Measuring the effects and feasibility of virtual reality in developing empathy among medical students in a paediatric setting

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Abstract

Background: Delivering empathetic care is an integral part of clinical practice and has been shown to directly impact patient outcomes. Virtual reality (VR) technology offers a resource and time-efficient method to enhance empathy skills in medical students by providing a unique insight into patient perspectives.

Objective: Our study aims to evaluate the effectiveness and feasibility of incorporating VR technology into a medical student curriculum to improve empathy in a paediatric setting.

Methods: Using a virtual-reality headset, participants experienced a short paediatric clinical scenario, depicting a ward round from the viewpoint of a child. The Jefferson Scale of Empathy questionnaire, which measures empathy in physicians, was completed pre- and post-VR experience. Participants also completed an anonymous survey at the conclusion of the session, which included open-ended questions about the VR experience.

Results: There was a significant increase in self-reported mean empathy scores post VR experience ($p < 0.0001$). Qualitative analysis of the open-ended survey questions about the VR experience identified four key themes. These included lack of involvement of the patient (child) in the clinical encounter, minimal introduction and communication with the patient and carer, the overwhelming nature of a clinical consult and the importance of considering a patient's perspective.

Conclusions: VR technology is an effective educational modality to improve self-reported empathy in medical students immediately following the intervention. As VR is resource and time efficient, it has considerable potential to be implemented into existing educational activities for healthcare students and professionals.

Keywords: medical education; virtual reality (VR); empathy

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Background

Empathic clinical practice, where healthcare professionals are able to understand patients' perspectives, is widely recognised as an essential skill in the delivery of quality healthcare. Research has shown that empathy not only improves patient satisfaction following a clinical encounter (Kim et al., 2004; Walsh et al., 2019; Wang et al., 2018) but also enhances the therapeutic relationship, leading to better clinical outcomes (Derksen et al., 2013; Hojat et al., 2011; Lelorain et al., 2023) and improved treatment adherence (Kim et al., 2004). Empathic clinical practice is particularly important in paediatrics, as children are less likely to be able to articulate their thoughts or feelings, meaning that healthcare professionals need to imagine themselves "in the child's shoes" in order to connect with the child and understand their perceptions. This assists the professional to proceed and respond in an appropriate way.

Empathic practice is now widely integrated as a fundamental part of the medical school curriculum (Patel et al., 2019). Despite this, longitudinal research indicates a decline in empathy in medical students and doctors over time (Hojat et al., 2009) and that there is a negative correlation between burnout and empathy in healthcare staff (Wilkinson et al., 2017). Various influences including, but not limited to, performance pressures, negative role modelling and lack of targeted programs beyond medical school have been shown to contribute to this fading empathy (Neumann et al., 2011).

Reassuringly, research suggests that core skills, such as compassion and empathy, can be nurtured and taught (Batt-Rawden et al., 2013). Several educational approaches have been utilised and shown to be effective in cultivating and enhancing empathic skills in medical students. These include engaging in reflective practice, roleplay, role modelling and simulation (Batt-Rawden et al., 2013). Additionally, explicit teaching of empathic values through didactic methods has been shown to be successful in combination with practical training (Batt-Rawden et al., 2013). Although effective, many of these suggested methods, for example, simulation training, are time and resource intensive.

Virtual reality (VR) is a computer-based simulation program that aims to create a 4-dimensional experience for the user. This technology has been increasingly adopted into educational environments as a learning tool. Once created, VR is a time- and energy-efficient resource that has been shown to be effective in improving self-reported empathy in healthcare settings (Hu & Lai, 2022; Tay et al., 2023; Thng et al., 2022). Hu & Lai (2022) used VR to assess empathy in dental students, measuring empathy before and after the students experienced a VR scenario portraying the viewpoint of a child attending the dentist. This study demonstrated a significant increase in empathy scores immediately post intervention and an increase in self-perceived confidence in communicating and interacting with children (Hu & Lai, 2022). In addition to this study examining dental students' empathy scores after a VR experience, there have been two recent studies examining the impact of a VR experience on medical students' empathy. Alieldin

et al. (2024) showed improvement in post-test empathy scores for first-year medical students following an immersive VR experience depicting older adults struggling with social isolation, and Lin et al. (2024) conducted a case control study, which identified improved understanding of depressive disorders in medical students who experienced a VR experience of a depressed medical student. Our study is the first that aims to evaluate the effectiveness and feasibility of incorporating VR technology into a medical student curriculum to improve empathy in a paediatric setting.

