

Development of a novel Immersive Virtual Reality Classroom for student teachers to practice their Microteaching Skills

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Microteaching is a well-studied and practised area of teacher training. This paper addresses an under-explored area in an Irish context by detailing the development and implementation of a purpose-built Immersive Virtual Reality (IVR) classroom designed as a platform to allow trainee teachers to practice and develop their microteaching skills. IVR has the potential to enhance immersion, increase motivation and engagement, and possibly improve learning outcomes. Through repetition, student teachers are given the opportunity to practice and learn how to teach in a safe virtual environment. The skills practised in the virtual classroom may translate to real-world teaching environments. The paper presents the development through co-design of MiTeachVR an IVR prototype with the potential to form a new paradigm in teacher training as an additional safe method that will allow student teachers to learn through repeated practice and self-reflection in a purpose-built virtual classroom.

Keywords: Virtual Reality, Prototyping, Co-Design, Microteaching Skills, Teacher Training, Theoretical Knowledge, Classroom Practice

Three Key Highlights:

- Microteaching affords student teachers the opportunity to practice, reflect and refine their teaching skills in a safe environment.
- IVR creates a highly interactive, three-dimensional environment that immerses users in a computer-generated world.
- MiTeachVR is a novel IVR system as a tool for independent microteaching practice.

Introduction

The training of skilled teachers is of societal importance nationally and internationally (Bakır, 2014), as is the development of pre-service teachers' professional competence (Depaepe and König, 2018), before they embark on their teaching career. Having classrooms with qualified and experienced teachers is deemed to be a high priority in any society (Alonso *et al.*, 2021). A report on "School Placement in Initial Teacher Education" in the Irish education system recognises the importance of School Placement for the professional learning of student teachers, as it provides "diverse and extensive opportunities to learn the art, craft and science of teaching" (Hall *et al.*, 2018, p. 12). The report indicates that partnerships between Schools and Higher Education Institutes (HEI) are needed to enable the integration of practice and theory. However, it highlights the challenges in securing school placements for both student teachers and HEI's (Hall *et al.*, 2018).

Microteaching: Microteaching is part of the repertoire of learning tools used in Initial Teacher Education (ITE). It is a carefully planned teaching session where student teachers deliver short, focused lessons to practice and improve their teaching skills in a controlled, safe, and supportive environment (Singh and Sharma, 2010; Remesh, 2013; Hama and Osam, 2021). It affords an opportunity for reflection while providing feedback to student teachers about the effectiveness of their teaching (Patil and Bhuiyan, 2015). Microteaching resides between the theoretical knowledge of teaching and classroom training, bridging the gap between theory and practice (Griffiths, 1977; Brent, Wheatley and Thomson, 1996; Fernández, 2005; Ledger and Fischetti, 2019).

Immersive Virtual Reality: IVR is a technology that simulates realistic scenarios in a virtual environment (VE) that users perceive as comparable to the real world (Hoffman, 2004; Makransky and Lilleholt, 2018; Kuleto *et al.*, 2021). VR has been widely adopted in other areas of professional training including engineering, science and nurse education (Abulrub,

Attridge and Williams, 2011; Liou and Chang, 2018; Chang and Lai, 2021). It has only recently been adopted in teacher education programs (Huang *et al.*, 2023), with limited uptake in ITE programs (Ledger and Fischetti, 2019). With the emergence of simulated virtual learning environments, IVR has transitioned from being a technology used in the classroom to a technology that is the classroom and has been termed “Microteaching 2.0” (Ledger and Fischetti, 2019). Microteaching 2.0 represents a significant advancement in ITE, combining traditional pedagogical methods of microteaching with advanced IVR technology to prepare student teachers for teaching in the real world.

