

Spotlight

Technological innovations in initial teacher education

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The key messages in this Spotlight reveal that:

- ⚡ A growing number of initial teacher education (ITE) providers in Australia are using virtual reality (VR) technologies to help prepare pre-service teachers for classroom teaching.
- ⚡ Emerging technologies can provide pre-service teachers safe learning environments to bridge the gap between theoretical learning and real-life application.
- ⚡ VR-simulated classrooms can be customised across different contexts and complexity levels, allowing personalised support for pre-service teachers to build their confidence and hone specific skills.
- ⚡ Simulations afford pre-service teachers opportunities to experiment with rapport-building and classroom management strategies before or between real classroom practical experiences.
- ⚡ VR technologies can foster communities of practice in ITE programs, enabling teacher educators and pre-service teachers to collaborate and

actively engage in reflective practice processes based on their interactions.

Introduction

Initial teacher education (ITE) providers across Australia prepare classroom-ready teachers for our schools. In order to graduate, pre-service teachers must demonstrate they meet the Graduate career stage of the Australian Professional Standards for Teachers (Teacher Standards), which include the capacity to effectively manage a range of classroom situations (classroom management) (AITSL, 2019). ITE programs in Australia are designed to integrate theoretical coursework with professional experience, including practical placements within schools. While practical placements require a substantial investment in time and effort from ITE providers and schools alike, they are imperative for allowing pre-service teachers to develop, practise and demonstrate their ability to teach and manage a classroom. School placements are generally considered by pre-service teachers to be the most important aspect of their ITE course (Brown, 2008; VicGov, 2022).

Pre-service teachers gradually build confidence in their capacity to create safe and effective learning environments throughout their ITE program. Developing confidence is key to quality teaching and can be a powerful influence on a pre-service teacher's commitment to the profession, as well as their career adaptability and optimism (McLennan et al., 2017). Gaining confidence as a pre-service teacher comes from opportunities to observe and practise effective teaching, and therefore is influenced by the quantity and quality of practical experiences. Pre-service teachers require authentic teaching experiences, with mentoring^[1] from experienced educators, and with opportunities for reflection and self-assessment^[2]. These experiences provide pre-service teachers with opportunities to develop a repertoire of strategies for navigating the challenges that may arise in classrooms.

Australia's ITE providers are constantly looking for innovative approaches to complement traditional professional experience placements and to further support pre-service teachers in building their classroom competencies and confidence.

“With the emergence of simulated learning environments, technology has transitioned from being used in the classroom to technology as the classroom ”

–Ledger & Fischetti 2020, p40.

This Spotlight describes virtual reality (VR) technologies that are being used and further developed to help prepare pre-service teachers for classroom teaching. A growing trend in Australia's ITE space involves using VR-based simulations as classroom learning environments for pre-service teachers to practise teaching skills before real-world application. For example, Australian ITE providers that have recently adopted some VR platforms for this purpose include the University of New England, Griffith University, Murdoch University, the University of Newcastle, Swinburne University of Technology, the University of Western Australia, La Trobe University and the University of New South Wales. Overseas, innovative technologies are also being used in teacher preparation, for example, TeachLivE (University of Central Florida) and the Virtual Sim(HU)lation Model (Achva Academic College, Israel).

One Australian ITE provider, the University of Newcastle, has implemented a suite of VR-based technologies and leads research on their utility for pre-service teacher education. For these reasons, this Spotlight showcases their efforts and experiences. Nonetheless, AITSL recognises that a national community of practice exists between Australian universities and that such collaboration underpins further development and expansion across ITE programs. Future directions for emerging technologies in pre-service teacher education are also discussed in this Spotlight.

Virtual reality classrooms in ITE

VR technologies are ready to transform ITE by providing immersive classroom environments as interactive learning experiences for pre-service teachers. These technologies have made significant strides in capability since their inception (circa 1960s), particularly in recent years. VR technologies simulate three-dimensional (3D) computer-generated environments, allowing users to interact and experience a sense of immersion^[3]. Various VR platforms can achieve different levels of immersion (see Figure 1) (Huang et al., 2021).

Figure 1. Modes of VR based on immersion (adapted from Huang et al., 2021).

Non-immersive VR



Non-immersive (also called desktop) VR systems are primarily accessed and enjoyed from a seated or stationary position, typically using a personal computer or gaming console. Users can engage with virtual environments using devices such as keyboard, mouse, gaming controllers and touch screen.

