# Exploring Healthcare Virtual Simulation Modality Preferences an Interprofessional Learning Experience

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Abstract: Background: Various simulation platforms are available to employ a trial-and-error teaching method via artificial experiences to engage healthcare professional students in activities reflecting real-life experiences without risks. Objective: To understand faculty preferences regarding two different types of virtual simulation platforms. Methods: Upon completing two 30-minute avatar-based simulation experiences employing a patient case under two different simulation platforms (A=AI generated avatar, B=Live actor avatar) participants completed online surveys including the Interprofessional Collaborative Competency Attainment Scale (ICAAS), demographic information, sliding scale to assess perception of verbal and nonverbal communication, and open question items assessing perception of communication, perceptions in avatar type preference, and if the experience promoted confidence, ability and knowledge. Sample: This pilot study consisted of 9 faculty members from various allied health professions. Results: Participants preferred the Live actor avatar over the AI avatar experiences for verbal communication and authenticity of emotions. Following the Live avatar simulation, participants reported improved perception of confidence, ability, and knowledge necessary for interprofessional teamwork. Conclusion: The small sample size may affect the generalizability of the results, participants perceived value to both types of avatar patient experiences with the perceptions more favourable for simulating patient centred interactions with the live actor avatars.



## 1 INTRODUCTION

As health professions educators it is imperative that we prepare students to effectively meet the needs of today's ever-changing healthcare landscape. Academic institutions must prepare health professional students to be ready to address these needs upon entering the workforce. To meet this challenge, health professional educators continually infuse innovative and effective teaching methods and evidence based instructional materials into the academic environment to ensure that students are ready for person-centered entry-level practice. Not surprising academic institutions are turning to simulation-based platforms as a teaching modality employing a trial-and-error method of teaching and learning via artificial experiences that engage learners in activities that reflect real-life conditions without risk taking consequences (Zhai, X. et al. 2021).

Traditionally, health profession programs have infused individualized simulation experiences to promote and assess students' understanding of complex clinical scenarios via a hands-on active learning approach. Simulated scenarios which incorporate students from across professional disciplines have emerged over the past several years to provide a unique opportunity to merge theory with practice by highlighting the interdependency that exists amongst and between health professionals when providing person centered team-based care (Clapper, 2010). The nature of such diverse, in-person interprofessional simulation experiences have been found to spontaneously enhance student communication skills and promote development of respect for different value systems through effective

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personal interactions (Rider, Kurtz, Slade, et al, 2014). While there are numerous benefits of in-person simulation experiences, including the development of leadership and teamwork (Endacott et al., 2014), improved decision making and critical thinking (Rhodes and Curran, 2005), clinical skills and clinical performance benefits (Alinier et al., 2006), enhanced patient deterioration management (Cooper et al., 2012), and situation awareness improvement (Bogossian et al., 2014) have been noted in the literature. Additoinally, notable barriers including lack of time, resources, financial cost, and workload issues (Al-Ghareeb, Cooper, 2016) have also been reported.

As an alternative to traditional, in-person simulations, active learning using virtual reality platforms or gaming platforms, have been employed as an environment for meaningful educational scenarios. Virtual reality (VR) has demonstrated usability as a teaching modality to enhance interprofessional collaboration and communication (Qiau et al., 2021). In general, diverse, virtual interprofessional simulation learning experiences have been found to spontaneously enhance student communication skills and promote the development of respect for different value systems through effective personal interactions (Rider, Kurtz, Slade, et al, 2014).

The Perception –Action Theory which provides a framework for understanding how individual preferences influence learning processes within the cognitive system was used as a lens to guide the study. This theory posits that perception and action are interdependent, forming a continuous feedback loop that shapes how we interact with and learn from our environment (Biwer et al. 2020). The continuous feedback loop between perception and action allows learners to adapt their strategies based on the outcomes of their actions. This adaptability is crucial for personalized learning, where students adjust their approaches based on what works best for them (Fujii 2024). Students who are given the autonomy to choose their learning methods and environments have been noted to perform better academically; thus, accommodating students learning preferences can lead to more effective, meaningful learning experiences (Biwer et al. 2020, Fujii, 2024).