MiTeachVR: MiTeachVR, which stands for ‘Micro-Teaching in Virtual Reality’ is a purpose-built prototype virtual classroom that helps bridge the gap between theory and practice in teacher education. It allows student teachers to practice their fundamental teaching skills in a life-size virtual classroom, record their sessions, and reflect on their performance through a playback option. The system captures the student teachers' voice, hand and head movements, and simulates various teaching activities such as using a PowerPoint presentation and writing on a whiteboard. MiTeachVR provides a safe space for student teachers to practice their skills in a virtual environment, and may be particularly beneficial for those who have not yet taught in a physical classroom. While it is not a replacement for school placements, MiTeachVR complements microteaching and offers an opportunity for independent practice before embarking on a school placement.

This paper outlines the development and testing of the MiTeachVR system with students and lecturers, and presents the preliminary feedback from participants.

Methods – System Development

Co-Design: Co-Design involves the active participation of various stakeholders including end-users in the design process, with the intention that it will lead to improvements and innovation (Burkett, 2012; Dollinger and D’Angelo, 2020). The MiTeachVR system was developed using a collaborative co-design approach, which involved designers, developers, microteaching subject-experts and end-users working together to create software that meets the needs and expectations of student teachers as potential users. The development process consisted of five stages; including design, alpha and beta versions, live prototyping, and data collection as shown in Figure 1. Each stage was crucial to ensure that the system was functional and reliable while providing insights and improvements during the development trajectory.