Semi-immersive VR



Semi-immersive VR systems use wall-mounted displays and motion tracking devices (e.g., controllers & cameras) for a higher degree of immersion and more intuitive interactions. These systems provide a higher level of immersion compared to non-immersive systems while still allowing users to maintain awareness of the real world.

Fully-immersive VR



Fully-immersive VR systems aim to provide users with a highly immersive virtual reality experience, where they feel completely transported and immersed in a virtual environment. These systems cover their users' field of view and typically involve advanced motion tracking, realistic visuals, and the ability to interact physically with virtual world.

VR technologies have undergone considerable advancement while being integrated into numerous professions, primarily for the purposes of practicing complex skills before real-world applications. For instance, such technologies support the teaching of technical skills in medical fields (neurosurgery and nursing), aviation and military training (Cross et al., 2022; Dadario et al., 2021). VR has also been a game-changer in the gaming industry, providing players with realistic and astonishingly immersive experiences. While ITE providers worldwide have only recently begun to utilise VR technologies (McGarr, 2020; Huang et al., 2021), the potential for pre-service teacher education is yet to be fully realised.

“With the exponential growth of consumer-level VR hardware and software during the last decade, both the creation and application of VR in the educational context has become increasingly feasible and scalable.”

–Huang et al 2021, p3.

Case study: Suite of simulations at the University of Newcastle

The University of Newcastle offers its pre-service teachers a suite of interactive simulation learning environments that includes simSchool, simTeach (Mursion) and simCave. Each simulation platform targets different aspects of teacher preparation: simSchool provides individual gaming practice to hone classroom decision-making skills; simTeach (Mursion) is a platform to practise teaching; simCave immerses pre-service students into diverse classroom and school contexts. The three types of VR technologies offer varying degrees of immersion and aim to prepare pre-service teachers for ‘diverse contexts and diverse students’ (UON, 2023).

[Watch here](#) as Associate Professor Debra Donnelly and Dr. Emma Shaw from the University of Newcastle describe the three VR technologies and how they support pre-service teachers as they develop their teaching skills and confidence.

The three types of VR learning environments utilised at the University of Newcastle can be categorised using Huang’s (2021) three modes as non-immersive VR (simSchool), semi-immersive VR (simTeach) and fully-immersive VR (simCave) simulations (see Figure 1). Collectively, they are described as ‘situational simulations’ as they model real classroom environments and interpersonal interactions (McGarr, 2020). The following sections of this

Spotlight describe each technology sequentially. Sim suite products have been used as examples of technologies available for ITE providers; however, the purpose of this Spotlight is to encourage the consideration of innovative technological approaches for supporting the professional experiences of pre-service teachers.

SimSchool

Non-immersive computer-based simulations were the original VR platforms adopted across ITE programs. Of these technologies, simSchool is the most established classroom-based learning tool (circa early 2000s) and offers pre-service teachers opportunities to build teaching skills through experimentation with learning situations (Hopper, 2018; Christensen et al., 2011; Zibit & Gibson, 2005). The platform is game-based and uses traditional computer devices (e.g., desktop computer & monitor) to display a simulated classroom environment populated with virtual students (simStudents) (see Figure 2). Pre-service teachers assign learning tasks and practise different teaching strategies by selecting various drop-down menu options, then observe their impact on 'authentic' virtual students (SimSchool, 2023). Virtual students respond in very individual ways and have the ability to express feelings "through facial expression, body positions, and distracted behaviour" (SimSchool, 2023).

Figure 2. SimSchool VR simulations provides classroom learning environments (image from simSchool).



The simSchool platform offers hundreds of hours of VR-simulations based on primary and secondary educational contexts and being web-based, allows for self-paced learning and repeated practice. The virtual classrooms are customisable and can suit different geographical and demographical contexts, including age and ethnicity (SimSchool, 2023). They are designed to serve as virtual practical placements to augment ITE programs for teacher preparation. SimSchool provides an experimental platform ideal for pre-service teachers to build an initial understanding of classroom dynamics and management challenges. SimSchool is currently the

only VR-simulation platform that provides pre-service teachers with 'automated' formative feedback during and after learning activities (Ledger & Fischetti, 2020). Automation is provided through an artificial intelligence (AI) engine^[4].