To date, limited evidence is available differentiating amongst the various simulation-based platforms' impact on learning. This article presents pilot data exploring faculty preferences regarding two different types of simulation platforms used to promote student learning, one using AI generated avatar patients and the other using Live actor avatar patients. Recognizing this interdependency between perception and action, in this study we sought to explore different simulation-based learning experiences and individual perceptions towards them. We believe findings from this pilot project will further inform the development of meaningful simulation-based learning experiences. Additionally, given the limited evidence supporting avatar simulation-based learning experiences' ability to mimic real-life scenarios, the accuracy of the case portrayal and verbal and nonverbal communication authenticity will be explored in both the AI generated avatar patient and the Live Actor avatar patient scenarios.

# 2 INTERVENTIONS

In this pilot study two distinct VR platforms, with different ways of animating avatars, were utilized to explore preference. In both cases the same patient information was used in the development of the virtual patients. The patient was, CJ Williams, a middle-aged man, who has been seeing a team of interprofessional healthcare providers for balance, coordination, memory issues, and has recently received an unexpected diagnosis of multiple sclerosis. The learning objectives for the scenario are for the team of healthcare professionals to work as a team and counsel CJ regarding the unexpected diagnosis and obtain necessary information from CJ to create a comprehensive treatment plan to meet his needs.

## 2.1 Live Actor Avatar

The first VR Platform, ENGAGE™ (Willmington, DE, USA), utilizes live actor VR avatars to support human actors who wear VR headsets to bring avatars to life (Figure 1). The actor performed in a virtual environment, and their basic head, eye, and arm movements were captured in real-time to animate the avatars using the Meta Quest Pro VR headset. The same actor portrayed the avatar in all sessions. The participants met in a conference room on campus and interacted with the avatar in the ENGAGE™ platform using one computer to perform the telehealth conference call.


Figure 1: Live Actor Avatar Interface on EngageXR™.

## 2.2 AI Avatar

The second VR platform, VICTORY XR™ (Davenport, IA, USA), which was used to develop the AI avatar (CJ) interface and utilizes artificial intelligence (AI) to animate avatars using the ChatGPT 4.0 text to speech model. Internet download speeds of over 50mbs and upload speeds over 15mbs are required for operation of the AI avatar. CJ (Figure 2) was programmed to be pleasant and agreeable, have knowledge of the signs and symptoms of multiple sclerosis, and was given the same case specific information as the Live Actor avatar. Avatar graphics include simple head, face, eye and hand movements that accompany the speech. While the AI is processing a response CJ adopts a thinking posture with his head down and hand on their chin, the avatar takes anywhere from 6-10 seconds to respond. The participants met with the avatar on campus in the same conference room used for the Live Avatar. Participants gathered and utilized one computer using a direct web link to the telehealth session on device.

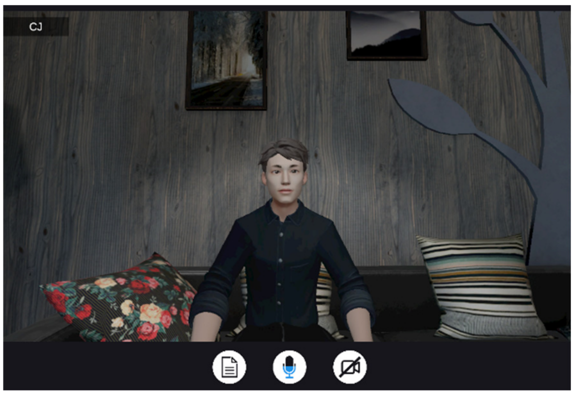


Figure 2: AI Avatar Interface on VictoryXR™.

# 3 METHODS

This study employed an embedded (QUAL/Quan) counterbalanced mixed method approach (Creswell et al., 2011) and University IRB approval was obtained. Simulation best practices, as reported by Violata et al., 2023, relating to outcomes, objectives, simulation design and facilitation of a participant pre-briefing and debriefing were included in this study.

