Teacher Perspectives on Challenges and Opportunities for Immersive Virtual Reality Learning Integration in Australian Schools

Erica Southgate
University of Newcastle

Paul Unsworth
Adelaide University

Matt Bower
Macquarie University

James Birt
Bond University

Dara Tafazoli
University of Newcastle

Michael A. Cowling
RMIT University

Abstract
The impact of using immersive virtual reality (iVR) technologies is well known across the recreational gaming, training, and healthcare sectors. However, iVR's trajectory into education, especially across schooling contexts, is less known and at an early adoption phase. Only a few studies have deeply interrogated the teacher perspective on the benefits of iVR or how it is positioned pedagogically alongside curriculum as a powerful digital learning technology. This article reports on an exploratory descriptive survey of 66 Australian school teachers, two-thirds of whom had experience using iVR in classroom. The survey combined closed- and open-ended questions to elicit teachers' demographic and professional profiles, technical choices, pedagogical applications, perceived benefits, barriers to use, and professional learning needs. Descriptive statistics and thematic analysis were used to compare the perspectives of iVR users and non-users. Findings reveal that early adopters demonstrated innovative pedagogical applications and a strong emphasis on student engagement, while non-users cited cost, access, and curriculum alignment as key barriers. The study provides valuable insights into the enablers and constraints of iVR integration and contributes evidence to inform professional learning, policy development, and scaling strategies in Australian schools.

Keywords: Australian schools, educational technology adoption, immersive virtual reality (iVR), K-12 education, pedagogical integration, professional learning, teacher perspectives

Southgate , E., Unsworth, P., Bower , M., Birt , J., Tafazoli, D., & Cowling , M. A. (2026). Teacher Perspectives on Challenges and Opportunities for Immersive Virtual Reality Learning Integration in Australian Schools. *Online Learning*, *30*(3), 1–23. https://doi.org/10.24059/olj.v30i3.5154

Over many decades, considerable research has sought to understand the adoption of new digital technologies in different educational contexts (Abdelazim et al., 2025; Aldunate et al., 2013; Granić, 2022; Straub, 2009). Several influential theoretical models have been developed to explain adoption patterns, including the Innovation Diffusion Theory (IDT; Rogers, 2003), the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2003), and the Technology Acceptance Model (TAM; Davis, 1989). These frameworks remain central to understanding why some educators adopt innovations earlier than others and the conditions under which new technologies are integrated into schools.

IDT suggests that the newness of a technology creates uncertainty for users who seek out examples of effective practice to inform their evaluations (Rogers, 2003). The model posits five adopter categories (i.e., innovators, early adopters, early majority, late majority, and laggards) based on their willingness to engage with an innovation (Rogers, 2003). Early adopters play a particularly important role in education, as they act as opinion leaders and demonstrate how technologies can be pedagogically embedded, thereby influencing wider uptake across schools. TAM and UTAUT/UTAUT2 complement IDT by focusing on the psychological and contextual factors shaping adoption, including perceived usefulness, ease of use, social influence, facilitating conditions, and behavioural intentions. These models have been widely applied in educational technology research to understand the diffusion of innovations such as mobile learning, learning management systems, and more recently, virtual reality (VR) (Açıkgül & Şad, 2020; Geriş & Kulaksız, 2025).

Immersive virtual reality (iVR)—VR mediated by a headset (Slater & Sanchez-Vives, 2016)—has a well-established history of use in training within aviation, defence, mining, construction, and healthcare (Fu et al., 2022; Scorgie et al., 2024). There is growing investment in immersive technologies, with the augmented reality (AR) and VR market projected to be US$50.9bn in 2026 (Statistica, n.d.). While the history of training applications of iVR is relatively well understood, its use in schools sits within an early emergence phase (Southgate, 2023; Schott et al., 2024). As such, theoretical perspectives such as IDT and UTAUT are particularly useful for interpreting the role of early adopter teachers in shaping future directions for classroom integration.

This research invited Australian teachers to share their perspectives on iVR for teaching and learning purposes. Framed as an exploratory descriptive study, its intentions were to (a) investigate the technical choices, pedagogical applications, and experiences of teachers who have used iVR in their classrooms at this phase of early innovation diffusion; (b) compare the perspectives of teachers who have used iVR with those who have not; and (c) explore the implications for scaled adoption of the technology in Australian schools, based on teacher's perspectives. The study contributes to our understanding of the pedagogical integration of iVR in Australian schools, the experiences of early adopter teachers, the professional learning needs of teachers regarding the technology, and insights into scaling up the technology.

Literature Review

VR refers to a 3D computer-generated environment that can be experienced on a computer or mobile device screen, in a CAVE (Cave Automatic Virtual Environment, a room that surrounds the user with projection screens), or through a head-mounted display (HMD), commonly called a VR headset. The term iVR denotes VR mediated through an HMD (Slater & Sanchez-Vives, 2016). HMDs block out stimuli from physical surroundings, immersing users in virtual environments characterised by content stability, persistence, dimensionality,

embodiment, interactivity, and shared or social experiences (Rauschnabel et. al., 2022). Simulated virtual environments can be hyper-realistic or highly imaginative 3D representations and simulations (Grau, 2004).

The attraction to iVR as an educative tool derives from its possibilities to enhance learner sensory experience and sense-making while immersed in virtual 3D worlds (Di Natale et al., 2020). VR offers a set of unique learning affordances that can enhance children's cognition and learning by providing safe experimentation, real-time interactive solo and shared simulations of contemporary places and historical experiences, visualisation of 3D virtual objects for the development of spatial reasoning, representation of abstract concepts, and active learning through constructive creation (Conrad et al., 2024; Dalgarno & Lee, 2010; Pellas et al., 2021). Maas and Hughes (2020) contend that VR games, simulations, and virtual worlds can increase school student's engagement by enhancing curiosity, attention, motivation, interest, and enjoyment. Furthermore, a recent systematic review found that gamified VR is an effective educational tool across all educational levels and subject areas (Lampropoulos & Kinshuk, 2024). Research has also illustrated how school student-created iVR content can stimulate critical and creative thinking through increased collaboration (Liu et al., 2025; Southgate, 2020). For Indigenous students, iVR provides imaginative opportunities to draw on cultural funds of knowledge for authentic learning experiences (MacGill & Unsworth, 2022). A recent report produced by the Immersive Learning Research Network (iLRN) contends that the progressive uptake of immersive technologies in education will play a major role in shaping how educators apply digital learning technologies such as iVR in learning designs aligned to pedagogies that promote authentic learning, creativity, collaboration, and expression (Lee et al., 2020).