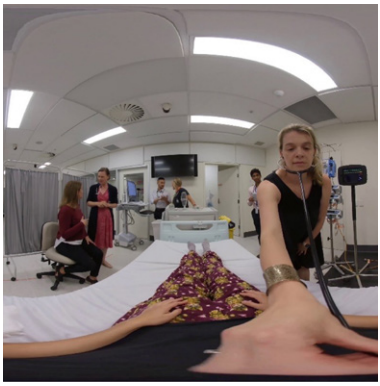
Method

Concurrent quantitative and qualitative data collection methods were used to evaluate the empathy of participating medical students. Medical students participated in a VR experience depicting a clinical scenario between May 2020 and August 2022 and completed a pre- and post-VR empathy questionnaire followed by an open-ended survey after the VR experience. This study spanned more than 2 years due to the impact of the COVID-19 pandemic on data collection.

The study was conducted at a single tertiary-level paediatric hospital in Australia. Ethics approval was obtained from the Royal Children's Hospital Ethics Committee (Reference Number 62638) to survey medical students' perspectives after a VR experience.

Image 1

2D Still From VR Scenario



A recording of a short clinical scenario from the point of view of a child admitted with asthma was created for the study. The scenario lasted 2.5 minutes and commenced with a nurse administering salbutamol to the child ("viewer") via a spacer followed by an intentionally chaotic review by the medical team (Image 1). The medical review included multiple team members simulating a ward round and initiating minimal interaction with the child, several overlapping conversations, unclear instructions and abrupt departure. The viewer was immersed in the scene through the use of a VR headset (Oculus Quest, Facebook Technologies LLC), with freedom to choose where they focused their vision

and attention. They were seated with their feet off the ground to simulate the body positioning of the child, who was lying in a hospital bed in the scenario.

The study participants were Doctor of Medicine (medical) students who were on their child and adolescent health placement at a tertiary-level teaching hospital. They were in the third year (of 4 years) of their post-graduate Doctor of Medicine course. Approximately 200 medical students per year were notified about the study at structured teaching sessions, and 22 students opted in to participate. All participants received a plain language participant information sheet before providing written consent.

Measures of empathy were anonymously obtained using numerically matched pre- and post-experience Jefferson Scale of Empathy (JSE) questionnaires (Hojat, Gonnella, Nasca, Mangione, Veloksi, & Magee, 2002). The JSE questionnaire includes 20 questions, responded to on a 7-point Likert-type scale, with a higher score indicating a more empathic behavioural orientation. Further information was collected through an online survey completed at the completion of the session, which explored the students' experience of VR, using open and closed-ended questions. There were four open-ended questions that asked students how the VR experience enhanced their understanding of paediatric patient experiences, what the scenario made them reflect on, what they would change in their own practice on the basis of the scenario and how the experience could be improved for VR use in the future.

Scores for empathy were calculated from the questionnaire as per the scoring algorithm provided by Thomas Jefferson University (Hojat, Gonnella, Nasca, Mangione, Vergare, & Magee, 2002). A Shapiro-Wilk test confirmed normal distribution of pre-test empathy scores. The mean empathy scores pre- and post-VR experience were calculated and compared using paired t-tests. The Cohen D score was calculated as a measure of the effect size, or standardised mean difference, of the overall empathy scores. Data for the three main components of the questionnaire, "perspective taking", "compassionate care" and "standing in patient shoes", were analysed separately, and the mean scores for each component were compared. Qualitative data collected from the open-ended questions in the VR survey were analysed using inductive content analysis (Vears, 2022) to identify themes that had direct relevance to practice. Researchers CVH and NN read and familiarised themselves with the text answers and identified key areas of content, then they undertook line-by-line coding to understand the detail within participant responses. They later convened to discuss and compare their coding decisions, collaboratively developing the final themes.

Results

There was a total of 22 participants; 17 (77%) were female, and 16 (73%) were 22–24 years old, with the full age range being 22–36 years old. Whilst approximately two thirds had previous experience with VR, only one participant had encountered VR depicting a clinical scenario.

There was a significant increase in empathy scores following the VR scenario. The mean pre-VR empathy score was 113.9 (SD 7.6) and the mean post-VR empathy score was 122.5 (SD 8.1) ($p < 0.0001$). The Cohen D score was 1.1, indicating a large effect. Of the three components of the empathy questionnaire ("perspective taking", "compassionate care" and "standing in patient shoes"), changes in scores in "perspective taking" were the most significant ($p < 0.0001$), followed by "compassionate care" ($p < 0.01$) (see Table 1).