Potential subjects were identified through association with the university's professional healthcare and allied healthcare programs. Potential subjects were sent the approved letter of solicitation via email. Individuals that indicated interest in participating in the study were sent an approved informed consent. Once the informed consent was received participants were sent information on learning experience date for the 60 minutes on campus commitment, a 20-minute online survey, and 15-minute case specific information designed to prepare them for the simulated interaction. Subjects were required to complete the online survey and the case specific information prior to the on-campus session.

All potential participants who agreed to complete 15-minute prep work, participate in the 60- minute in person learning experience and complete the 20-minute online post survey were invited to self-select participating in one of two interprofessional group sessions based upon their availability. Groups 1 (day 1 participants) and 2 (day 2 participants) were then randomly assigned into either Case A (AI Avatar) and Case B (Live actor Avatar) first. The simulated patient experience order was counterbalanced and groups completed both experiences on the same day in alternate order, a rest period was provided between sessions to minimize the potential for cognitive fatigue.

On the scheduled testing day subjects reported to a specific room on campus at a specified time. Upon arrival, participants were assigned a subject number by a member of the research team. The participants were given 10 minutes to re-orientate the case information and discuss the case with their IPE team members. The participants had 30 minutes to complete the simulated patient interaction. After the first session, subjects completed a post simulation survey (15-20 minutes) and took a scheduled 15-minute rest break. Participants then engaged in the second 30-minute patient simulation using the same case but alternate simulation modality and completed the same 15- 20-minute post experience survey. The survey was distributed via an online Qualtrics link containing demographic questions, the revised Interprofessional

Collaborative Competency Attainment Scale (ICASS), six questions assessing their perception of communication and three open-ended questions exploring perceptions regarding their preferences with avatar learning and if the experience (AI vs Live) promoted their confidence, ability, and knowledge.

Descriptive statistics and frequencies were run on all quantitative data collected. Differences between subjects' responses for the ICAAS between simulation rounds (AI avatar verse live actor avatar) were assessed with non-parametric Wilcoxen signed ranks test. Differences between the perception of communication scale between simulation rounds (AI avatar verse live actor avatar) were assessed using a paired t-test and effect sizes were estimated with a Cohen's d. For the qualitative analysis, the PI manually decoded and encoded the responses from the survey's open-ended questions. The process of coding employed first cycle coding practices described by Saldana (2016). Specifically, the PI used in-vivo coding, or direct quotes from the participants and descriptive coding of brief phrases or words. Codes were then arranged into categories. The PI created a data codebook that was provided to the co-PIs for their independent review of proposed codes, and categories. Once a 100% intercoder agreement was established for the codes and categories, the PI and co-PIs generated consensus driven thematic analysis statements addressing each of the research questions. Once the PI and co-PIs analysed both data sets, they converged both the quantitative and qualitative data to create a better understanding of the participants' responses.

## 3.1 Instruments

The learning experiences generated by the AI and live Avatars were evaluated post interaction using the validated revised ICASS, which is 21-item questionnaire intended to measure interprofessional communication and collaboration on a 5-point Likert scale (1=poor, 2=fair, 3=good, 4= very good, and 5= excellent), which has been used in similar avatar simulations (Rippon et al., 2023). The subject perception of the authenticity of the avatar communication was evaluated using a 6-item survey, created to assess perception of authenticity of verbal and non-verbal communication, and was rated on a sliding scale (0=not authentic to 100= completely authentic). The perception of avatar communication underwent face validity. Speech Language Pathology (SLP) faculty were included in the face validation and deemed all items pertaining to verbal and non-verbal communication were important to include and easy to assess. The 6-items demonstrated strong internal consistency a priori ($\alpha$ = .951) and moderate inter-rater reliability with intra-class correlation (ICC) average measures (ICC= .745, $p<.001$). Items pertaining to verbal communication (n=3) had a strong inter-item correlation (r= .837-.877) and items pertaining to non-verbal communication (n=3) had a moderately strong inter-item correlation (r=.712-.774).

