ASCILITE 2024

Navigating the Terrain:

Emerging Frontiers in Learning Spaces, Pedagogies, and Technologies

How simulated learning can support a more diverse inclusive society

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Combinations of simulations and games provide learners with a virtual environment where they can immerse themselves in highly contextualised, work-related scenarios, encouraging experimentation and learning from mistakes without compromising the safety of real patients. This pilot study investigated how interactive online simulations supported medical and pharmacy students' disciplinary knowledge, care of diverse patients, and the development of students' professional attitudes and beliefs. Four urinary tract infection (UTI) scenarios (two involving transgender patients) were delivered to students through an interprofessional-education (IPE) activity. Evaluation involved pre- and post-activity questionnaires. There were 26 participants (18 females/ 8 males; range: 18 – 36 years]), including 11 medical and 15 pharmacy students. We found statistically significant changes in self-reported knowledge, skills and confidence to manage UTI (all $p<0.001$); competence to care for transgender patients (2.21 vs. 2.74; $p=0.001$) and awareness of specific health needs of transgender people (3.74 vs. 4.42; $p=0.028$). This pilot study demonstrated the potential of simulation-gaming platforms in evaluating and enhancing students' learning, offering a novel and sustainable approach to IPE. Simulations are a versatile teaching approach that can be adapted to promote cultural awareness and inclusivity across various fields in higher education.

Keywords: diversity, simulation-based learning, health professional education

Introduction

With evolving technological advances and increasing diversity in our societies, students need to be prepared for their future profession and have the required skills to achieve professional competencies (Alenezi et al., 2023). Knowledge application in real-life problems related to a professional field is critical for the development of complex and professional skills (Ahmad, 2020). In higher education, a combination of simulations and games provide opportunities for learners to immerse in a virtual environment to make decisions to solve highly contextualised, work-related problems in a controlled and collaborative environment. The integration of simulations and games when designed effectively using a situated cognition framework, has the potential to engage learners from diverse cultural and accessibility backgrounds to achieve a virtual immersive yet authentic environment as well as receiving immediate feedback through games scoring (Lovelace et al., 2016). In this paper we will introduce the use of a simulation-game based learning (SGBL) activity to examine both the provision of care for diverse patient populations with urinary tract infection (UTI) and the effectiveness of SGBL for promoting culturally safe and inclusive care of diverse populations. Diverse populations include transgender people (people whose gender identity differs from the one assigned to them at birth). Studies have reported that people who are transgender and gender diverse (TGD) often experience being stigmatised, marginalised, and refused care in healthcare settings (Coleman et al., 2022). We will present an explanatory case study, involving situated cognition. As will be discussed, our results indicate pharmacy and medical students felt more competent to provide healthcare to transgender patients. This has implications for educators, both in and external to health professions, including science and engineering.

What is Simulation-Game Based Learning (SGBL)?

SGBL is an educational approach that can utilise technology such as computer programs to simulate real-life professional scenarios. Virtual learning platforms can provide learners with opportunities to apply knowledge, develop skills and receive immediate feedback through game-based assessment. A review by Hallinger and Wang (2020) reported that SGBL has been widely used across numerous disciplines including management, aviation, medical, health, science, technology, engineering and mathematics (STEM) and teacher education. SGBL has also been explored in health professional education (Edgar et al., 2024), pharmacy (Koryayem et al., 2022) and engineering education (Verner et al., 2024). As reinforcement and feedback is paramount in the success of adult learners, SGBL has the capability to integrate assessment components and provide a platform to receive instant feedback from instructors (Coyne et al., 2019). Simulations allow for repetition of the activity to consolidate learning, as well as teaching theoretical concepts, interpretation skills and data handling (Coyne et al., 2019). The standardised nature of SGBL also strengthens the validity of assessments, as scenarios remain relatively consistent (Lee et al., 2020).

Simulations generally involve an "active" method of learning, in which students are immersed and participating in the content they are being taught which aligns with the situated cognition theory for learning (Paige & Daley, 2009). It embraces all the elements of immersive active learning, inseparability of knowledge and action, incorporating real world scenarios (Paige & Daley, 2009). Research has shown that the use of appropriate educational technology, incorporating active learning pedagogy such as problem-based and team-based learning in SGBL, improves student academic achievement (Cai et al., 2022).