Table 1

Differences in Mean Jefferson Scale of Empathy Scores Pre- and Post-VR Intervention

Questionnaire Component	Number of Participants	Number of Questions	Pre-VR Intervention Mean	Post-VR Intervention Mean	Difference in Means	*P*-Value
Total questions	22	20	113.9	122.5	8.6	$p < 0.0001$
Perspective taking	22	10	129.1	141.3	12.2	$p < 0.0035$
Compassionate care	22	8	128.9	137.4	8.5	$p = 0.011$
Standing in patients' shoes	22	2	90.5	83	-7.5	$p = 0.344$

Table 2

VR Experience Survey Responses

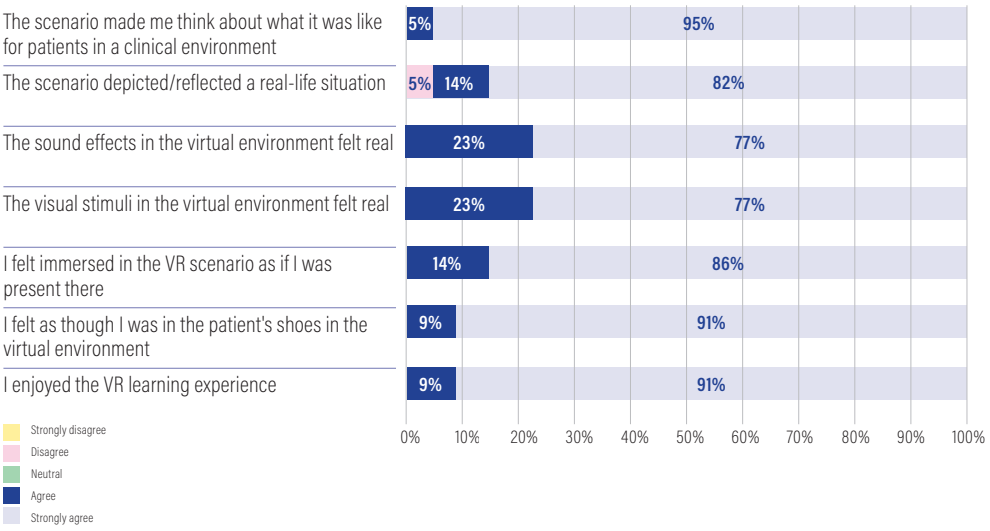


Table 3

Illustrative Quotes From Participants for the Four Themes Identified From the Post-Survey Qualitative Data

Involvement of Patient in Clinical Encounter	Introduction and Communication With Patient/Carer
The child is extremely passive in the medical process. (P1)	*Always greet the child and build some initial [rapport].* (P1)
Things are done to the child with minimal explanation. (P1)	*Made me reflect on my own encounters when I haven't been introduced to the patient* (P2)
The patient was ignored by much of the staff. (P2)	*I will try to ensure I give the patient an explanation of who I am.* (P2)
Making sure to speak TO the patient rather than to each other ABOUT the patient (P3)	*Poor communication of treatment pathway or plan to the patient/carer* (P4)
Doctors are often talking to each other but not to the patient. (P3)	*Make eye contact with the patient* (P4)
I would like to explain things to the child more and involve them. (P5)	*Often things aren't explained to the patient.* (P4)
Engagement with the patient and parent throughout the ward round (P7)	*Having people discuss me in front of me yet not communicate any of that to me is disconcerting.* (P6)
Bringing the patient into the conversation (P7)	*Keeping parents in the loop with patient plans* (P7)
Interact with the patient. (P9)	*Be more mindful of non-verbal communication* (P10)
	Giving clear important information to the patients (P11)
	It's important to talk to the child and not at them. (P11)
Overwhelming Nature of the Clinical Consult	**Consideration of Patient's Perspectives**
It's an overwhelming experience with so many lights, noises and people. (P1)	*It was clear that the mother was upset with the lack of explanation about what was happening.* (P2)
The amount of people in the patient's room can be overwhelming. (P3)	*There was no time in this scenario given to the patient to see how they were coping.* (P2)
It feels overwhelming with all the noise and people in a small room. (P6)	*I will try to acknowledge patient's emotions.* (P2)
Patient feelings of powerlessness or being overwhelmed (P8)	*Be mindful of patient's comfort, especially if it is a crowded, loud and confusing environment.* (P8)
How it's very noisy in the hospital (P9)	*Be mindful of how the patient views the surrounding environment.* (P10)
Very loud, noisy, overwhelming (P9)	*The mother was left with no answers and felt neglected.* (P10)
It can be an overwhelming environment. (P10)	*Remembering to view the situation from their perspective* (P12)
Hospitals can be a scary environment for patients, especially children. (P10)	

All participants reported enjoying the VR learning experience, expressing that it depicted a real-life scenario. None of the participants found the VR headset uncomfortable to use, though one commented on the headset being "too tight" (P20) (Table 2). All (100%) of the participants agreed that the auditory and visual stimuli in the virtual environment felt real and that they felt immersed in the scenario: "It felt like I was really there" (P5). Almost all (95%) participants felt as though they were in the patient's shoes, and all (100%) reported that the scenario made them reflect on what it was like for patients in a clinical environment (Table 2). Importantly, all (100%) participants indicated that they

would benefit from utilising VR as a learning tool, with several suggestions about how VR could be extended to other learning environments, including "student orientation" (P7) and "workplace aggression training" (P1).