## 3.2 Sample

There were 9 participants enrolled in this pilot study (N=9). All were faculty in the health and allied health professions (Athletic Training= 2, Physician Assistant=1, Physical Therapy=3, Occupational Therapy=1, Speech Language Pathology=2), with over 2 years of teaching experience, and all (n=9) had previous experience with patient care. Of the 9 participants 2 identified as male and 7 identified as female, were between the ages of 35-55, and with no formal training in VR simulation. Subjects self-selected into group 1 (n=3) and group 2 (n=6).

# 4 RESULTS

All 9 participants completed both the AI avatar and Live actor avatar interactions on the same day. There were technical issues with the Wi-Fi during day one of testing, which required the Live avatar encounter to be delayed. Additionally, there were technical issues with the AI avatar sessions, the system stopped responding early in one encounter and the encounter needed to be stopped and restarted. After restarting the participants were able to complete the session in its entirety.

## 4.1 Quantitative

For the AI avatar interaction subjects had a mean perception of the avatar's verbal communication, with 100 indicating the highest level of authenticity, of 47.2 $\pm$33.9, a mean perception of the avatar responding appropriately to questions of 56.4 $\pm$33.8, and a mean perception of displaying appropriate vocal characteristics (such as tone, rate of speech and loudness) of 44.9 $\pm$27.9.

For the AI avatar interaction participants had a mean perception of the avatar's non-verbal communication of 47.2 $\pm$33.9, a mean perception of displaying authentic facial responses of 31.8 $\pm$24.8, and a mean perception of displaying authentic emotions of 35.5 $\pm$ 27.0.

For the Live avatar interaction participants had a mean perception of the avatar's verbal communication, of 97.8 ± 4.8, a mean perception of the avatar responding appropriately to questions of 98.1 ±2.6, and a mean perception of displaying appropriate vocal characteristics (such as tone, rate of speech and loudness) of 91.2 ± 15.4. For the Live avatar interaction participants had a mean perception of the avatar's non-verbal communication of 63.6 ±20.2, a mean perception of displaying authentic facial responses of 59.1 ±15.9, and a mean perception of displaying authentic emotions of 84.9 ±16.8.

For analysis of the difference in perception of the avatar communication, due to the small sample size both non-parametric and parametric t-tests were run. Since the data was normally distributed and there was a large effect size the parametric results are being reported. Participants reported significant differences in the authenticity of the AI and the Live avatar communication with a paired t-test analysis. Participants had a 41.7 ±34.7 higher perception of the Live Avatar responding appropriately to questions (t=3.792, p=.004, 95% CI 16.8-66.5) and avatar modality had a strong effect size (*d*=1.199). Participants had a 27.3 ±25.9 higher perception of the Live Avatar displaying authentic facial responses (t=3.331, p=.009), with avatar modality having a strong effect size (*d*=1.053). Participants had a 49.4 ±35.9 higher perception of the Live Avatar displaying authentic emotions (t=4.341, p<,.001, 95% CI 23.6-75.1), with avatar modality having a strong effect size (*d*=1.373). Subjects had a 46.3 ±29.6 higher perception of the Live Avatar displaying appropriate vocal characteristics (t=4.934, p<.001, 95%CI=25.1-67.5), with avatar modality having a strong effect size (*d*=1.560).Participants had a 50.6 ±37.3 higher perception of the Live Avatar displaying authentic verbal communication (t=4.290, p<.001, 95%CI= 23.9-77.3) with avatar modality having a strong effect size (*d*=1.357). Subjects had a 34.9 ±32.0 higher perception of the Live Avatar displaying authentic non-verbal communication (t=3.445, p=.004, 95%CI= 11.9-57.8) with avatar modality having a strong effect size (*d*=1.090).

