(1), 77–112. doi:10.1007/s10648-019-09498-w
- Sam, C. (2012). Activity theory and qualitative research in digital domains. *Theory into Practice*, 51(2), 83–90. doi:10.1080/00405841.2012.662856
- Šumak, B., Heričko, M., Pušnik, M., & Polančič, G. (2011). Factors affecting acceptance and use of Moodle: An empirical study based on TAM. *Informatica (Ljubljana)*, 35(1), 91–100.
- Sural, I. (2018). Augmented reality experience: Initial perceptions of higher education students. *International Journal of Instruction*, 11(4), 565–576. doi:10.12973/iji.2018.11435a
- Thomas, M., & Schneider, C. (2018). Language teaching in 3D virtual worlds with machinima: Reflecting on an online machinima teacher training course. [IJCALLT]. *International Journal of Computer-Assisted Language Learning and Teaching*, 8(2), 20–38. doi:10.4018/IJCALLT.2018040102
- Vallade, J. I., Kaufmann, R., Frisby, B. N., & Martin, J. C. (2020). Technology acceptance model: Investigating students' intentions toward adoption of immersive 360° videos for public speaking rehearsals. *Communication Education*, 1–19. doi:10.1080/03634523.2020.1791351
- Van De Bogart, W., & Wichadee, S. (2015). Exploring students' intention to use LINE for academic purposes based on technology acceptance model. *International Review of Research in Open and Distance Learning*, 16(3), 65. <https://www.erudit.org/en/journals/irrodl/1900-v1-n1-irrodl04980/1065974ar/abstract/>. doi:10.19173/irrodl.v16i3.1894
- Van Roy, V., Vértessy, D., & Vivarelli, M. (2018). Technology and employment: Mass unemployment or job creation? Empirical evidence from European patenting firms. *Research Policy*, 47(9), 1762–1776. doi:10.1016/j.respol.2018.06.008

- Vélez, N., & Gweon, H. (2021). Learning from other minds: An optimistic critique of reinforcement learning models of social learning. *Current Opinion in Behavioral Sciences*, 38, 110–115. doi.org/10.1016/j.cobeha.2021.01.006. doi:10.1016/j.cobeha.2021.01.006 PMID:35321420
- Vigliarolo, B. (2020). *91% of businesses already using or planning to adopt AR or VR technology*. TechRepublic. <https://www.techrepublic.com/article/91-of-businesses-already-using-or-planning-to-adopt-ar-or-vr-technology/>
- Wan, A. T., Sun, L. Y., & Omar, M. S. (2018). Augmented reality technology for year 10 chemistry class: Can the students learn better? *International Journal of Computer-Assisted Language Learning and Teaching*, 8(4), 45–64. doi:10.4018/IJCALLT.2018100104
- Wang, F., Qian, Z., Lin, Y., & Zhang, W. (2021). Design and rapid construction of a cost-effective virtual haptic device. *IEEE/ASME Transactions on Mechatronics*, 26(1), 66–77. doi:10.1109/TMECH.2020.3001205
- Wu, J. G., Miller, L., Huang, Q., & Wang, M. (2021). Learning with immersive virtual reality: An exploratory study of Chinese college nursing students. *RELC Journal*, 00336882211044860. doi:10.1177/00336882211044860
- Wu, J. G., Zhang, D., & Lee, S. M. (2023). Into the brave new metaverse: Envisaging future language teaching and learning. *IEEE Transactions on Learning Technologies*, 1–11. doi:10.1109/TLT.2023.3259470
- Zainuddin, Z., Chu, S. K. W., Shujahat, M., & Perera, C. J. (2020). The impact of gamification on learning and instruction: A systematic review of empirical evidence. *Educational Research Review*, 30, 100326. doi.org/10.1016/j.edurev.2020.100326. doi:10.1016/j.edurev.2020.100326
- Zhang, Y. & Wildemuth, B. M. (2009). Unstructured interviews. *Applications of Social Research Methods to Questions in Information and Library Science*, 222–231.