An AI engine at the core of simSchool

SimSchool designers continue to enhance the program's virtual students by updating the AI engine that is used to simulate the various student behaviours, learning abilities and emotions. The AI engine assigns personalities and learning dispositions to the virtual students and operates the many variables defining academic performances and classroom behaviours (Zibit & Gibson, 2005; Christensen et al., 2011). Virtual students are afforded artificial emotional intelligence and can individually react to classroom management strategies, tasks and vocal intonations set by the pre-service teacher (via drop-down menus). How pre-service teachers direct the learning environment determines whether each virtual student is engaged, confused, or bored and impacts classroom behaviour. Virtual students can express a range of emotions (even cry), seek the teacher's attention (e.g., raise hands) and show annoyance or stress. The makers of simSchool state that their virtual classrooms are 'grounded in established theories of cognition, emotion and social behaviour, and provides users authentic experience vetted through a decade of continuous research, field testing, and clinical practice' (SimSchool, 2023).

Educational benefits of simSchool

SimSchool is one of the longest applied and most researched VR platforms in ITE programs worldwide. Most studies on simSchool have focused on pre-service teachers gaining self-confidence with classroom management, as measured using self-reporting questionnaires. Major findings indicate that pre-service teachers who use simSchool develop confidence with classroom management more quickly and gain a greater understanding of the educational needs of diverse learners (Hopper, 2018; Johnston & Collum, 2020). The platform allows pre-service teachers to discover that students exhibit mixed abilities and learning dispositions and that different strategies are therefore required for classroom management and student engagement. SimSchool can foster self-reflection and group discussions between pre-service teachers, and with ITE educators, on classroom teaching practice and management challenges (McGarr, 2020). One recurrent criticism from pre-service teachers reflects the platform's level of animation and gamification (McGarr, 2020). It seems that this current generation of pre-service teachers wants cutting-edge graphics and game flow.

Commentary from the University of Newcastle on simSchool

"Although the quality of the simulation may not be state of the art, the benefit of simSchool is measurable. Its ability to focus pre-service teachers on the importance of decision making that links theory and practice is at the core of its implementation. It highlights the importance of evidence-based decision making in all aspects of teaching - every word, movement, decision, resource and instruction a pre-service teacher makes when interacting with simSchool will impact the quality of the interaction within the classroom. The AI feedback identifies areas of strength and weaknesses for reflective and improved practice to occur."

SimTeach (Mursion)

VR-simulation technologies in ITE have recently evolved to enable pre-service teachers to interact with a virtual classroom of avatar students. Live-performing actors appear in virtual classrooms as avatars, 'operating as puppeteers', controlling the avatars' actions (e.g., movements & tasks) to provide more realistic interactions and discourse (Fischetti et al., 2022; Murphy et al., 2021). Trained improvisation actors working behind the scenes adopt student personalities and learner profiles and use vocal synthesisers to impersonate real-life students as avatars. While pre-service teachers see avatars embedded in a virtual classroom on a large monitor screen, the actors observe the pre-service teachers via webcams, allowing them to react to teacher speech and gesturing (body language) (see Figure 3). Interactive conversations make the simulation more realistic than is currently possible with AI-generated virtual students, which only have pre-programmed responses.

Figure 3. SimTeach (Mursion) uses avatars (controlled by actors) to provide more responsive and realistic teaching experiences (image from [simLab](#)).



Human-in-the-loop technology makes simulation learning more realistic

The integration of human and artificial intelligence in VR has been dubbed human-in-the-loop (HITL) simulation technologies. [TeachLive™](#) is one of the original human-in-the-loop platforms developed for ITE (inception 2012), and through its commercial partner [Mursion™](#) is now available to ITE providers worldwide as [simTeach](#). More than 80 universities worldwide currently use the platform in ITE programs (Ersozlu et al., 2021). In Australia, both Murdoch University and the University of Newcastle collaborate to implement and research [simTeach](#), to improve graduate outcomes for their respective pre-service teachers (Ledger & Fischetti, 2020). Pre-

service teachers at these and several other Australian universities (e.g., the University of Western Australia and Swinburne University of Technology) can experience virtual classrooms with five adolescent avatars (actors) (Stage 4; Years 7-8), whose adopted personalities and learning characteristics are typical of young adolescents taught in Australia's schools.

[Watch here](#) as Simulation Specialist, Shannon, from Swinburne Online explains how human-in-the-loop technology works and how it aims to help pre-service teachers like Steph prepare for the classroom. Steph studied a Bachelor of Education (Primary) while living remotely in South West Victoria (Mortlake) and made use of the technology online.