Qualitative analysis identified four key themes from student responses. These included lack of involvement of the patient (child) in the clinical encounter, minimal introduction and communication with the patient and carer, the overwhelming nature of a clinical consult and the importance of considering a patient's perspective. Themes are discussed below, with additional quotes included in Table 3.

Theme 1: Involvement of patient (child) in the clinical encounter

A key observation of all participants was the degree to which the child was engaged in the encounter—separate to the engagement of the parent at the bedside. Participants described a sense of discomfort at watching this unfold in the virtual scenario from the child's perspective. By holding the viewpoint of the child, it was made visible to the participants when the child was approached "physically" or "examined" without warning. Many participants commented that "the patient was ignored by much of the staff" (P2) during the encounter. They felt the "disconcerting" nature of being discussed without being spoken to directly. "It's important to talk to the child and not at them," suggested one student (P11). Some also identified the need for "consent" and privacy issues that may arise from lack of consent. Another participant (P11) suggested that to obtain permission and involve the child in their medical care, "explain what you are doing before you touch them".

Theme 2: Introduction and communication with patient and carer

All participants identified communication skills as an explicit gap in the scenario and a learning point for their own practice. Although participants highlighted different areas of communication, for example, structuring an encounter and rapport building, the importance of non-verbal skills and cues stood out as a particular learning. Several participants reflected on the lack of appropriate communication, as health professionals in the VR scenario were going in "without introducing themselves or explaining the plan" (P18) to the patient and carer. "It is important to clearly communicate what is happening," one student (P10) commented following the encounter, whilst another noted, "The mother was upset with the lack of explanation" (P2). Many students said that improving communication was something they would focus on in their own practice after watching the scenario, with one commenting that "[I should] always remember to introduce myself to the patient and their family" (P13). Additionally, some students highlighted the importance of one's own body language and non-verbal communication, "as it can determine how a patient feels about treatment" (P10), and that one should "be more mindful of non-verbal" cues (P10).

Theme 3: The overwhelming nature of a clinical consult

A recurring theme identified by students was the chaotic and overwhelming nature of the clinical environment for the patient. They commented on the many individuals present

in the scenario, the movement, the noise and the many different strands of conversation that they could focus on by moving their gaze around the scenario—often not knowing where to look. Participants noted that "hospitals can be a scary environment for patients, especially children" (P3), with many strangers crowding in a small room, bright lights, noise and multiple conversations happening at once. Participants also noted that children may have "feelings of powerlessness" (P8) in such a setting and recognised the important role that the healthcare team plays in "creating a caring and attentive manner and environment" (P8).

Theme 4: Consideration of patient's perspective

Many of the students indicated that the VR scenario made them reflect on the patient's perspective of a clinical encounter. They felt deeply immersed in the scenario, and their responses afterwards reflected an emotional, not just cognitive, domain to their learning. Focusing on the illness and "forgetting we're dealing with a person first and foremost" (P22) were issues identified as causing the apparent lack of empathy they observed. Many suggested being mindful of one's own communication and approach and "tak[ing] a step back to see … how the patient may be feeling" (P22). The participants suggested that perspective-taking and mindfulness practice were changes that could be prompted by the VR experience.

Discussion

This is the first study that measures empathy change in medical students after exposure to a paediatric scenario utilising VR technology. In keeping with a similar study conducted with paediatric dental students (Hu & Lai, 2022), our study demonstrates a meaningful increase in self-assessed empathy scores immediately following the VR intervention. In addition to this perceived increase in empathy, our medical student participants self-identified how overwhelming a clinical consult could be for a patient (child) and their carer and the importance of communication skills, such as adequate introductions, using appropriate verbal and non-verbal cues and ongoing involvement of patients/carers, during the clinical encounter.