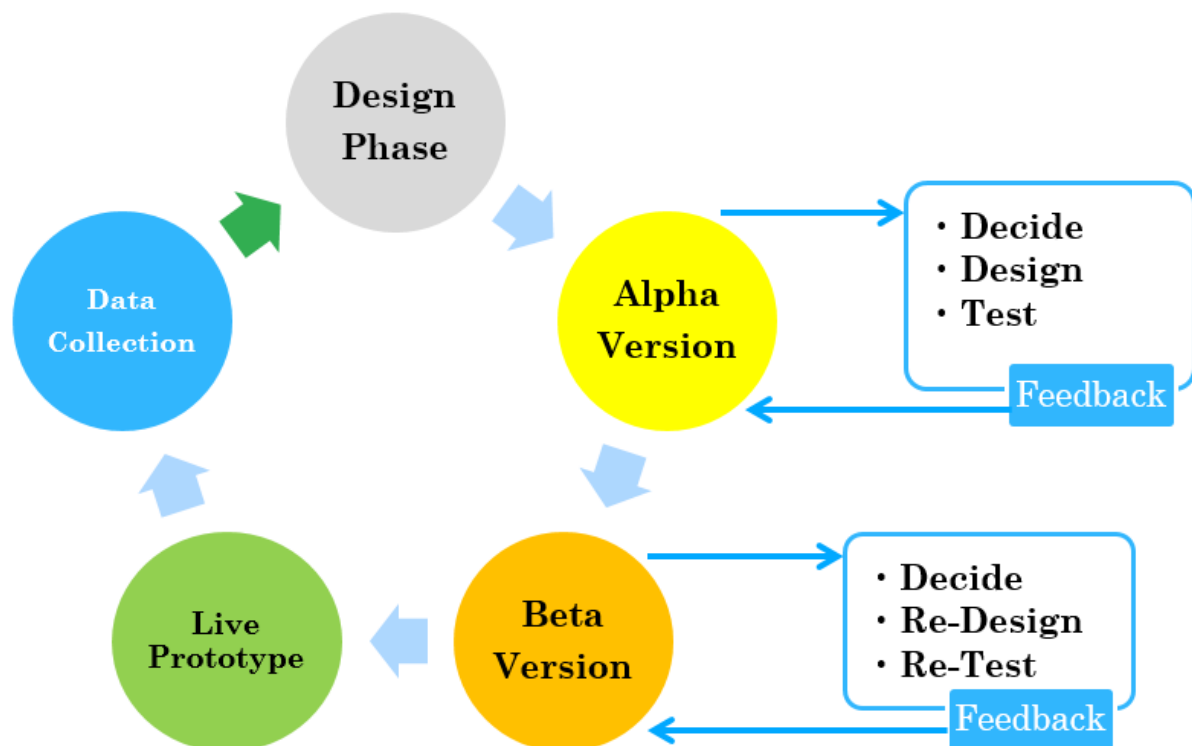


Figure 1. MiTeachVR Design Process Cycle

Design Phase: This stage involved requirements gathering and mapping of microteaching skills that could be enacted in a virtual classroom. The system design was created by defining what would be incorporated into the MiTeachVR system based on the capabilities and limitations of the software and hardware. The development platform used was Unity and the hardware was the Oculus Quest 2. The MiTeachVR system is designed as a full-scale classroom environment with a diverse mix of avatars, allowing student teachers to experience what it is like to stand in a classroom in front of students. Users can upload a PowerPoint allowing them to deliver their lesson using suitably selected teaching materials. A virtual whiteboard allows users to select a pen and write on the board in a similar way they would in the real world. Another function mimics the distribution of class materials to students, with a further function to recognise if users are aware of avatar interactions during a lesson. The system can capture verbal and non-verbal communications as it records the user's voice as they deliver their lesson, and tracks their position, head and hand movements as they navigate around the classroom using handheld controllers or by walking in the real world. Through the playback function users can reflect on skills including how they presented their lesson, considering timing, flow, progression, clarity of voice and appropriate language used. By critically evaluating and self-reflecting on their teaching performance, student teachers can identify strengths and areas for improvement. In consultation with their lecturers, the recording can be viewed to obtain further feedback.

Alpha Version: The alpha version incorporated a simple design (Figure 2) with rudimentary features and functionality. This allowed the system to be tested, including checking the scale of the classroom in VR, the layout and position of artefacts as well as its functionality and usability. Internal testing by the development team identified some bugs. External testing by student teachers identified further areas for improvement. These changes were incorporated into the system, leading to the development of the beta version.

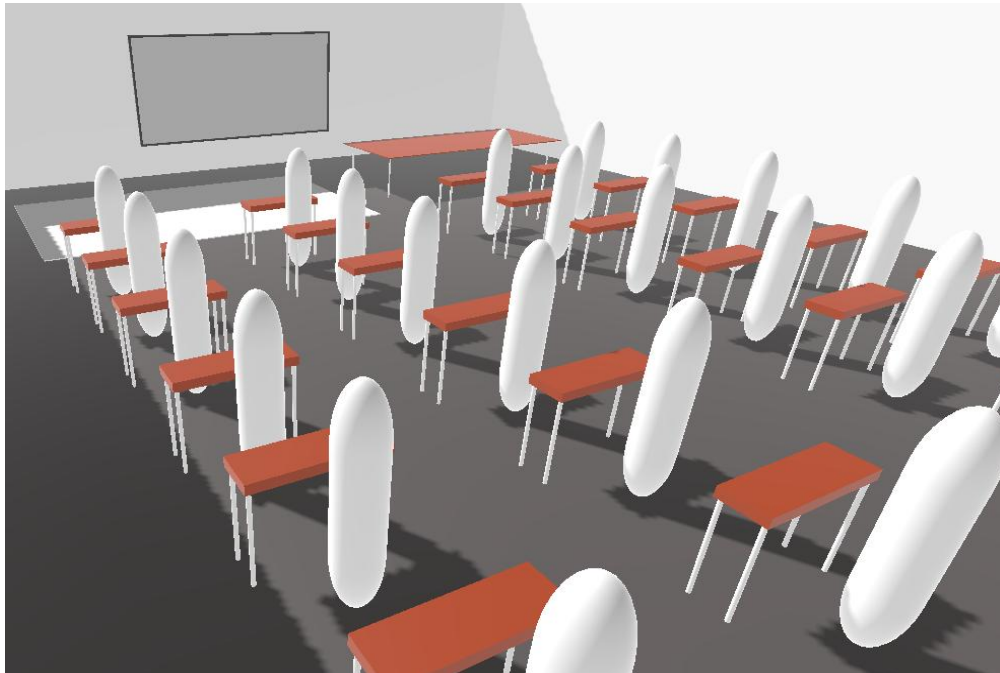


Figure 2. MiTeachVR Alpha version Classroom Design

Beta Version: The MiTeachVR beta version was released to external testers including student teachers and lecturers, who were instructed on how to use the system. After using the system, they provided feedback through short interviews. This iterative process resulted in suggestions for improvements, which were incorporated into the system, followed by a system feature freeze where no new features would be added. This resulted in a stable system focusing only on bug fixes and performance. The final changes incorporated into the system included classroom aesthetics, artefacts (tables, clock, wall art etc.) and avatars. Following further internal and external testing the system was released as the live prototype version. Iterative development helps in identifying and resolving issues early, adapting changes and requirements, and ensuring that the final system closely aligns with user needs (Lewrick, Link and Leifer, 2020).