APPENDIX A

Instrument - TAM Questionnaire

Figure 2.

## Corporate learners’ perceptions towards extended reality technology as a learning aid in the workplace

This is an invitation to take part in a research study about how learners view the use of virtual reality/ augmented reality in workplace learning. This information is designed to tell you what it will involve.

Please see the following documents in the email sent to you before proceeding with this survey:

- 1) Ethics Approval Form
- 2) Information Sheet and Consent Form

By submitting the form, you have consent to be part of this study and allow the use of the information for the purpose of this research.

Figure 3.

### Demographic Information

Gender \*

☐ Male

☐ Female

Age \*

Choose ▾

Have you ever used extended reality technology before attending this course (in any settings; not limited to learning)? \*

☐ Yes

☐ No

Figure 4.

**Technology Acceptance Model Questionnaire**

Instructions:

Choose the option that best represents your opinion on the use of extended reality technology in the course that you have attended.

Definition:

Extended Reality Technology – refers to Augmented Reality and/or Virtual Reality activities embedded in the course.

Figure 5.

**Perceived Usefulness**

Using extended reality technology in learning enables me to attain the learning outcome more quickly.

	1	2	3	4	5	6	7	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

Using extended reality technology in learning would improve my job performance. \*

	1	2	3	4	5	6	7	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

Using extended reality technology in learning would increase my productivity. \*

	1	2	3	4	5	6	7	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

Using extended reality technology in learning would enhance my effectiveness on the job. \*

	1	2	3	4	5	6	7	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

Figure 6.

Using extended reality technology would make it easier to learn the items relating to the job. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

I would find extended reality technology useful in learning. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

Figure 7.

**Perceived Ease of Use**

Learning to use extended reality technology would be easy for me. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

I would find the easy-to-get extended reality technology to do what I want it to do. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

## APPENDIX B

### Instrument – Interview Questions

#### 1) Assessing Subject – Learner

- Do you have prior experience before the course? What are those experiences like?
- Do you find the technology easy to pick up?
- What do you think might be a possible challenge to learn to pick up the technology?
- Do you think it is useful in learning? How so?

Figure 8.

My interaction with extended reality technology would be clear and understandable. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

I would find extended reality technology to be flexible to interact with. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

It would be easy for me to become skillful at using extended reality technology. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

I would find extended reality technology easy to use. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

- What do you like/dislike about this?
  - Do you think that age matters in adoption?
- 2) Assessing Rules - Course sign-up / registration requirements. Instructions regarding accessing the tools.
- Is it easy for you to sign up for this course?
  - Was the instruction clear?
  - Are there any challenges that you have encountered during sign-up / guidelines?
- 3) Assessing Tools – Tools and environment when accessing E-learning Courseware with embedded VR interactions / AR mobile Applications.
- Do you have the necessary tools (i.e. iPads, smartphones, headsets) to access the contents?
  - Is the environment conducive to such learning?
  - Do you encounter challenges in accessing the content?
- 4) Assessing Community– Other students/facilitators

Figure 9.

**Attitude Towards Usage**

I think extended reality technology makes learning easier. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

I have a generally favorable attitude towards using extended reality technology. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

Using extended reality technology brings a lot of enjoyment in learning. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

- How was your interaction with fellow colleagues and peers when using this tool?
  - Do you think others will find it useful?
- 5) Assessing Division of Labour
- Was it easy to navigate the learning task?
  - What are the tasks that were allocated to different parties (i.e. trainers/administrators/ learners)?
- 6) Assessing object
- Do you find it engaging?
  - Does it helps you in learning? How so?

Figure 10.

**Intention to Use**

I think that using extended reality technology in learning is a good idea. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

I intend to use extended reality technology for learning in the future. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

I intend to sign up for courses that uses extended reality technology. \*

1 2 3 4 5 6 7

Strongly Disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ Strongly Agree

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