However, due to the relatively recent commercial availability of the technology, research on secondary teachers and iVR across national contexts remains in its early stages. A recent study of 137 Belgian teachers who had not used iVR, aimed at identifying factors contributing to their behavioural intention to use the technology, found that while teachers expected iVR to enhance teaching practice, they indicated the need for technical, practical, and pedagogical support (Boel et al., 2023). The importance of teacher support and professional development has been indicated in prior research (see Mystakidis & Christopoulos, 2022). A survey by Khukalenko et al. (2022) of 20,876 Russian educators (representing 7% of the total teacher population) revealed moderately positive perceptions of iVR, with educators in the early stages of integration emphasising the need for professional development and increased technical support.

Further, research points to a range of privacy and safety issues associated with iVR use, especially for children (OECD, 2024; Southgate et al., 2026). Steele et al. (2020) explored U.S. educators' perspectives on the ethical use of iVR applications and the measures they take to protect students' health and safety during VR use. Their study highlighted key concerns, including emotional and psychological safety, social aspects such as personal identity protection, potential physical risks posed by VR headsets, ethical considerations in designing VR scenarios, and the responsibility of teachers to monitor and ensure student well-being. Stranger-Johannessen and Fjørtoft (2021), who collected data from Norwegian teachers identified as early adopters of iVR, underscored the pivotal role of teachers' initiative and confidence with technology in determining the success of integration. Finally, in a systematic review of educational technology adoption, Granić (2022, p. 9739) highlighted the need for more research on "cost-effective/pennyworth" factors related to better understand the most efficient solutions for deploying VR and AR within educational

context with relatively limited budgets. These findings align with theoretical models of adoption such as the IDT (Rogers, 2003) and the UTAUT (Venkatesh et al., 2003), which emphasise the importance of perceived benefits, facilitating conditions, and the leadership of early adopters in shaping diffusion trajectories.

Overall, studies conducted with teachers underscore the early stage of iVR implementation in classrooms and the complexities that early adopters face in negotiating the intricate relationship between technological, ethical, pedagogical, content, and curriculum knowledge required for effective classroom integration. Furthermore, there is a growing need to focus on metacognitive development and fostering creative student output rather than encouraging passive content consumption (Southgate, 2020, 2023; Wei et al., 2025). While research in this area is emerging, there is a relative paucity of detailed classroom use cases. Beck et al. (2023) argue that more research should focus on the actual practices of instructors deploying the technology, a sentiment echoed in a recent OECD (2024) report. Despite these insights, little is known about how teachers who have adopted iVR compare to those who have not, particularly within the Australian K-12 system. The research reported in this paper sought to address the gaps in knowledge about educator practice and professional learning needs with a view to understanding enablers and barriers to scaling up the use of iVR in schools.

Research Design

This research was an exploratory descriptive study. Following Stebbins (2001), an exploratory approach was taken due to the relative lack of research on the phenomenon, in this case, the teachers' perspectives on using iVR in Australian schools. The study was guided by the following research questions:

RQ1. What are the technical choices, pedagogical applications, and experiences of early adopter teachers who have used iVR in their classrooms?

RQ2. How do the perspectives of teachers who use iVR compare to teachers who do not, with respect to rationale, benefits, issues, and professional learning needs?

RQ3. What are the implications of teacher perspectives for scaling up the technology in Australian schools?

Instrument, Recruitment and Ethics

A survey, comprising closed- and open-ended questions, was developed to elicit the experiences and perspectives of Australian teachers who had used iVR in their classrooms (iVR teachers) compared to those who had not used the technology (non-iVR teachers). The survey was based on the Unified Theory of the Acceptance and Use of Technology 2 (UTAUT2) model (Venkatesh et al., 2012), which has previously been applied to pre-service teacher intentions to use iVR in their classes (Bower et al., 2020). The UTAUT2 model includes dimensions relating to performance expectancy, effort expectancy, social influence, facilitating conditions, hedonistic motivation, price value, habit, and behavioural intention. Because of survey length considerations, we included one refined Likert item per dimension, contextualised for practicing teachers. For example, social influence was measured with the item: "I'm influenced by others to use iVR in my classes." While this approach precluded the use of internal reliability testing, the constructs themselves have demonstrated consistent validity in multiple prior studies, including those in VR contexts.

The first section of the anonymous survey comprised questions on demographics (gender identity, age, level of education) and professional background (teaching specialisation, sector, postcode of school or early childhood centre, and current role), and whether teachers had used iVR in their teaching. In the second section of the survey, teachers who had used iVR were asked Likert scale items relating to the UTAUT2 model. Cognisant of the time it would take participants to complete the closed- and open-ended survey questions that followed, only one Likert scale item was used for each of the eight UTAUT2 dimensions investigated, hence construct reliability measures were not applied. However, the UTAUT2 instrument has been validated in numerous educational technology contexts, including for virtual reality, with acceptable to good levels of instrument validity and model fit (Açıkgül & Şad, 2020; Bower et al, 2020; Geriş & Kulaksız, 2025). Teachers who had used iVR were also asked to respond to questions about how they had used iVR in their classes, including the products used, pedagogical applications, learner year level, and reasons for using iVR, along with its perceived benefits and concerns. They were also invited to provide advice for teachers interested in adopting iVR. Non-iVR teachers were asked about their reasons for not using iVR, concerns about the technology, perceived benefits, and enablers for its use, and what they would like to learn about iVR for learning.

Inclusion criteria for the survey were: (1) currently teaching in an Australian early childhood centre, primary or secondary school, or a vocational institution catering to school-aged students; and (2) having either used or not used iVR in the classrooms. Recruitment occurred via social media platforms, including Twitter (now X), LinkedIn, and teacher professional learning Facebook groups. A poster and video containing a QR code link to the survey were posted to these sites by the researchers. The survey was open for completion between 14th of October 2022, and 21st April 2023. The study was approved by the University of Newcastle Human Research Ethics Committee (HREC) (Number H-2022-0307) and subsequently approved by the HRECs of the institutions of other authors.

Participants

Sixty-six teachers participated in the survey, with two-thirds (n=44) having used iVR in their classrooms (the iVR group) and one-third (n=22) being non-iVR users. Across both groups, female teachers made up the largest proportion of respondents. A significant percentage had been teaching for more than 10 years and held postgraduate qualifications, with in the majority serving as classroom teachers. Most were secondary school teachers, while early childhood educators were not well represented—unsurprising, given the safety concerns related to using the technology with young children. Table 1 provides a demographic and professional profile of participants. While the number of participants is below the conventional threshold typically sought for survey research and therefore limits the representativeness and generalisability of the findings, the dataset nevertheless provides important insights into opportunities and constraints identified by teachers who are at the forefront of iVR adoption. These exploratory findings help to characterise the pulse of the iVR movement in Australian schools at this early stage.