Participants reported some differences between the learning experiences, AI and Live Avatar, based on the ICAAS. A Wilcoxen signed ranks test indicated, compared to before the learning activities, subjects had no significant difference between perception of their ability to collaborate interprofessional (p=.121). However, participants did report, after the Live Avatar simulation, a significantly higher perception of their ability to; actively listen to IP team members' ideas and concerns (z=2.041, p=.041), provide constructive feedback to IP team members during (z=1.994, p=,046), learn with, from and about IP team members to enhance care (z=2.410, p=.016), identify and describe their abilities and contributions to the IP team (z=2.428, p=.015), be accountable for their contributions to the IP team (z=2.32, p=.026), recognize how others' skills and knowledge complement and overlap with their own (z=2.157, p=.031), use an IP team approach with the patient to assess the health situation (z=2.379, p=.017), use an IP team approach with the patient to provide whole person care (z=2.716, p=.007), include the patient/family in decision making (z=2.200, p=.028), address conflict in a respectful manner (2.165, p=.030), and develop an effective care plan with IP team members (z=2.041, p=.041). There was no significant difference between perception of their ability following the AI and Live Avatar simulation to; promote effective communication among members of the IP team (p=.053), express their ideas and concerns in a clear concise manner (p=.579), seek out IP team members to address issues (p=.149), work effectively with IP team members to enhance care (p=.057), understand abilities and contributions of IP team members (p=.055), actively listen to the perspectives of IP team members (p=.141), take into account the ideas of IP team members (p=.071), and negotiate responsibilities with overlapping scopes of practice (p=.123).

## 4.2 Qualitative

Table 1 provides the participants in vivo codes and associated categories that emerged from responses to the question asking them to share, their thoughts regarding the AI Avatar Based Virtual Learning Experience just completed and its impact on their skills as a healthcare professional. Upon reviewing the categories that emerged following participation in the AI specific case scenario the thematic analysis statement is proposed, faculty perceived that AI Avatar Based Virtual Learning Experience promoted collaboration amongst professionals, provided and opportunity for practice, and assisted in supporting person centred care practice. However, technical issues were present that negatively impacted the learning experiences. Ultimately, the AI avatar scenario appeared less realistic.

Table 2 provides participants in vivo codes and associated categories emerging from responses to the question asking them to share, their thoughts regarding the LIVE Avatar Based Virtual Learning Experience and its impact on their skills as a

Table 1: Participants' perceptions regarding AI Avatar Based Virtual Learning Experience.

| Participant | Please share with us your overall thoughts regarding the Avatar Based Virtual Learning Experience you just completed and its impact on your skills as a healthcare professional. In vivo codes | Category |
|---|---|---|
| F2 | I thought it was a great experience to collaborate with other team members. It may be beneficial as a learning experience to support collaboration and advocacy for an individual's profession. It also assists in looking at the whole person rather than just the deficits my area may address | Collaboration Whole person |
| F4 | This is great for healthcare students to practice interviewing and developing their clinical reasoning and clinical decision making | Promotes practice |
| F5 | There was initial discomfort in the interaction. It was difficult to navigate the "humanistic" aspect that is often associated in these meetings. | Technical issues |
| F1 | It is valuable for sure but has some limitations. Our group had some strong OT and SLP that have more recent clinical experience than I have so I really let them run with things. We didn't have any conflict as a provider group. I observed quite a bit more than participated as I wanted to "stay in my lane". | Collaboration |
| F10 | This experience was challenging, and I don't feel like I gained a lot from it. It didn't have a great impact on me as a professional because communication breakdowns were frequent, and it was challenging to navigate individually and as a team. | Technical issues Limited impact |
| F9 | This type of avatar was less realistic, and it was difficult to keep the flow of the conversation | Technical issues Less realistic |
| F6 | Having the AI avatar was much more difficult to interact with. Responses were delayed and the ability for the team to interact was limited. The avatar cut us off, so our answers were limited to how much it allowed us to speak | Technical issues Less realistic |
| F11 | Due to the design of this avatar, the interactions did not feel authentic. There were awkward pauses, and the conversation did not flow in a realistic manner. | Technical issues Less realistic |
| F7 | The AI felt very robotic. His responses, both verbal and non-verbal, were no realistic. He was pausing a lot and taking over the healthcare team. This inhibited the ability of healthcare members to collaborate. There was a feeling of trying to rush through because it didn't feel real | Technical issues Less realistic |
| F8 | AI Needs much improvement | Technical issues |