SimTeach (Mursion) as an advancement on micro-teaching

ITE programs have traditionally used micro-teaching for their pre-service teachers to practise classroom management skills. The approach has a long history in teacher training programs (circa 1960s) and customarily entails condensed lesson planning, delivering lessons within a role-playing context, and scaled down classroom settings (e.g., 5-10 pupils) (Allen & Eve, 1968; Cavanaugh, 2022). Pre-service teachers are afforded opportunities through micro-teaching to “plan, practice, rehearse and reflect-on-action ^[5]” and to develop competencies in clearly defined teaching skills (Ledger & Fischetti, 2020). The complexities of actual teaching are reduced, making the exercise less confronting, and immediate feedback can be sought, often with the opportunity to observe digital recordings (videoed) to support reflective practice. Video recording represented the first major advancement for micro-teaching, allowing asynchronous viewing and feedback.

More on micro-teaching: Various manifestations of micro-teaching have permeated ITE programs across the globe (Cavanaugh, 2022; Kroeger et al., 2022). While application may deviate amongst ITE programs, research consensus suggests that benefits of micro-teaching for pre-service teachers include “increased self-awareness and confidence, promoting reflexivity and a positive impact on identity ^[6] development and self-efficacy ^[7]” (Griffiths, 2016). While prominent in the 1960s to 1990s, micro-teaching to a small group of school students has since rarely been used for professional experience in ITE programs. Difficulties with accessing school students led to peers (other pre-service teachers) being used instead of actual students (Ledger & Fischetti, 2020; Kroeger et al., 2022). However, micro-teaching among peers has its critics, who question authenticity (Griffiths, 2016).

SimTeach (Mursion) simulations provide a modern twist to traditional micro-teaching strategies, “where the students are virtual and the teaching is real” (Fischetti et al., 2022). Avatars remove the requirement for school students or peers and enable pre-service teachers to conduct micro-lessons (usually 8-10 minutes) in contextualised settings as required. Moreover, avatars shape classroom dynamics and behaviours and can customise learning environments as pre-service

teachers grow in competencies and confidence (Ledger & Fischetti, 2020). As pre-service teachers progress and become more confident, more challenging behaviours and tasks can be provided to facilitate continued and scaffolded development.

Educational benefits of simTeach (Mursion)

A recent systematic review of over 100 publications that focused on human-in-the-loop technologies (e.g., simTeach) in ITE, revealed that ‘integration of simulations’ in ITE programs and ‘instructional skills development’ were the most commonly researched topics prior to 2018 (Ersozlu et al., 2021). This review highlighted that the benefits of simTeach (Mursion) clearly outweighed any limitations and its authors concluded that this technology “has proven itself to be a genuine alternative for better preparing pre-service teachers for real-life classroom contexts.” By 2018, more than 75 ITE providers worldwide had implemented simTeach (Mursion) into their teacher education programs (Ersozlu et al., 2021).

More recent research from the University of Newcastle has demonstrated the effectiveness of using simTeach (Mursion) to help pre-service teachers develop classroom management confidence (Ledger & Fischetti, 2020; Fischetti et al., 2022; Donnelly et al., 2023). An initial study of 376 first-year pre-service teachers reported through a questionnaire that simTeach (Mursion) was effective for building their confidence, identifying specific learning needs and preparing them for practical placements (Ledger & Fischetti, 2020). A follow up survey-based study of 198 pre-service teachers in the early years of their degrees substantiated these findings, further demonstrating a clear benefit for pre-service teachers in their “preparation for real practicums” (Fischetti et al., 2022). Pre-service teachers who do not meet practical placement performance standards also benefit from using simTeach (Mursion) to become more confident and skilled in the classroom (Donnelly et al., 2023). Therefore, simTeach (Mursion) can also facilitate remedial needs-based intervention for underperforming students. The authors of the aforementioned studies suggest implementing simTeach (Mursion) as a form of micro-teaching as a mainstream approach within ITE programs.

Commentary from the University of Newcastle on simTeach

“In addition to simulating classroom scenarios, simTeach (Mursion) has the ability to simulate any interaction with children, parents, colleagues or principals. With the increase in anti-social behaviour toward teachers and principals, a scenario has been developed at Murdoch and Newcastle to simulate an interaction with an irate parent. Typically, Teacher Standard 7 has been difficult to evidence in an ITE program, however, simulation offers opportunity to present any difficult scenario or conversation pre-service teachers may be exposed to within and out of the classroom setting.”