Table 1

Demographic and Professional Characteristics of Participants

Demographics and professional profile	iVR group		Non-iVR group	
	n	%	*n*	%

Gender				
Female	25	56.8	17	77.3
Male	17	38.6	4	18.2
Non-binary	1	2.3	1	4.5
Prefer to self-describe	1	2.3	0	0
Age [a]				
25 - 29	0	0	2	9.1
30 - 39	10	22.7	2	9
40 - 49	8	18.2	7	31.8
50 - 59	14	31.8	6	27.2
60+	3	6.8	1	4.5
Highest level of Education				
Bachelor's degree	15	34.1	5	22.7
Graduate diploma/certificate	6	13.6	2	9.1
Postgraduate degree	18	40.9	14	63.6
Other	5	11.4	1	4.5
Teaching level of education				
Primary	4	9.1	11	50
Secondary	36	81.8	11	50
Other	4	9.1	0	0
Years of teaching				
0 - 4	2	4.5	4	18.2
5 - 9	6	13.6	5	22.7
10 - 14	6	13.6	3	13.6
15 - 19	5	11.4	2	9.1
20 - 24	10	22.7	2	9.1
25 + years	15	34.1	6	27.2
School sector				
Early childhood centre (public or private)	0	0	1	4.5
Public/government school	17	38.6	11	50
Catholic school	2	4.5	7	31.8
Independent school	20	45.5	3	13.6
Job role				
Classroom teacher	14	31.8	14	63.6
Head of Department	11	25	2	9.1
ICT integration / digital learning leader	9	20.5	4	18.2

Principal / deputy principal	1	2.3	0	0
Other	9	20.5	2	9.1

[a] Reflects the number and percentage of participants answering the age question with missing data for 9 (21%) of iVR group and 4 (18%) of non-iVR group.

Data Analysis

Researchers utilised both quantitative and qualitative analysis. The researchers employed SPSS 28 to conduct descriptive statistics of the quantitative variables, which involved calculating the frequency and percentage of these variables. The researchers conducted this analysis separately for iVR teachers and non-iVR teachers to provide a comparison of their perspectives. Qualitative thematic analysis was conducted through NVivo 14. To begin, two investigators familiarised themselves with the qualitative data by reading all participant responses to gain a comprehensive understanding of the range of perspectives and experiences expressed by both iVR and non-iVR teachers. Next, two investigators engaged in open, axial, and selective coding processes (Williams & Moser, 2019) to identify, label, and synthesise codes reflecting recurring patterns, concepts, and themes within the dataset. Participant numbers reflecting key themes were counted and are reported, for ease of reading, in rounded percentages with illustrative quotations where appropriate.

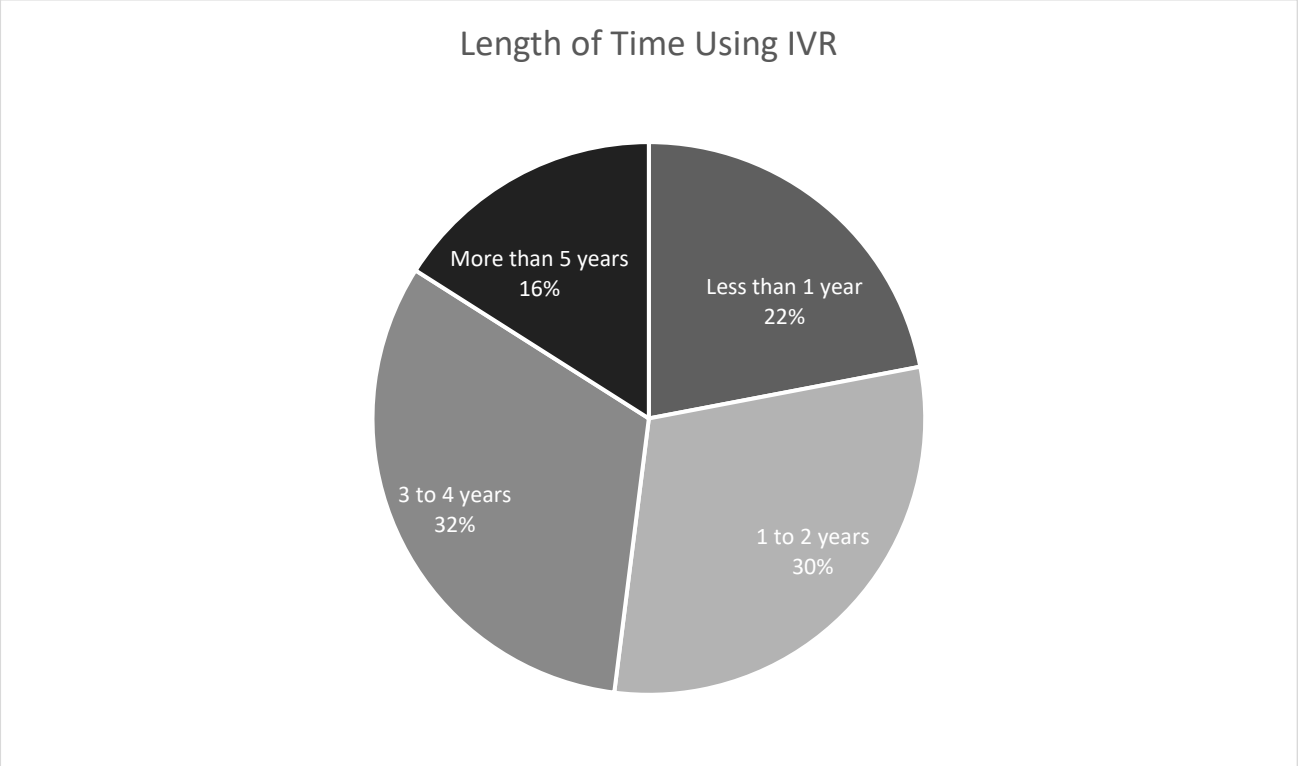
Findings

RQ 1: What are the technical choices, pedagogical applications, and experiences of early adopter teachers who have used iVR in their classrooms?

The length of time that iVR teachers had used the technology in classrooms varied, with almost half having more than 3 years of experience (Figure 1). Forty-one teachers who had used iVR in their classrooms responded to the question, “What iVR hardware and apps have you used or facilitated the use of in the classroom?” From their responses, we categorised headsets according to their potential for three degrees of freedom (3DoF) and/or six degrees of freedom (6DoF). DoF refers to degrees of interaction and navigation or how much a user can move in an immersive 3D environment, enabled by the bodily positional tracking systems built into the VR hardware. Generally, 3DoF provides less interactivity than 6DoF. There was considerable variation in the types of headsets used by teachers (Figure 2), with around 41% having used 6DoF headsets, which are generally more expensive.