Live Prototype: The live prototype version (Figure 3) incorporated the functional and aesthetic improvements, which were tested with student teachers and lecturers involved in microteaching. The purpose was to gather their opinions and views on the usefulness of the MiTeachVR system.



Figure 3. MiTeachVR Live version Classroom Design

Data Collection: The data was collected with student teachers and lecturers. Student teachers participated in two sessions, a training session to learn how to use the system, followed a week later by a live microteaching session in the MiTeachVR classroom. Students uploaded a PowerPoint to the MiTeachVR system and recorded themselves completing their teaching session. This was followed up by playing back their session and reviewing their performance.

Lecturers were asked to review a previously recorded ‘phantom’ student session with the intention of providing feedback to the ‘phantom’ student. They were also asked to upload their own PowerPoint presentation, deliver their teaching session, and review their session to understand the capabilities of the MiTeachVR system. This was useful as they also experienced the system from the student’s perspective.

After the sessions, the participants took part in a semi-structured interview to get feedback and gather their experience of the MiTeachVR system.

Data Analysis: Based on short interviews following the beta phase, a number of deductive themes were used to guide the semi-structured interviews following the alpha phase. The semi-structured interviews were analysed using Braun and Clarke's (2022) six-phase Reflective Thematic Analysis (RTA), following a predominantly inductive approach to find patterns in the data to create a codebook to help interpret and explain the participants' experiences.

Preliminary Data: Due to the limitations of this paper it is not possible to explore in-depth the identified themes, instead a brief synopsis of the data will be presented. In general, participants were positive towards the MiTeachVR system and its capabilities. Participants felt the system has the potential to help improve student confidence, presentation skills and public speaking. This indicates that it is a safe environment for student teachers to practice, make mistakes, review their performance and learn through self-reflection. Some student teachers reported that they felt anxious while participating in traditional microteaching sessions and were very conscious of their peers and any mistakes they could potentially make while delivering their session. They indicated that the MiTeachVR classroom allowed them to make mistakes and restart the session without feeling pressure to perform in front of their peers.

Participants found the record and playback function to be advantageous with the potential to help improve teaching practice by enabling students to watch and listen to their recorded session in the VR environment. They could analyse their teaching performance, learn from it, and potentially make changes to improve their teaching. Some participants felt

it was a safe environment for them to review their performance in private away from their peers.

Some participants saw the potential to be able to use the MiTeachVR system beyond microteaching, indicating that it would be useful to practice and plan for future real-world classes. All the student participants indicated that they would be willing to use the MiTeachVR system as part of a microteaching module. They indicated the potential to use the MiTeachVR system as an independent learning tool to practice on campus or at home. Some participants felt that a dedicated space for using the MiTeachVR system would be of benefit as it would reduce the setup time.

From a technical perspective, the majority of participants found the system straightforward and easy to use, especially after the initial training session, although a small number indicated that they might require some technical support. The majority of the participants indicated that they liked the environment design, functionality and the ability to navigate around the virtual world as they walked in the real-world. A small number of students were ambivalent towards the system as they felt uneasy while immersed in the VR classroom as they were unsure if they would walk into physical objects in the real-world environment. The majority of participants liked the avatars and felt they were diverse. Some commented on the lack of interactivity and felt that being able to interact with the avatars would increase the level of realism within the virtual classroom.