Professor Susan Ledger, Dean of Education, University of Newcastle.

SimCave

Immersive VR refers to types of computer-generated experiences that are designed to fully engage the senses of the user and create a feeling of 'presence' in a virtual environment (Weber et al., 2021). The aim is to give the user the impression that they have completely entered the synthetic world. This can be achieved by either using head-mounted display technologies or through multi-wall VR projections (e.g., simCave) (Billingsley et al., 2019; Radianti et al., 2020). Head-mounted displays allow high-resolution VR to be projected directly in front of the user's eyes, creating virtual environments where users can interact through audio and haptic devices (gloves & body tracking suits, etc.). In contrast, simCave utilises multi-wall VR projections to create a large simulation space for educational purposes (see Figure 4). CAVE is a recursive acronym that stands for CAVE Automatic Virtual Environment. Developed by Igloo Vision, the simCave immersive space at the University of Newcastle was designed for collaborative group learning activities that focus on different school and classroom contexts. Wraparound visuals and audio simulate realistic scenarios using content from 360-degree videos and images or internet-based content (plus capacity for interactive VR games). According to the creators of simCave, the "immersive space is a bit like stepping inside a giant VR headset – except you can get whole groups inside."

Figure 4 SimCave provides immersive VR experiences for pre-service teachers (images from University of Newcastle)



360-degree virtual reality simulations

Recent technological innovation has enabled VR simulations to be enriched using 360-degree cameras (omnidirectional cameras) that capture the full spherical view of a specific environment. Best experienced through either head-mounted displays or CAVE-based technologies (e.g., simCave), 360-degree VR simulations can provide pre-service teachers with exemplars of teaching and classroom management practices. Real-life classroom events can be observed live or recorded and displayed through 360-degree VR simulations to provide authentic learning experiences deemed 'more useful in teacher education than traditional video' (Theelen et al., 2019; De Back et al., 2021; Kosko et al., 2021). Immersive 360-degree VR environments can

capture whole classroom dynamics, allowing for multiple perspectives when observing, appraising and reflecting on teacher-student interactions. The simCave and similar multi-wall VR spaces allow small groups of pre-service teachers to learn together from examples of different teaching pedagogies and classroom contexts.

Educational benefits of simCave

Research on the use of multi-wall VR spaces (such as simCave) in ITE has only just begun due to its emergence as a relatively new practice. However, several studies have investigated 360-degree VR simulations provided through head-mounted displays (Theelen et al., 2019; Kosko et al., 2021). Such studies supported the use of 360-degree video in ITE and demonstrated that this approach develops pre-service teachers' ability to notice classroom events better when compared to traditional video. Theelen and colleagues (2019) further found that pre-service teachers using 360-degree video improved in applying theory-based terminology to describe classroom events, while Kosko's team (2021) found that they also attended to more student actions having better situational awareness.

CAVE rooms possess a number of features that make them ideal for immersive collaborative learning activities. One clear advantage over head-mounted displays is that CAVE rooms do not isolate users, allowing multiple users to share and collectively benefit from simulated learning experiences.

Commentary from the University of Newcastle on simCave

"University of Newcastle is using simCave to immerse pre-service teachers in a range of different school settings – rural and remote, multicultural, special and inclusive education, Indigenous community schools, etc. SimCave transports them to the school through the eyes of a student and a teacher. The simCave also provides opportunity to zoom into the school and speak with the teacher or principal during the experience. Although in its infancy at University of Newcastle, students are learning to be users of the technology as well as creators of 360-degree content for the learning space and their specific learning areas or phases of learning."

Professor Susan Ledger, Dean of Education, University of Newcastle.