Figure 1

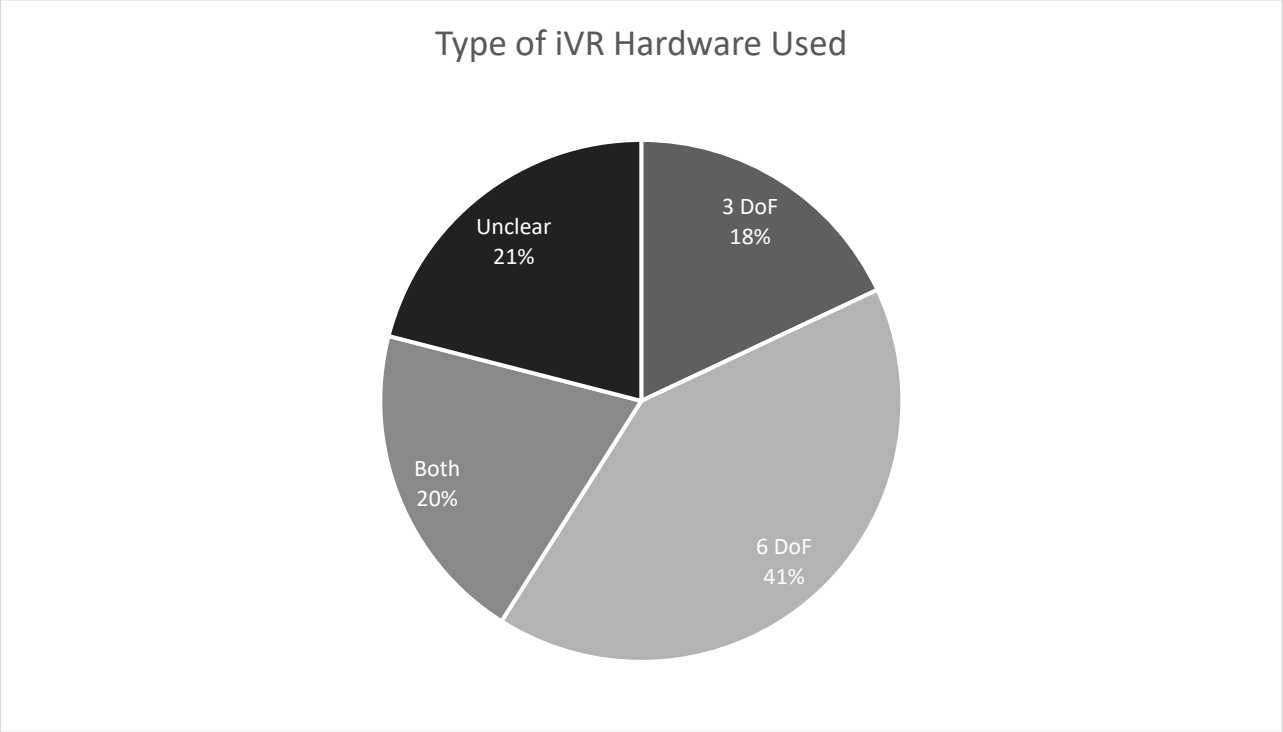
Length of Time Using iVR



Of those who had used 3DoF, most mentioned using smartphones inserted into a VR headset. Of the 6DOF headsets used, 20 respondents specified Meta headsets, eight used HTC headsets, while other headsets were PICO (n=2), HP (n=2), and Lenovo (n=1). One participant mentioned using a CAVE, and one stated they had used a 360-degree camera to produce content. Two participants described going on an excursion to a commercial VR lab, and another described an incursion from a VR company. A range of applications were mentioned, including National Geographic, Space Station, Human Anatomy, and Anne Frank House experiences; CoSpaces; Tilt Brush; Google Earth and Expeditions; and 360-degree videos. One participant mentioned using a game engine to develop content.

Figure 2

Type of iVR Hardware Used



As shown in Table 2, iVR teachers reported an array of pedagogical applications. These included virtual tours and excursions (37%), students as VR content creators (28%), using VR experiences as a stimulus or extension to a lesson (12%), simulation learning (12%), and fostering empathetic learning (9%). It was reasonably common for students to use VR applications to create content that demonstrated their learning (28%). Additionally, iVR was used for research (3%), collaboration (7%), and demonstrations (5%). The technology had been used across various subject areas, including STEM (30%), geography, history, civics and citizenship (21%), media, English, and creative studies (14%), language learning (5%), physical education (5%), and as an extra-curricular activity (7%). Table 2 presents illustrative teacher quotations that demonstrate these pedagogical uses.

Table 2

Teacher Examples of Pedagogical Uses VR

Pedagogical use	Participant quotation
Virtual tours/excursions	"I used it to show some tours of Spain and also the reef environment." "(Used it) for visiting cities overseas and looking at the ancient world."
Stimulus and extension to a lesson	"In English classes using VR panoramas as story starters. Using 360cities as a way to take students to places in novels that students find it hard to relate to then using the experience to improve contextual understanding of the writing craft…"
Simulation	"Had students complete a spacewalk." "Use it for science simulations where expensive equipment is not found in (the) college." "(Use) mechanic/driving simulators"
Empathetic learning	"We opened up learning and social awareness and engagement using virtual reality in class. Empathy for different societies and increased emotional awareness and connection to learning was evident."
Student content creation	"I've generally tried to engage students in creating experiences rather than using prepackaged content." "Their (student) project was to create a school virtual tour using a 360 camera to take photographs of the school." "We are using Oculus headsets in a remote school to tell local stories through art using Tilt Brush."

Teachers generally expressed positive attitudes towards using iVR in their classrooms (Table 3). For example, 95.5% of teachers agreed that using iVR with students was enjoyable, and the majority (90.9%) indicated that they would continue to use iVR in future teaching. Most respondents (70.4%) thought the technology offered good value for money. Additionally, 61.3% agreed or strongly agreed that the technology improved their teaching, and 66% felt confident in using the technology for educational purposes. However, a sizeable minority (25%) only mildly agreed with the latter proposition, suggesting some uncertainty about its educational applications. While most teachers (54.6%) felt they had enough resources to support the use of iVR with students, a sizable minority were either neutral (11.4%) or disagreed (34.1%), indicating variation in the availability of resources to effectively integrate the technology into teaching.

Table 3

Teacher's Experiences and Attitudes Towards Using iVR in Class

	iVR group	
	n	%
Using iVR helps improves my teaching		
Strongly disagree	0	0
Disagree	1	2.3
Mildly disagree	2	4.5
Neutral	5	11.4
Mildly agree	9	20.5
Agree	14	31.8
Strongly agree	13	29.5
I know how to use iVR for education		
Strongly disagree	0	0
Disagree	0	0
Mildly disagree	2	4.5
Neutral	2	4.5
Mildly agree	11	25.0
Agree	20	45.5
Strongly agree	9	20.5
I'm influenced by others to use iVR in my classes		
Strongly disagree	3	6.8
Disagree	6	13.6
Mildly disagree	6	13.6
Neutral	9	20.5
Mildly agree	10	22.7
Agree	5	11.4
Strongly agree	5	11.4
I have the necessary resources and support to use iVR with my students		
Strongly disagree	4	9.1
Disagree	6	13.6
Mildly disagree	5	11.4
Neutral	5	11.4
Mildly agree	9	20.5
Agree	12	27.3
Strongly agree	3	6.8
Using iVR with my students is enjoyable		
Strongly disagree	0	0
Disagree	0	0
Mildly disagree	0	0
Neutral	2	4.5
Mildly agree	8	18.2
Agree	15	34.1