Ethical Considerations

“Ethics are the principles of what is, and what is not, acceptable behaviour when carrying out research” (Walker, 2010, p. 247). This research involved the participation of human volunteers. Ethical considerations of confidentiality and anonymity were very carefully considered. Participants were using IVR headsets in which they were immersed in a

virtual classroom and away from the real-world, which may lead to a sense of vulnerability. At every step of the research, clear instructions and boundaries were in place to protect the participants and the researcher. According to Walker (2010), the main principle that should underpin our research is that participants should come to no harm as a result of participation and they should exit the research in the same condition they entered.

Participant Selection: Convenience sampling was employed to recruit participants, 18 years and above. To be eligible students had to be registered on a teacher education programme, and participating in or recently participated in a microteaching module. Lecturers were recruited if they were teaching on a microteaching module.

Plain Language Statement, Consent Form and Right to Withdraw: All participants were provided with a copy of the Plain Language Statement (PLS) outlining the nature of the research and what participation involved. Participants consented to take part in the research by reading and signing a Consent Form. The PLS and Consent Form emphasised confidentiality and anonymity, and clarified that participation was voluntary and withdrawal for any reason was acceptable and participants would not be disadvantaged in any way.

While every effort was made to provide anonymity, the very nature of in-person research diminishes anonymity at the point of testing. However, any data collected was anonymised. Where a participant withdrew from the research their data was excluded from the analysis and deleted from the data set.

Discussion

A collaborative design approach was paramount within this research, by involving end-users in the project at an early stage. This was beneficial in terms of understanding the end-user needs and expectations. Focusing on potential users of a solution is a key element of design thinking (Lewrick, Link and Leifer, 2020). By involving end-users (student teachers

and lecturers) in the design process, the system was developed to meet their needs and expectations, leading to several rich and diverse suggestions in terms of functionality. The ideas, suggestions, and clarification helped keep the project moving and contributed to its development. However, it was impossible to include every suggestion in the final system. Managing end-user expectations and the iterative nature of co-design can be complex and time-consuming; however, the benefits outweigh the challenges. Involving end-users throughout the development created a sense of commitment and buy-in, leading to greater support and advocacy for the final MiTeachVR system.

The preliminary results showed positivity towards the MiTeachVR system and its potential use as a tool in microteaching and align somewhat with the work of Ledger and Fichetti (2019), where students indicated that Microteaching 2.0 reinforces reflective practice, improved preparation and confidence for real-world classrooms. In general, participants did not see the MiTeachVR system as a replacement for traditional microteaching practice; instead, they indicated that it could be used in conjunction with traditional delivery methods. This may shift the role of lecturers involved in microteaching as the delivery of microteaching lessons and practice is reimaged. The MiTeachVR system has the potential to be further developed and may have a role in ITE.

Limitations

The MiTeachVR system is a novel concept prototype with limitations in its capabilities and functionalities. One of the weaknesses of the MiTeachVR system is the lack of interaction between the student teacher and the avatars, which may detract from the experience depending on the microteaching skill being practised by the student teacher during a specific practice session. This could be addressed in future versions with the possibility of incorporating artificial intelligence to create an interactive teacher and student environment.

The initial investment to introduce the MiTeachVR system and any on-going associated costs may be prohibitive especially considering the financial constraints HEIs are currently facing.

Conclusion

Based on the feedback from participants, the MiTeachVR system has the potential to enhance microteaching in ITE within HEIs. While it is not a solution to the placement issues for student teachers or a direct replacement for current traditional microteaching practices, it has the potential to reshape how microteaching is delivered in ITE, providing opportunities for independent and flexible learning and classroom readiness for student teachers transitioning to real-world classrooms. The MiTeachVR system offers a safe, repeatable, and reflective space for student teachers to engage in experiential learning. The insights ascertained from this research demonstrate how microteaching pedagogy can be reimaged with the rise of new technologies and may be of interest to teacher educators, policy makers, Governmental and other teaching stakeholders when planning for the future microteaching needs for student teachers. Through further collaborative development with student teachers, lecturers and external stakeholders, the MiTeachVR system may prove to be an effective valuable tool in the delivery of microteaching practice in ITE.

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