Building competencies and confidence with virtual reality

VR environments mimicking realistic scenarios have opened new possibilities and opportunities for situated learning experiences in ITE programs. These simulations allow pre-service teachers to practise and demonstrate teaching skills in safe and controlled environments, building their confidence. VR classroom contexts can be customised to successively increase in complexity and challenge, to scaffold and support gradually building the confidence of pre-service teachers. Virtual classrooms can therefore serve as intermediate preparatory experiences between

coursework and practical placements or actual teaching. General ways that virtual classrooms can provide opportunities to build competencies and confidence in classroom management include the following (McGarr, 2020; Huang et al., 2021):

- Bridge theory-practice gaps in teacher education: Simulated classroom environments can provide pre-service teachers with opportunities to transfer theoretical understanding to practical applications, applying pedagogical knowledge gained to realistic situations to develop competencies and confidence with classroom management.
- Cyclic process of feedback and practice: Pre-service teachers can engage in an iterative process of feedback and practice, adjusting their teaching strategies accordingly. Lessons can be modified until pre-service teachers feel confident in their capabilities.
- Customised learning experiences: Personalised learning environments can be tailored to specific learning needs of individual pre-service teachers, allowing them to focus on areas in need of support or practice.
- Inclusive education: VR classroom environments can provide pre-service teachers with opportunities to practise their teaching skills with under-represented minority groups, which can be challenging to access in real-world classroom settings. These experiences can help pre-service teachers develop inclusive and culturally responsive teaching practices and prepare them for working with diverse student populations.
- Manage challenging behaviours: Contend with aspects of challenging pupil behaviour in less pressurised environments without negative repercussions. Allows pre-service teachers to develop resilience and build coping mechanisms in controlled settings.
- Manage difficult conversations with parents/carers: Developing positive relationships with parents or carers is an important part of the role of a teacher. Simulation allows pre-service teachers to practise strategies to effectively work with parents and carers.
- Increased Accessibility: Many VR classroom environments can be accessed from anywhere with an internet connection, allowing pre-service teachers to engage in professional learning experiences without the constraints of time or location.

The above benefits of VR simulation platforms for pre-service teacher education are likely to premise their continual development and expansion across ITE programs. These technologies, when implemented effectively, add a level of authenticity to university-based learning experiences and help address any deficiencies in practical placements. The latter being important as pre-service teachers may not observe mentor teachers using effective classroom management strategies (Huang et al., 2021).

Simulation apprenticeship

VR classroom environments can provide pre-service teachers with a form of “simulation apprenticeship” (Zibit & Gibson, 2005). Pre-service teachers who engage with these resources can gradually build their understanding of classroom management and develop their teacher identity through an apprenticeship-style learning approach. The traditional paradigm relies largely on practical placements within schools, where pre-service teachers come to understand effective classroom management practice by observing and working with mentor teachers while on the job. VR simulations afford more apprenticeship opportunities for pre-service teachers. Simulated learning experiences can offer pre-service teachers valuable practice time for experimenting with different classroom management strategies before or between real classroom experiences.

Research suggests that pre-service teachers who gain more professional experience tend to develop greater confidence in engaging students and managing classroom behaviour (Colson et al., 2017; Fischetti et al., 2022; Donnelly et al., 2023).

“A new teacher entering the classroom is like a novice pilot flying an airplane for the first time. While the simulation is certainly a simplified model of a real classroom, it nonetheless offers focused training possibilities—just as a flight simulator, while not a real airplane, is an adequate environment for training pilots.”

–Zibit & Gibson, 2005, p2.

Learning to teach is not just a matter of acquiring knowledge and skills in isolation but is instead an active process of participation and engaging in authentic tasks and activities (i.e., situated learning^[8]) (Lave & Wenger, 1991; Ledger & Fischetti, 2020). Pre-service teachers begin as apprentices and aim to become classroom ready graduates through engagement, gradual understanding and building of confidence to link theory and practice. Using VR learning environments allows ITE programs to provide better communities of practice, where educators and pre-service teachers can together actively engage in teaching and learning classroom management. Establishing a community of practice benefits all invested parties and from an ITE provider perspective, it allows for greater control over pre-service teacher preparation prior to and in addition to practical placements. In this way, pre-service teachers can develop confidence with classroom management by having more opportunities to practise their teaching skills and ultimately become classroom ready.

View to the future

Extended reality (XR) is an umbrella term encompassing several forms of technologies that blend digital and physical worlds, including virtual reality (VR), augmented reality (AR), and mixed reality (MR), and is predicted to be one of the most transformative technological trends over the next 10 to 20 years (KPMG, 2022; Gupta, 2023). While VR requires users to view simulated 3D computer-generated environments, AR instead superimposes computer-generated input, such as images, sound, and graphics on a user's view of the real world, providing a composite view in real time (e.g., Pokémon Go). MR is an extension of AR that allows users to interact with virtual objects in the real world (Southgate et al., 2019; Reiners et al., 2021). The XR market is projected to grow from AUD 27.2 billion (USD 18.4 billion) in 2022 to AUD 674.5 billion (USD 457.06 billion) by 2030 (Gupta, 2023). Moreover, XR technologies are touted by global experts as ‘evolving rapidly’ and at a ‘point ready to fundamentally transform learning forever’ (KPMG, 2022).