Diversity of learners

There is an increasing diversity of learners from diverse cultural and social backgrounds, and with varying accessibility and equity issues (Magodi et al., 2023). (Coyne et al., 2019). SGBL can provide learners with diverse social backgrounds opportunities to share knowledge and experiences, in a controlled and collaborative environment. *Pharmacy Simulator* is a serious gaming platform that facilitates learning by allowing the user to explore and experiment with how they approach the scenario (Bindoff et al., 2014). Every action the learner performs (interacting with objects, choosing dialog options) will not only elicit an appropriate response in the scenario, but also has a hidden score and feedback associated with it. When the learner reaches an endpoint of the scenario a scorecard is presented which itemises every action they performed with the feedback and score associated. Learners will typically absorb this feedback and will repeat the scenario several times until they are satisfied with their performance. In this pilot study, *Pharmacy Simulator* was used to investigate the impact on students on a scenario related to a diverse vulnerable population with a UTI.

The Study

Guiding research questions

RQ1) How do interactive online simulations support development of students' disciplinary knowledge to support respectful and inclusive care of diverse patient populations? RQ2) What impact, if any, do diversity-specific simulations have on students' professional attitudes and beliefs?

Context of the Study

Four scenarios addressing assessment and management of UTI in the primary care setting were developed (two based in general practice (GP); two in community pharmacy). One scenario in each setting was a relatively 'simple' UTI presentation, while the other addressed respectful management of UTI in a transgender patient. This was clinically relevant given that transgender people report significant rates of UTI due to bathroom avoidance.

Ethics

The study was granted ethics approval by the Curtin University Human Research Ethics Office (Approval number: HREC2023-0472) on 21st August 2023.

Methods

Scenario development involved a common practice in the health professions known as consumer consultation. In this approach, an individual with relevant lived experiences was recruited to participate in scenario design and review, to ensure that the scenarios created were sensitive to their perspectives and needs. The learning outcomes of the scenarios were designed to reflect the learning objectives for UTI management within the relevant units in the Bachelor of Medicine/Bachelor of Surgery (MBBS) and Bachelor of Pharmacy (Hons) (BPharm(Hons) programs at Curtin University. The scenarios were face and content validated by two student volunteers prior to the evaluation phase. First and Second Year of the MBBS, or Second and Third Year of the BPharm (Hons) students at Curtin University, aged ≥18 years, were recruited to participate in a voluntary extracurricular workshop in October 2023. Students who took part in the workshop (participants) were requested to undertake approximately 30 minutes of pre-reading regarding UTI management and transgender health before attending the workshop. Participants were provided a 6-month user license for *Pharmacy Simulator* and were requested to create a *Pharmacy Simulator* account prior to workshop attendance. *Pharmacy Simulator* includes a setup and tutorial process which explains how to use the software, as well as online help and an instruction manual and videos which could be accessed as necessary. For each scenario, participants were required to select from a number of options considered as 'best', 'ok' and 'worst', each of which had a score. At the end of the scenario, participants were provided with feedback, which included an overall score based on the appropriateness of their selections. The online SBL scenarios were delivered to participants during a single structured 2-hour interprofessional education workshop, with facilitated pre-brief and debrief sessions. Participants were allocated to interdisciplinary groups (each comprising 4-6 students). Approximately one hour was allocated for participants to play through the scenarios and discuss the online simulations within their groups. During this time, participants were able to play through each scenario as many times as they wished. The outcomes of the workshop were evaluated using self-administered pre-workshop and post-workshop questionnaires.

Instrument development and administration

Pre- and post-workshop questionnaires were developed based on previously published and validated tools used to evaluate the outcomes of virtual SBL experiences, including the Placement Reflection Questionnaire (Robinson et al., 2020) (Figure 1).

<table>
<tr><th>Reference</th><th>Example of the type of question from each validate questionnaire</th></tr>
<tr><td>Placement Reflection Questionnaire questions (Robinson et al., 2020):</td><td>Please answer the following questions with reference to your knowledge, skills and confidence <u>before participating in this workshop</u>. Please indicate how you would rate your practical and theoretical knowledge about managing a patient with a urinary tract infection:
Not at all knowledgeable | 1 | 2 | 3 | 4 | 5 | Very knowledgeable</td></tr>
<tr><td>AHPQ questions (Lindquist et al., 2005):</td><td>We are interested in what you think about different health professional groups including your own. Below is a set of scales with two opposites on either side. Please indicate, by moving the slider, where you feel the typical medical doctor fits on each dimension.
CARING ◄——⬢——► NOT CARING</td></tr>
<tr><td>(LGBT) Patients Scale (Bear, Mukherjee, & Goldsmith, 2021):</td><td>We are interested in what you think your future role as a health professional will be in providing care to transgender people. For the purposes of this study, we use the term 'transgender' as a broad term describing people identifying with a different gender from their sex assigned at birth. For each of the following statements, please mark one box that best describes your level of agreement:
<table>
<tr><th>Statement</th><th>Strongly disagree 1</th><th>2</th><th>3</th><th>4</th><th>Strongly agree 5</th></tr>
<tr><td>a. I feel competent to provide care for transgender patients.</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>b. Transgender patients do not have any specific health needs.</td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
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Figure 1: Examples of questions from various validated questionnaires