Strongly agree	19	43.2
iVR for educational purposes is good value for money[a]		
Strongly disagree	2	4.5
Disagree	2	4.5
Mildly disagree	2	4.5
Neutral	6	13.6
Mildly agree	7	15.9
Agree	14	31.8
Strongly agree	10	22.7
I'm used to using iVR at school		
Strongly disagree	0	0
Disagree	4	9.1
Mildly disagree	5	11.4
Neutral	7	15.9
Mildly agree	9	20.5
Agree	12	27.3
Strongly agree	7	15.9
I intend to use iVR throughout my teaching in the future		
Strongly disagree	1	2.3
Disagree	2	4.5
Mildly disagree	0	0
Neutral	1	2.3
Mildly agree	6	13.6
Agree	16	36.4
Strongly agree	18	40.9

[a] One participant did not answer this question.

iVR teachers were asked what advice they would give other teachers about using the technology in classrooms (Table 4). The most common and detailed guidance involved the need for teachers to familiarise themselves with the technology before implementation, followed by pedagogical, safety, and professional learning advice. There was also encouragement ("Don't be afraid. Give it a go"). Only one teacher advised not to try iVR, while another advised waiting until it was affordable.

Table 4

iVR Teacher Advice with Illustrative Quotations

Type of advice	Participant quotation
General encouragement (provided by 23% of teachers)	"Go for it—try it and be prepared to learn from the experience." "Give it a go, and don't be afraid to fail forward."
Familiarisation with iVR (trial, test, play, explore)	"Teachers must make time to play in this space to work out how to use VR to develop or enhance student learning….

(provided by 25% of teachers)	Work out what can go wrong before you go into class so that students have a successful experience on the first go." "Make sure you know the space well yourself. Immerse yourself, know the issues."
Professional learning curve (provided by 18% teachers)	"Bring in industry experts or startups to help build staff and student confidence and capability"
	Create a supportive PL (professional learning) network so you are not doing all the hard work alone."
Pedagogical tips (advice from 20% of teachers)	"Start with it in small discrete lesson segments to cement teacher management of the use of the tools, ensure resource development is effective in complementing the use of IVR, and noting what pedagogical style best supports the use of IVR to maximise both outcomes and engagement."
	"Use it in a group work environment where kids cycle through more independent activities so you can work with a small group using VR until they are used to it."
Student safety (advice from 16% of teachers)	"Student safety is more important than innovation, make sure the physical space is conducive to safety. Don't take short cuts here."
	"Always make sure you can see what the kids can see in the headset"
	"Be careful with data sharing. Keep your students safe online."
Cost and investment (advice from 9% of teachers)	"Do your research and talk to other schools before investing."
	"Now in particular, don't rush out and buy the device you like best as it may not work in your school environment."

RQ 2: How do the perspectives of teachers who use iVR compare to teachers who do not, with respect to rationale, benefits, issues, and professional learning needs?

Among iVR teachers, reasons for using iVR technology centered around enhancing student engagement and learning experiences. This meant providing fun, quality, authentic, and creative learning opportunities (98%). Other reasons included curiosity to trial the new technology (18%), benefits of simulation for learning (16%), boost student career aspirations (9%), and interest in professional development (5%). One teacher elaborated on using the technology to provide learning opportunities for students from diverse backgrounds:

> I found my students, who predominantly come from backgrounds where they speak languages other than English, struggled to understand how writers use setting to create meaning for example. The use of VR was able to help illustrate this and then students were able to understand the concept and apply the concept in their own writing. Also, with an increasing focus on exploring multimodal texts using VR provides a unique opportunity to explore the multimodality of VR texts.

Non-iVR teachers primarily identified reasons unrelated to learning for eschewing the technology, with cost and access to funding cited by 50% of this group. Other reasons for not using iVR were lack of access to technology (23%), concerns about curriculum alignment (23%), and time constraints (3%).

Examining the benefits of using iVR for student learning revealed commonalities among both iVR and non-iVR teachers. Both groups identified the enhancement of student engagement (50% of iVR and 37% of non-iVR teachers) and the way iVR could provide opportunities that were not possible for students in the real world (11% VR teachers and non-iVR teachers 14%). The potential of the technology to foster authentic, creative, collaborative, and active learning was acknowledged by both groups (25% VR teachers and non-iVR teachers 27%). A small minority in each group identified using iVR to help students develop technology skills. Both groups raised safety concerns, with 14% of iVR teachers and 10% of non-iVR teachers indicating this was an issue. The iVR group, having direct experience, provided a more nuanced perspective, specifically highlighting COVID-related hygiene concerns (35%) and ethics and privacy issues (5%). Technical challenges, such as school network firewalls, bandwidth limitations, and the need for equipment updates and maintenance, were mentioned by both groups. Unsurprisingly, iVR teachers expressed greater concern over these technical issues (iVR teachers 20% versus non-iVR teachers 9%), given their practical engagement with the technology. Access to resources (cost and appropriate classroom space) and time were also identified as a significant barrier by both groups (iVR teachers 41% and non-iVR teachers 59%). As one non-iVR teacher explained, “Our school funding doesn’t allow for the purchase of these resources and then there is the time needed to ensure it is appropriately integrated into the curriculum and teachers are supported with the implementation.”

There were some commonalities around professional learning needs, with both groups wanting opportunities to explore features of iVR platforms and apps (36% of iVR and 41% of non-iVR teachers). Both groups also emphasised the need for professional development focused on the pedagogical and curriculum aspects of iVR for learning (30% of iVR and 36% of non-iVR teachers). Notably, only iVR teachers highlighted the need for professional learning on safety and ethics (11%) and strategies for integrating the technology at the school level (16%).

Discussion

RQ1. What are the technical choices, pedagogical applications and experiences of early adopter teachers who have used iVR in their classrooms?

The study revealed that teachers who have used iVR in their classrooms were mainly secondary school educators with substantial teaching experience; 82% had over 10 years of experience, and 34% had more than 25 years. Most iVR teachers were familiar with both 6DoF (high-end) and 3DoF hardware, although their use of 3DoF hardware was

pedagogically varied. The majority of iVR teachers expressed confidence in their ability to use the technology, though 25% indicated some uncertainty about its pedagogical value. This ambivalence is understandable given that iVR technology is still in its early adoption phase in schools. This reflects Rogers' (2003) IDT, which suggested that early adopters often balance enthusiasm with uncertainty as they experiment with a novel innovation.