A key advantage of utilising VR as an educational platform is the ability to simulate environments and perspectives that cannot otherwise be experienced by learners. Dyer and colleagues (2018) used VR to simulate macular degeneration and high-frequency hearing loss and successfully demonstrated an increase in empathy and understanding of patient experiences in health professional students. Comparably, a quasi-experimental study that used VR to reproduce the symptoms of psychosis while performing a cognitive task showed improved empathy levels and attitudes towards schizophrenia by health professional students (Marques et al., 2022). Similar to our results, these study outcomes indicate that VR can be effective in eliciting empathetic responses to situations and symptoms that students and healthcare providers may otherwise find difficult to simulate or imagine. VR education technology makes use of the well-established experiential

learning theory (Kolb & Kolb, 2012) in allowing students to walk through a scenario as though in "real time".

What differentiates VR from other more common methods of experiential learning, such as simulation training, is that this experience takes place in an immersive setting, situating the student in the patient's shoes (Mystakidis & Lympouridis, 2023). Through utilisation of an immersive learning platform, such as VR, medical students were able to effectively take a patient's perspective and visualise the environment from their eyes. The results of this study highlight the potential utility of incorporating an immersive platform, such as VR, into medical student curricula to promote empathetic care.

Other learning methods commonly utilised to foster empathetic practice include simulation training, role playing and reflective writing. Simulation training requires facilitators and equipment, making it time and resource intensive (Alanazi et al., 2017). Role-modelling scenarios rely heavily on clinical supervisors and real-life clinical examples and are difficult to standardise. Empathy education using VR technology offers the benefits of simulation training and exposure to standardised clinical scenarios, with relatively few resources (Pottle, 2019). Although some equipment resources are required, initial investment into VR equipment is becoming more affordable and accessible, particularly considering increased utilisation in educational and non-educational environments. VR empathy training can also be undertaken alone, with self-assessment or using a facilitated discussion following the VR experience. Our study demonstrates that an opportunity for self-reflection following the VR intervention via completion of the post-experience questionnaire and survey proved to be an engaging and constructive exercise. Students were able to assess pre-conceived notions and communication shortfalls to help inform their behaviour in future clinical scenarios.

This study has several limitations, including the small sample size and time taken to complete the study. The COVID-19 pandemic, with the largely off-site and online student presence, made recruitment challenging. The pandemic also led to an extended time to complete data collection. As students opted in to participate in our study, there is the possibility of selection bias, which may have impacted results. Although our study measured post-intervention empathy levels, we did not measure empathy levels beyond the immediate post-intervention period. Hu & Lai (2022) used the same empathy measuring scale and showed a decrease in empathy to the pre-intervention scores over time, highlighting the need for repeated and regular empathy enhancing interventions (Menezes et al., 2021; Neumann et al., 2011).

An important future consideration would be to compare the benefits of watching the recorded clinical scenario using VR with a 2-dimensional platform. Although we attributed the significant change in empathy scores in our medical student cohort to the immersive VR experience, it is possible that this level of immersion is not required and a 2D projection of the same recorded scenario could have similar benefits, with much less significant resource implications.

There are a number of future applications of VR technology in the healthcare setting, both in empathy education and a range of other health related topics. Our study demonstrates that VR technology is effective as a standalone educational tool. VR can, of course, also be used in conjunction with other teaching and learning methods to offer a multi-modal approach to empathy training in health professions (Menezes et al., 2021; Thng et al., 2022). In addition, the content of the clinical scenario in VR empathy education can be modified and adapted according to learner requirements. Simple scenarios that are specialty specific can be used for beginner students or more complex nuanced clinical situations can be utilised for advanced trainees or graduated clinicians who require upskilling. It has wide applicability across multiple specialities (Dyer et al., 2018; Marques et al., 2022). VR technology can also be adapted to include medical professionals from different specialities or different professions for interdepartmental or interprofessional education. VR offers a unique insight into perspective taking that would otherwise be difficult to achieve purely by imagination and has been shown to have significant impact on immediate self-assessed empathy.

Conclusion

This study demonstrates improved immediate empathy scores in medical students following exposure to a VR clinical scenario. In addition, students were able to provide insightful reflections about patient experiences and the importance of effective communication in healthcare. VR technology is an increasingly accessible and easy to implement learning modality that can be a valuable addition to empathy education for health professionals. This could include repeated, short VR perspective-taking experiences to provide interval "empathy dosing" and avoid the waning of empathy that is seen in health professionals over time. Future considerations include exploration of other VR-based scenarios for specific target populations and specialties or multi-user experiences to simulate a multiprofessional environment. Longitudinal studies are required to evaluate the effectiveness of VR empathy education over time to create more robust educational modules and to better understand its impact sustainability.

Conflicts of interest and funding

The authors declare no conflicts of interest or funding.

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