Participants' attitudes pre- and post-workshop to their own healthcare profession and the other healthcare profession (i.e., pharmacist for pharmacy students; doctor for medical students) were evaluated using the

validated Attitudes to Health Professionals Questionnaire (AHPQ); (Lindquist et al., 2005) and attitudes to provision of care for transgender patients were incorporated, using a modification of the Attitudes towards Lesbian Gay Bisexual Transgender (LGBT) Patients Scale (Bear et al., 2021) (Figure 1). The questionnaires were administered online via Qualtrics. Participants were provided with a URL and QR code and asked to complete the questionnaires at the designated times during the workshop. All participants were offered lunch during the workshop and received a $10 Curtin Student Guild gift card as compensation for their time and effort in participating in the survey.

Analysis

Quantitative data were downloaded from Qualtrics into IBM SPSS Statistics 27® for analysis. Descriptive statistics were reported for the responses to the reflection and modified Attitudes towards LGBT Patients Scale questions; and the 'caring' and 'subservient' subscales of the AHPQ were calculated according to the published methodology (Lindqvist et al., 2005). Differences between the pre-workshop and post-workshop data were analysed using paired Student's t-tests for normally distributed data, and the Wilcoxon signed-rank test for data that were not normally distributed.

Results

Twenty-six of the 32 workshop participants responded to questionnaires (respondents) - 18 females (69.2%) and 8 males (30.8%), with a median age of 21 years (range 18-36). Respondents included 11 medical students (42.3%) and 15 pharmacy students (57.7%)**.** Statistically significant changes in self-reported knowledge, skills and confidence to manage UTI (all p<0.001) were noted, as seen in Table 1.

Table 1 – Respondents' retrospective pre-workshop and post-workshop assessments of their knowledge, confidence and skills to manage a patient with a urinary tract infection.

Questions	Parameter	Mean ± SD*	p value
Please indicate how you would rate your practical and theoretical knowledge about managing a patient with a urinary tract infection (UTI)	Pre-Knowledge	3.05 ± 0.887	< 0.001
	Post-Knowledge	4.00 ± 0.649	
Please rate how certain you were that you have the skills to successfully manage a patient with a UTI	Pre-skills	2.75 ± 0.910	< 0.001
	Post-skills	3.90 ± 0.718	
Please rate how confident you were to manage a patient with a UTI	Pre-confidence	2.75 ± 1.118	< 0.001
	Post-confidence	3.90 ± 0.718	

*Responses were based on a 5-point Likert scale, with higher scores indicating greater knowledge, skills and confidence.

Results of the Attitudes to Health Professional Questionnaire showed respondents perceived doctors as more caring post-workshop (63.5 vs. 58.8; p=0.044). However, there was no change observed post-workshop in respondents' perception of pharmacists' caring, although there was a move towards being perceived as less caring, especially by pharmacy respondents (63.4 vs 72.5; p=0.051). No change was observed in respondents' perception of doctors' subservience (10.1 vs 10.3; p=0.879) although respondents perceived pharmacists as less subservient post-workshop (10.1 vs 15.2; p<0.001). With respect to participants' responses regarding the attitude to their future role as a health professional in providing care to transgender people, there were statistically significant differences in level of agreement pre- and post-workshop with respect to feelings of competence to provide care for transgender patients (2.21 vs 2.74; p=0.001) and transgender patients not having any specific health needs (3.74 vs 4.42; p= 0.028).

Conclusion

This pilot study demonstrated that the online interactive simulation, using *Pharmacy Simulator,* supported students' disciplinary knowledge to support care of diverse patients, with respect to knowledge, skills and confidence related to UTI management. The findings have implications for the future use of simulations both in health profession courses as well as other courses including science and engineering. Additionally, our study connects with a much broader discourse of how to prepare students for an increasingly diverse world. Arising

from our study are several key areas for future research. For example, the impact on students dealing with diverse populations in other disciplines should be investigated. This pilot study has shown that simulations are a versatile teaching approach that can be adapted to various fields in education, introducing skills for inclusivity and cultural awareness of various populations. Developing inclusive attitudes to our globally diverse population should be embedded in the curriculum of higher education programs to empower learners as they progress to professional practice so they can better serve the unmet needs of diverse communities. This is relevant not only in healthcare but across a broad spectrum of disciplines.

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