The iVR group had largely positive perspectives on integrating the technology into classrooms compared with the moderately positive perception of iVR from early adopter Russian teachers (Khukalenko et al., 2022). In contrast to Khukalenko et al.'s large-scale findings, which emphasised caution and resource constraints, our smaller sample of Australian teachers demonstrated higher levels of pedagogical experimentation and confidence, suggesting contextual differences in diffusion trajectories. From a TAM perspective (Davis, 1989), this difference may be explained by perceived usefulness: Australian iVR teachers articulated concrete pedagogical affordances, while Russian teachers' evaluations were more tentative. This indicates that perceived usefulness, core to TAM, is strongly shaped by local contexts and opportunities to experiment.

Most participants in our much smaller scale study had developed confidence and technical capability in using iVR and had demonstrated an understanding of its unique learning affordances (Pellas et al., 2021), including but not limited to, student engagement. Their increasing confidence also resonates with UTAUT2's (Venkatesh et al., 2012) construct of facilitating conditions: where institutional support and access existed, teachers were more likely to embed iVR pedagogically.

While iVR was mostly employed in STEM subjects, our teachers also reported its use in creative arts, social sciences, humanities, physical education, career education, and extracurricular activities. This cross-curricular application is like research with early-adopter Norwegian teachers (Stranger-Johannessen & Fjørtoft, 2021). However, unlike Norwegian study, which emphasised teacher enthusiasm in STEM-heavy contexts, our findings reveal evidence of broader cross-disciplinary uptake, including in literacy and cultural education. This suggest that iVR's pedagogical potential may be more expansive than commonly assumed.

Notably, almost a third of iVR teachers used the technology to foster student content creation. This resonates with the call for teachers to move beyond student consumption of pre-packaged content to encourage learners to create and share their own iVR experiences, thereby building mastery and soft skills (Southgate, 2020, 2023). Our results extend this argument by showing that such creative use is already emerging organically among early adopters, highlighting an opportunity for future professional learning to consolidate these practices.

While the survey indicated teacher engagement with a range of iVR applications, there is a need to better understand commonalities and differences in the ways teachers use iVR across subject areas. Future comparative research could examine whether the patterns of adoption we observed (i.e., cross-curricular use and content creation) represent a uniquely Australian trajectory or align with trends in other national contexts. It is also essential to explore how teachers design or weave the technology into the curriculum in ways that leverage the unique learning affordances of the technology for students at different developmental stages and with sociocultural differences. Additionally, further evidence is required on the effects of different design configurations of the technology (e.g., multi-user

environments, interaction modalities, and authoring and generative tools) on the type, size, and growth of learning outcomes, and importantly, student perspectives related to these.

RQ2. How do the perspectives of teachers who use iVR compare to teachers who do not use IVR with respect to IVR rationale, benefits, issues, and professional learning needs?

The main reasons iVR teachers gave for adopting the technology reflected their desire to offer engaging and quality learning experiences. In contrast, non-iVR teachers stated lack of resources, especially the high cost, as the main reason for not using iVR. This contrast underscores a "pedagogical versus pragmatic" divide between the groups: adopters foregrounded student-centred benefits while non-adopters highlighted institutional and infrastructural constraints. Furthermore, this divide echoes UTAUT2's distinction between performance expectancy (adopters emphasising enhanced learning outcomes) and price value (non-adopters foregrounding financial and resource constraints).

Many non-iVR teachers also highlighted the limited access to iVR equipment, with around a quarter expressing curiosity about how iVR could align with the curriculum. Interestingly, both groups identified student engagement as a key benefit of using iVR, recognising its ability to offer unique, immersive learning opportunities that extended beyond the student's real-world experiences. Moreover, both groups recognised the potential of iVR to foster active, authentic, and creative learning. This convergence suggests that while actual practice is uneven, a shared pedagogical vision exists across both adopters and non-adopters, echoing findings from Boel et al. (2023) and Khukalenko et al. (2022), which is also consistent with TAM's focus on perceived ease of use and usefulness: even non-users acknowledged pedagogical potential, but lacked hands-on experience to confirm ease of integration.

This pedagogical focus was reflected in the professional learning needs identified by both groups who wanted opportunities to learn about pedagogical approaches and curriculum design for iVR. Both groups wanted increased access to iVR platforms and apps so that they could explore the pedagogical potential in more depth. Extant literature consistently highlights these types of professional learning needs identified by teachers (Boel et al., 2023; Khukalenko et al., 2022; Mystakidis & Christopoulos, 2022). However, it is worth noting that only iVR teachers explicitly asked for professional learning on safety and ethics, with many demonstrating a clear understanding of the related issues. This insight aligns with other research, such as that by Stranger-Johannessen and Fjørtoft (2021), which points to experienced iVR users being more cognizant of safety concerns.

Furthermore, the practical experience of iVR teachers allowed them to identify more technical barriers to integration in school settings. Although iVR teachers generally viewed the technology as being value for money, both groups cited resources as a key barrier especially cost and to a lesser extent teacher time and appropriate classroom space to operationalise the system in. Taken together, these findings suggest that scaling adoption requires bridging both the pedagogical aspirations of adopters and the pragmatic concerns of non-adopters.

RQ3. What are the implications of teacher perspectives for scaling up the technology in Australian schools?

Scaling up the integration of iVR in Australian schools would require attention being paid to several areas. A key issue involves addressing the professional learning needs of early adopter teachers to further develop their classroom experimentation and innovation with the technology in a safe and ethical manner. This will involve professional learning developed by researchers, industry, and teachers themselves. Interestingly, some iVR teachers in our study wanted professional learning on more broadly integrating the technology across their schools, indicating that scaling up is already part of their thought processes.

Developing communities of practice and mechanisms to showcase the pedagogical and curriculum practice of iVR teachers and their students' learning through the technology is vital if other teachers are to have their questions about integrating an emerging technology into class are to be addressed. This aligns with Rogers' (2003) notion of early adopters acting as role models who reduce uncertainty for the early majority. Our findings reinforce the importance of leveraging early adopters as catalysts for broader diffusion.

For scaling to occur, it is important to develop a low or no-cost systematic program of hardware and software access so that teachers, along with giving them time to familiarise themselves with and explore VR hardware and software in a supported manner. iVR teachers generally thought the technology was value for money. Understanding more about why teachers see value in investing in the technology will be vital in building a case for schools to commit to such a commercially young technology (Granic, 2022). Part of this may be, as Southgate (2020) suggests, challenging teachers' perception that each student requires a headset (1-1 device idea) and instead, designing units of work which weave the VR component into a broader learning sequence that allow a class of students to cycle in and out of a few headsets that are used to enhance specific learning objectives. This does raise the question of needing to know more about the cost, teacher preferences, and efficacy of different models of VR delivery (in-class, VR lab based in school, incursions from commercial companies, and excursions to commercial facilities).

Core to any scaled community of practice or access program will be developing an understanding of how different types of iVR can be used safely and efficaciously in primary as well as secondary schools and outside of STEM subjects. Scaling across the curriculum must include, but reach beyond, technology-focused/rich subjects to encourage teachers in other subject areas to explore technology for their discipline. Research that is embedded in classrooms will be required to develop authentic evidence that deeply considers the needs, geographic and socio-cultural contexts, and interests of school communities in all their diversity. Such an evidence base, which includes rigorous case studies across school subjects with student perspectives foregrounded, will resonate with teachers who might be curious about the technology and encourage them to "Give it a go, and don't be afraid to fail forward."