Table 2: Participants' perceptions regarding LIVE Avatar Based Virtual Learning Experience.

| Participant | Please share with us your overall thoughts regarding the Avatar Based Virtual Learning Experience you just completed and it's impact on your skills as a healthcare professional | Category |
|---|---|---|
| F5 | I felt that the use of VR enabled a greater humanistic aspect that made it easier for us to interact both as a team and as 1:1 clinician with the patient | Realistic |
| F1 | I liked this better as the patient was very realistic. Changes in voice tone are important to understanding the patient | Realistic |
| F2 | The sim allowed me to confront a more genuine patient experience where not all my ideas would be well received by the patient and forced me to offer a variety of solutions. It also encouraged patient therapist collaboration. | Realistic Collaboration |
| F4 | This is a great way for students to practice interview and the clinical decision making | Promotes practice |
| F10 | It was interesting, and the conversation flowed very easily. I appreciated hearing from my colleagues and how they approach CJ differently and similarly to me. It was a great learning opportunity. | Communication |
| F6 | I thought it went really well. I liked the overall mannerisms and discussion | Communication Realism |
| F8 | | |
| F9 | Excellent, the software was very interactive and facilitated a logical flow of ideas. | Communication |
| F11 | This was my first interaction with CJ and felt that it was a great way to allow for interdisciplinary work. Engaging in IP work enhances clinical skills and pushes your knowledge and communication abilities. The Avatar Based experience allowed for a real-life simulation of a team meeting. | Communication Realistic |
| F7 | The client was extremely realistic. It felt like talking to a real patient. The responses were very real. The questions were real. The client's tone of voice and the way they sounded unsure felt personal rather than robotic. | Realistic |

healthcare professional. Upon reviewing the categories that emerged following participation in the LIVE specific case scenario the thematic analysis statement is proposed, faculty perceived that LIVE Avatar Based Virtual Learning Experience promoted collaboration and communication among professionals, provided an opportunity for practice, and was realistic to person centred care.

# 5 DISCUSSION

This mixed method study examined participants' perceived preferences of interactions with AI avatar patients and Live Avatar patients, learning experiences with the AI avatar patients and live Avatar patients, and perceived differences of the participants' perceptions on overall communication with both the AI and live Avatar patients. Interactions were assessed according to verbal communication when interacting with the AI and live avatars respectively. Participants' verbal communication with the live avatar was preferred over verbal communication with the AI avatar. Study participants reported that the live avatar responded in a "socially appropriate" manner to questions and displayed the capability to vary vocal characteristics (tone, rate of speech and volume of speech) that assisted to create a realistic, patient conversation when compared to the verbal interactions with the AI avatar. Additionally, during the live avatar interactions, participants perceived the avatar as displaying authentic emotions and correspondingly reported the live avatar to display authentic verbal and non-verbal communication as well.

The avatar portrayed by the live actor offer a level of realism because they mirror the movements and utilize the voices supplied by real people. This approach captures some nuances of human behaviour, making interactions feel more genuine and emotionally resonant (Hadhazy, 2022). Additionally, live actor avatars provide a layer of emotional depth and convey a wide range of emotions, which is crucial for applications that require deep emotional engagement, such as virtual therapy or immersive storytelling (Hadhazy, 2022).

While AI avatars can perform a wide range of actions without human intervention, (Kyrlitsias, et al., 2022) and through the ability to react to conversational inputs are thought to converse in a natural and humanistic manner (Javaid et al., 2023) The use of text to speech technology and the difficulty of integrating Social Emotional Regulation (SER) systems limits the ability of the avatar to perceive and integrate non-verbal information in speech (Wani et al., 2021) and respond appropriately.