“Within 10 years, we will spend more of our waking time in the 3D world, in the virtual world than we will in the physical world.”

–Alvin Graylin in KPMG, 2020, p6.

Perhaps the greatest technological advancement to come in this space will be with AI. AI is expected to have a significant impact on the development and enhancement of XR experiences, especially when it comes to computer-generated people (e.g., virtual students). While emulating the complexity of human behaviour presents challenges, AI development is focusing on enhancing human-like entities to replace humans more effectively on various XR platforms

(Reiners et al., 2021). Such an advancement in VR would have the potential to supersede human-in-the-loop technologies, allowing for greater scalability beyond the use of paid actors (avatars). However, greater AI power may also bring challenges, and ethical considerations in the higher education context become very important for protecting the rights of both staff and students.

[Read more](#) about what it means for an AI system to make human-like decisions and the ethics and equity considerations for the use of AI in higher education.

Although still regarded somewhat as science fiction, all roads are seemingly leading to the “metaverse”, an AI-supercharged immersive virtual world facilitated by the use of VR head-mounted displays (KPMG, 2022). Imagine a virtual world where like-minded users, through digital avatars, explore, share, and interact together in real-time. The implications for learning beyond the confines of traditional settings would be extraordinary with such technological advancements. ChatGPT, an AI chatbot developed by OpenAI (released November 2022), was asked about the future of AI:

AITSL’s dialogue with ChatGPT (captured 02/5/2023)



How will artificial intelligence be further developed in the future?



Artificial intelligence (AI) is an ever-evolving field, and there are several ways in which it is likely to be developed further in the future. Here are some of the potential directions for AI development:

1. **Deep Learning:** Deep learning is a subfield of machine learning that uses artificial neural networks to model and solve complex problems. Deep learning has already shown significant progress in areas such as image and speech recognition, and it is likely to be further developed to enable AI to solve more complex problems.
2. **Reinforcement Learning:** Reinforcement learning is a type of machine learning that involves training AI systems by rewarding them for making correct decisions. This approach has shown promising results in areas such as game playing and robotics, and it is likely to be further developed to enable AI systems to make more sophisticated decisions in more complex environments.
3. **Natural Language Processing:** Natural language processing (NLP) is a subfield of AI that focuses on enabling computers to understand, interpret, and generate human language. NLP has already made significant progress in areas such as language translation, sentiment analysis, and chatbots. It is likely to be further developed to enable AI to understand and respond to more complex natural language queries.
4. **Explainable AI:** Explainable AI (XAI) is an emerging field that aims to make AI systems more transparent and understandable to humans. This is particularly important for critical applications such as healthcare, where the decisions made by AI systems can have a significant impact on human lives. XAI is likely to be further developed to enable humans to better understand how AI systems arrive at their decisions.
5. **Quantum Computing:** Quantum computing is a new paradigm of computing that has the potential to significantly accelerate the development of AI. Quantum computers can solve certain types of problems much faster than classical computers, which could enable AI systems to process larger and more complex data sets.

Overall, the development of AI is likely to continue at a rapid pace, and it is likely that new and exciting applications of AI will be discovered in the years to come.

Regenerate response

Send a message.

“In 2030, I believe a large portion of students will be attending higher education through a VR campus empowered by AI tutors. ”

–Taylor Freeman in KPMG, 2020, p32.

While hypothetical, potential applications of XR and AI technologies in ITE may be limited only by the imagination, the reality of development and design poses a major hurdle. Overcoming technological hurdles to improve XR and AI applications may also be costly in the short term (e.g., technical infrastructure costs), but products produced, in this case virtual learning environments, could be distributed economically at scale. Conversely, ongoing costs associated with implementing human-in-the-loop technologies in ITE (e.g., training & paying actors) limit the scalability of this technology (Huang et al., 2021). Technical infrastructure such as AI engines and

3D modelling software is an obvious pre-requisite for future development in the ITE context. Importantly, there are several design elements specific to teacher education that warrant being addressed, including issues of presence and teacher proximity.