This was an exploratory study involving a relatively small convenience sample that provided a self-report snapshot of experiences and perceptions. The sample size was not sufficient to be able to generalise effects to the broader population of teachers in Australia or internationally. However, the study did, offer nuanced insights into the early state-of-play of pedagogical integration of iVR in some Australian schools and indicated key barriers to scaling up the technology. As such, it extends the international literature by offering one of

the first comparative analyses of adopters and non-adopters of iVR in schools and provides an empirically grounded agenda for future scaling strategies.

Conclusion

Arguably, the adoption of iVR across schools and higher education in Australia is still in its emergent phase. Those use cases reported vary significantly across schooling demographics, geo-locations, ages, abilities, stages of students, and subject domains. Few studies have deeply interrogated its potential benefits and pitfalls. Some studies have been conducted with teachers to understand their experiences of integrating the technology and, for non-users, their perception of the usefulness of it in school settings. Understanding what enables iVR adoption and ongoing integration and barriers to this is important for addressing the issue of scalability of such a young technology. The present research has sought to address these research gaps by providing a comparative snapshot of Australian teacher perspectives from a user and non-user perspective, with findings largely resonating with the little research that has been previously conducted with educators. Our research has provided a nuanced picture of early adoption pedagogical uses, ethical and safety concerns, issues of access to equipment, funding and teacher time for familiarisation and experimentation, and a range of professional learning needs identified by teachers. While research understandably focuses on iVR learning efficacy, it is vital that the perspective of teachers be harnessed if iVR is to be widely adopted and effectively integrated into school classrooms.

iVR remains a relatively young commercial technology in schools, with research only beginning to capture its educational potential and practical constraints. While existing studies have focused on iVR's efficacy for student learning, this study emphasises the critical role of teachers in shaping the trajectory of adoption and integration. By comparing the perspectives of Australian teachers who have used iVR with those who have not, the study highlights both the enthusiasm of early adopters and the reservations of non-users.

The findings suggest that iVR adoption is currently shaped by a blend of perceived pedagogical benefits, resource constraints, and professional learning needs. Teachers who have engaged with iVR identified opportunities for fostering student engagement, creativity, and cross-curricular applications, but also raised important concerns about ethics, safety, and classroom logistics. Non-users, while recognising the potential value of iVR, were more likely to emphasise barriers such as cost, limited access to equipment, and lack of time for experimentation. These perspectives resonate with international research and can be further explained through established adoption frameworks such as the IDT (Rogers, 2003), TAM (Davis, 1989), and UTAUT2 (Venkatesh et al., 2012), which together underline the importance of perceived usefulness, facilitating conditions, and peer modelling in scaling emerging technologies.

Ultimately, this research offers a nuanced picture of early adoption in Australian schools. It points to clear enablers (including motivated teacher innovators, growing pedagogical confidence, and recognition of student engagement benefits) as well as barriers (such as access, time, and professional learning gaps). The results suggest that scaling iVR in schools will require not only investment in infrastructure and resources but also a systemic approach to professional learning, communities of practice, and ethical guidelines to ensure safe, equitable, and meaningful use across disciplines.

By foregrounding teacher perspectives, this study contributes to the emerging body of evidence on iVR integration in schools and underscores the importance of designing adoption strategies that reflect teachers' realities. As iVR continues to evolve, sustained research and practice partnerships will be essential in transforming isolated experiments into scalable, pedagogically grounded innovations that benefit diverse student populations. These findings provide policymakers, school leaders, and industry partners with practical insights into how iVR can be strategically and sustainably embedded into education systems.

Declarations

Ethics Statement

This study was conducted in accordance with recognized ethical principles and standards. Data were collected with informed consent and reported with respect for confidentiality and anonymity. The study was approved by the University of Newcastle Human Research Ethics Committee (HREC) (Number H-2022-0307) and subsequently approved by the HRECs of the institutions of other authors.

Funding Statement

This research received no funding.

AI Use Statement

Artificial intelligence was not used in this research.

Conflict of Interest Statement

The authors declare no conflicts of interest related to the research, authorship, or publication of this article.

References

Abdelazim, A., Al Breiki, M., & Khlaif, Z. N. (2025). AI in education: The mediating role of perceived trust in adoption decisions of school leaders. *Education and Information Technologies*. https://doi.org/10.1007/s10639-025-13596-4

Açıkgül, K., & Şad, S. N. (2020). Mobile technology acceptance scale for learning mathematics: Development, validity, and reliability studies. *International Review of Research in Open and Distributed Learning (IRRODL), 21*(4), 161–180. https://doi.org/10.19173/irrodl.v21i4.4834

Aldunate, R., & Nussbaum, M. (2013). Teacher adoption of technology. *Computers in Human Behavior, 29*(3), 519–524. https://doi.org/10.1016/j.chb.2012.10.017

Beck, D., Morgado, L., & O'Shea, P. (2023). Educational practices and strategies with immersive learning environments: Mapping of reviews for using the Metaverse. *IEEE Transactions on Learning Technologies, 17,* 319–341. https://doi.org/10.1109/TLT.2023.3243946

Boel, C., Rotsaert, T., Valcke, M., Rosseel, Y., Struyf, D., & Schellens, T. (2023). Are teachers ready to immerse? Acceptance of mobile immersive virtual reality in secondary education teachers. *Research in Learning Technology*, *31*. https://doi.org/10.25304/rlt.v31.2855

Bower, M., DeWitt, D., & Lai, J. W. (2020). Reasons associated with preservice teachers' intention to use immersive virtual reality in education. *British Journal of Educational Technology, 51(*6), 2215-2233. https://doi.org/10.1111/bjet.13009

Conrad, M., Kablitz, D., & Schumann, S. (2024). Learning effectiveness of immersive virtual reality in education and training: A systematic review of findings. *Computers & Education: X Reality*, *4*, 100053. https://doi.org/10.1016/j.cexr.2024.100053

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319–340. https://doi:https://doi.org/10.2307/249008

Di Natale, A. F., Repetto, C., Riva, G., & Villani, D. (2020). Immersive virtual reality in K-12 and higher education: A 10-year systematic review of empirical research. *British Journal of Educational Technology*, *51*(6), 2006–2033. https://doi.org/10.1111/bjet.13030

Dalgarno, B., & Lee, M. J. (2010). What are the learning affordances of 3-D virtual environments? *British Journal of Educational Technology*, *41*(1), 10–32. https://doi.org/10.1111/j.1467-8535.2009.01038.x

Fu, Y., Hu, Y., & Sundstedt, V. (2022). A systematic literature review of virtual, augmented, and mixed reality game applications in healthcare. *ACM Transactions on Computing for Healthcare (HEALTH)*, *3*(2), 22. https://doi.org/10.1145/3472303

Geriş, A., & Kulaksız, T. (2025). Predicting teachers' intentions to use virtual reality in education: A study based on the UTAUT-2 framework. *Research in Learning Technology*, *33*. https://doi.org/10.25304/rlt.v33.3429

Granić, A. (2022). Educational technology adoption: A systematic review. *Education and Information Technologies*, *27*(7), 9725–9744. https://doi.org/10.1007/s10639-022-10951-7

Grau, O. (2004). *Virtual art: From illusion to immersion*. MIT Press.