Additionally, participants reported that after the live avatar experience, they displayed significantly improved perceptions of skills necessary for effective interprofessional (IP) teamwork. Specifically, participants reported perceived improved skills and abilities when working with their IP colleagues including: active listening, providing constructive feedback , the ability to learn with, to, from and about other professionals on the team so to enhance patient care, describe their individual contributions to IP care, be accountable for their individual contributions to the IP team and use a team approach to develop a comprehensive, person and family centred plan of care.

This study findings further support and extend the recent research examining simulation modalities in healthcare education. Live avatars achieved substantially higher authenticity ratings in verbal communication and emotional expression. However, this should not discount the utility of AI-based simulation. Research examining AI Virtual Simulated Patients (AI-VSP) found high acceptance rates among diverse healthcare students (84-93% recommendation rates), suggesting AI can serve as a valuable supplementary training tool (De Mattei et al., 2024; Lanza-Postigo et al., 2024). Therefore, the use of AI avatars may be advantageous when more traditional forms of simulation are not possible, or the focus of the learning activity is skill development requiring the capability to repeatedly practice the same scenario.

Building on these findings, a 2024 study by Vogelsang et al. on simulated learning experiences involving immersive virtual reality has revealed significant student improvements in self-efficacy, particularly for specific clinical scenarios like managing aggressive behaviours in dementia care. Specifically in this study, the VR intervention group showed statistically significant improvements compared to controls, both immediate post-intervention and following clinical rotations.

A critical theme emerging across recent studies, and implied in this study, is the role of simulation in developing socioemotional competencies. A recent systematic review identified communication (34.4%) and self-efficacy (30.5%) as the most frequently trained skills during simulation experiences (Lanza-Postigo et al., 2024). This aligns with findings from both the AI avatar and VR studies, where improvements in interprofessional communication and self-confidence were consistently observed (De Mattei et al., 2024; Vogelsang et al., 2024). While standardized patients (28.4%) and high-fidelity simulation (26.1%) remain the most prevalent modalities for socioemotional skills training (Lanza-Postigo et al., 2024), our work and those of others in VR, suggests emerging technologies like AI and VR should complement, not replace, traditional approaches. Specifically, AI and VR can reduce some of the notable barriers including lack of time, resources, financial cost, and workload issues (Al-Ghareeb et al., 2016, Cooper etal., 2016) to simulation in healthcare. The use of VR allows for creation of virtual environments that may be costly to reproduce in the physical world, varied physical appearance, and for institutions without dedicated simulation spaces to facilitate these interactions.

Learning objectives and resources need to be considered when selecting VR simulation technology. Based upon the results of this study, Live actor avatar simulations were perceived to foster a more collaborative and patient-centred care approach. However, AI avatar experience may be preferable when the learning experience is focused on skill introduction, development, repeated practice and scalability.

### 5.1 Limitations and Future Research

Limitations of this study included its small sample size, which may affect the generalizability of the results, and technical issues surrounding the AI avatar experience which may have impacted participant's ability to achieve the learning outcomes. Although the study employed randomization and counterbalancing, there is always a potential for sequencing effects and participant fatigue. Additionally, given that the primary focus was to assess individual perceptions, behavioural tracking was not employed, thus may lead to social desirability bias. Future research should focus on assessment of engagement levels, speech analysis and avatar response time. Future research should also employ a longitudinal study to examine the perceptions of interprofessional team skills post-simulation and assess the long-term learning effects in healthcare students.

## 6 CONCLUSIONS

This study demonstrated participants in virtual simulation experiences preferring the bidirectional, authentic communication offered by the live actor AI avatar patients when compared to the AI driven avatar patients. While the sample size was small, the large effect size demonstrated a perceived value to both types of avatar patient experiences with the perceptions more favourable for simulating patient centred interactions with the live actor avatars.

This synthesis suggests a future where traditional and emerging simulation modalities work in concert, each addressing specific learning objectives while collectively providing comprehensive preparation for clinical practice. The challenge for educators lies in thoughtfully integrating these approaches to maximize learning outcomes while managing faculty abilities, student learning preferences, educational and environmental resource constraints.

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