Presence

The technical requirements for developing the physical components of XR applications in ITE should not be as challenging as, for example, surgical training, which requires finely tuned haptic or tactile capability. Instead, demands for education, where the priority is human interaction, are focused on presence, smooth rendering and clear audio. One primary goal of XR innovation is to make the learning experience as immersive as possible, to improve the sense of presence pre-service teachers have in virtual classroom environments. The complex psychological feeling of 'being there' in the virtual environment has been associated with higher motivation and enjoyment in learning (Weber et al., 2021; Huang et al., 2021). Skilled graphic designers using 3D modelling software can design realistic settings, but presence (including perceived realism) is also dependent on interactivity with virtual students. Despite simulations moving towards using computer-generated bots as virtual students, considerable advancement in AI is first needed to completely exclude humans from performing student roles. In the interim, human-in-the-loop technologies that merge AI and human intelligence to create student avatars, provide a workable and beneficial platform.

Teacher proximity

XR development in ITE should ideally allow for pre-service teachers to move around virtual classroom environments, allowing for teacher proximity in classroom management. Teacher proximity refers to the physical distance between the teacher and students during instruction or classroom activities. As physical closeness is known to have a significant impact on student behaviour and engagement, it is a valuable technique that should be included in every teacher's repertoire of classroom teaching skills. One limitation of simulated learning environments used currently in ITE programs is restricted motion, and therefore pre-service teachers have limited capacity to practise proximity control.

Conclusion

It is crucial that pre-service teachers graduate being classroom ready with a comprehensive set of classroom management strategies that enhance their resilience and confidence. Pre-service teacher competencies and confidence are built through opportunities to engage in authentic classroom tasks and activities, especially during practical placements within schools. VR-based classroom simulations can provide pre-service teachers with additional opportunities to develop, practise and demonstrate their teaching capabilities, including classroom management skills, in preparation for diverse and often challenging classroom and school contexts. VR platforms can offer safe, customisable, learning environments for personalised pre-service teacher education, enabling ITE programs to have a greater impact on the preparation of Australia's future teachers.

The challenge for ITE providers is to continue advancing the application of simulation technologies in pre-service teacher education. VR and AI technologies are developing rapidly and their use in pre-service teacher education has only gained momentum in the past decade.

Nevertheless, emerging research suggests that these technologies can markedly enhance pre-service teacher development by helping them become more classroom ready. The benefits of VR simulation platforms for pre-service teacher education should drive continual development and expansion across ITE programs. It is commendable that many Australian ITE providers are leading the way in implementing and researching simulation technologies and developing a strong national community of practice in the field.

Footnotes

1. AITSL has developed a Supervising Pre-service Teachers (SPT) [online training program](#) to support mentors with supervising pre-service teachers. The program is relevant to teachers who are supervising a pre-service teacher or thinking about a supervisory role. It may also be useful for school leaders, school-based practicum coordinators, and those taking on other mentoring roles.
2. Self-assessment encourages pre-service teachers to evaluate their own teaching practice, identify strengths and weaknesses, and set goals for improvement. This process fosters the development of teaching proficiency and confidence.
3. Immersion in virtual reality refers to the feeling of being fully absorbed and engaged in a virtual environment, to the point where the user forgets about their physical surroundings and feels as though they are actually present in the virtual world.
4. An artificial intelligence (AI) engine is a software program that provides the underlying infrastructure for building and deploying AI applications (e.g., chatbots, video games & virtual assistants). They are designed to handle the processing and analysis of large amounts of data, using various algorithms and models to perform tasks such as natural language processing, image recognition, decision-making, and predictive analytics.
5. Reflection-on-action in teaching refers to retrospective contemplation of one's own practice to encourage ideas on what needs to be changed for the future.
6. Identity in teaching refers to the beliefs, values and commitments an individual holds toward being a teacher. Teacher identity plays an important role in classroom competencies and confidence.
7. Self-efficacy in teaching refers to a teacher's belief in their own abilities to effectively carry out the tasks and responsibilities associated with teaching. Teachers with high self-efficacy tend to set challenging goals, persist in the face of obstacles, and employ various pedagogical strategies to meet the diverse needs of their students.
8. Situated learning posits that learning occurs through authentic activities, context and culture, and places great emphasis on relationships and interactions with others in order to build understanding.

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