Khukalenko, I. S., Kaplan-Rakowski, R., An, Y., & Iushina, V. D. (2022). Teachers' perceptions of using virtual reality technology in classrooms: A large-scale survey. *Education and Information Technologies, 27*(8), 11591-11613. https://doi.org/10.1007/s10639-022-11061-0

Lampropoulos, G., & Kinshuk. (2024). Virtual reality and gamification in education: a systematic review. *Educational Technology Research and Development*, *72*, 1691–1785. https://doi.org/10.1007/s11423-024-10351-3

Lee, M. J. W., Georgieva, M., Alexander, B., Craig, E., & Richter, J. (2000). *The state of XR and immersive learning outlook report: 2020 edition*. Immersive Learning Research Network. https://pure.bond.edu.au/ws/portalfiles/portal/37516351/State_of_XR_Outlook_Report_Executive_Summary.pdf

Liu, C., Meng, S., Zheng, W., & Zhou, Z. (2025). Research on the impact of immersive virtual reality classroom on student experience and concentration. *Virtual Reality, 29*, 82. https://doi.org/10.1007/s10055-025-01153-w

Maas, M. J., & Hughes, J. M. (2020). Virtual, augmented, and mixed reality in K–12 education: A review of the literature. *Technology, Pedagogy and Education, 29*(2), 231-249. https://doi.org/10.1080/1475939X.2020.1737210

MacGill, B., & Unsworth, P. (2022). Media arts in an education: A culturally responsive approach for developing digital and media literacies. In D. Price, B., MacGill, B., & J Carter (Eds) *Arts-based practices with young people at the edge.* Palgrave Macmillan. https://doi.org/10.1007/978-3-031-04345-1_6

Mystakidis, S., & Christopoulos, A. (2022). Teacher perceptions on virtual reality escape rooms for stem education. *Information*, *13*(3), 136. https://doi.org/10.3390/info13030136

OECD. (2024). Virtual reality and its opportunities and risks, in *OECD Digital Economy Outlook 2024 (Volume 1): Embracing the technology frontier*. OECD Publishing. https://doi.org/10.1787/a94253ae-en.

Pellas, N., Mystakidis, S., & Kazanidis, I. (2021). Immersive virtual reality in K-12 and Higher Education: A systematic review of the last decade scientific literature. *Virtual Reality*, *25*, 835–861. https://doi.org/10.1007/s10055-020-00489-9

Rauschnabel, P. A., Felix, R., Hinsch, C., Shahab, H., & Alt, F. (2022). What is XR? Towards a framework for augmented and virtual reality. *Computers in Human Behavior*, *133*, 107289. https://doi.org/10.1016/j.chb.2022.107289

Rogers, E. (2003). *Diffusion of innovations* (5th ed.). The Free Press.

Schott, C., Milligan, A., & Marshall, S. (2024). Immersive VR for K-12 experiential education–proposing a pedagogies, practicalities, and perspectives informed framework. *Computers & Education: X Reality*, *4*, 100068. https://doi.org/10.1016/j.cexr.2024.100068

Scorgie, D., Feng, Z., Paes, D., Parisi, F., Yiu, T. W., & Lovreglio, R. (2024). Virtual reality for safety training: A systematic literature review and meta-analysis. *Safety Science*, *171*, 106372. https://doi.org/10.1016/j.ssci.2023.106372

Slater, M., & Sanchez-Vives, M. V. (2016). Enhancing our lives with immersive virtual reality. *Frontiers in Robotics and AI*, *3(74)*. https://doi.org/10.3389/frobt.2016.00074

Southgate, E. (2020). *Virtual reality in curriculum and pedagogy: Evidence from secondary classrooms*. Routledge.

Southgate, E. (2023). Teachers facilitating student virtual reality content creation: Conceptual, curriculum, and pedagogical insights. In P. MacDowell, & J. Lock, J. (Eds.). *Immersive education: Designing for learning* (pp. 189-204). Springer. https://doi.org/10.1007/978-3-031-18138-2

Southgate, E., Maddock, T., Camporeale, E., & Burgess, R. (2026). Ethical issues with extended reality technology in schools and how teachers can respond to these in STEM education. In L. Leite, L. Dourdo, A. S. Afonso, S. Morgado, & L. Carvalho (Eds.), *Practical work in science education in the digital era: Challenges and opportunities* (pp. 407-419). Springer.

Statistica. (n.d.). *AR and VR – worldwide*. https://www.statista.com/outlook/amo/ar-vr/worldwide

Stebbins, R. A. (2001). *Exploratory research in the social sciences*. SAGE. https://doi.org/10.4135/9781412984249

Stenberdt, V. A., & Makransky, G. (2023). Mastery experiences in immersive virtual reality promote pro-environmental waste-sorting behavior. *Computers & Education, 198*, 104760. https://doi.org/10.1016/j.compedu.2023.104760

Steele, P. B., Burleigh, C., & Young, E. A. (2020). Considering educators' perceptions of ethics and safety in virtual learning environments (VLEs). *Journal of Educational Research and Practice, 10*(1), 404–418. https://doi.org/10.5590/JERAP.2020.10.1.26

Stranger-Johannessen, E., & Fjørtoft, S. O. (2021). Implementing virtual reality in K-12 classrooms: Lessons learned from early adopters. In V. L. Uskov, R. J. Howlett & L. C. Jain (Eds.), *International KES Conference on Smart Education and Smart E-Learning* (pp. 139–148). Springer. https://doi.org/10.1007/978-981-16-2834-4_12

Straub, E. T. (2009). Understanding technology adoption: Theory and future directions for informal learning. *Review of Educational Research, 79*(2), 625–649. https://doi.org/10.3102/0034654308325896

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425–478. https://doi.org/10.2307/30036540

Wei, X., Chen, Y., Zhao, P., Wang, L., Lee, L. K., & Liu, R. (2025). Effects of immersive virtual reality on primary students' science performance in classroom settings: A generative AI pedagogical agents-enhanced 5E approach. *Interactive Learning Environments*. https://doi.org/10.1080/10494820.2025.2514101

Williams, M., & Moser, T. (2019). The art of coding and thematic exploration in qualitative research. *International Management Review*, *15*(1), 45-55. http://www.imrjournal.org/uploads/1/4/2/8/14286482/imr-v15n1art4.pdf