White Paper

Educational Benefits of Using Virtual Reality Simulations

EDUCATIONAL BENEFITS OF USING VIRTUAL REALITY SIMULATIONS

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INTRODUCTION

Developing students' clinical readiness is a high-priority goal for nursing programs. Exposure to clinical situations is a cornerstone approach for engaging nursing students in domain-related activities. However, there are limits to how frequently and deeply students can immerse themselves in such situations. Simulations offer practical alternatives, allowing faculty to guide students in applying classroom learning and prepare them with requisite skills for successful clinical experiences.

Over the years, nursing faculty have relied on an array of low- and high-fidelity simulation modalities because they offer benefits that include, but are not limited to: (a) a range of easily accessible learning opportunities; (b) the freedom to make mistakes and to learn from them; (c) the ability to customize learning experiences; and (d) opportunities to provide detailed feedback and evaluation (Society for Simulations in Healthcare, n.d.). However, technological advancements have ushered in newer modalities that are rapidly catalyzing workforce education in the healthcare sector (Lee, et al., 2021). In this white paper, we focus on virtual reality (VR) simulations as a promising high-fidelity medium for supporting clinical readiness.

This paper describes specific learning benefits of using VR simulations for nursing students' preparation for clinical experiences and includes representative quotes from 10+ nursing faculty and 200+ students who have used Elsevier's Simulation Learning System with Virtual Reality (SLS with VR). An overview of extant literature in nursing education and related fields of education is also provided, with an encouraging note for educators interested in adopting VR simulations for clinical nursing education.

1. **Authentic experiences:** Nursing educators routinely use case studies, manikin-based simulations, live role-playing, and a host of other pedagogical approaches for situating students' understanding of professional praxis. VR simulation experiences of today can enable 'thick authenticity' (Shaffer & Resnick, 1999) for nursing students. In VR, students are engaged in three-dimensional learning environments that offer:

   a. Connectivity at the personal level (e.g., role-playing as a nurse, working in groups), to the real world (e.g., interacting with virtual characters like patients' employers), and to the discipline (e.g., scenarios targeting medical-surgical, fundamentals learning goals).

   b. Reflection on the complexities of clinical situations in which nursing students can learn to problem-solve in a safe environment.

   c. Representation pluralism for students needing multimodal ways to engage and express their emerging understanding (e.g., haptic feedback, audio-visual cues, interactive virtual characters).

Below are some relevant quotes from users of Elsevier's Simulation Learning System with Virtual Reality (SLS with VR) illustrating their engagement in authentic experiences:

> *"I enjoyed the chance to be able to be in [a] lifelike scenario in which I am performing patient care, without the fear of hurting a patient. Also, I found the questions that the characters asked in the simulation to be helpful in preparing a nursing student for real-life experience in which the student may be asked questions they had not anticipated."*
>
> — Nursing Student

> *"I enjoyed that I felt like I was in the patient's room and got to perform what felt like real patient care; this gave me more experience with patient care and working on my own."*
>
> — Nursing Student

2. **Dynamic clinical situations:** Even when healthcare professionals follow routine procedures and protocols, clinical situations are characteristically ever-evolving. Students should be exposed to a wide variety of clinical situations, especially in ways that reduce the complexity of clinical practice, make implicit practices of expert nurses explicit, and sequence learning activities according to students' zone of proximal development. These design strategies are essential for creating authentic practices accessible to learners (Edelson & Reiser, 2006). VR technology can satisfy these criteria.

Since VR is a delivery system for digital media, the technology allows for a wide number of clinical situations. VR simulations and the accompanying delivery systems (e.g., moderator tool, scenario bank) can allow nursing faculty to facilitate a variety of scenarios, enabling students to gain a comprehensive picture or focus on a specific skill. Choices on how to unfold scenarios and introduce virtual characters in VR simulations can vary and adapt over time based on student engagement and educators' moderations to better emulate a realistic clinical experience. Nursing faculty can also repeat similar case studies with variations to help students understand how their actions can result in different diagnoses or treatments. This capability is also hugely beneficial for teaching students how to respond under two realistic conditions: urgency in the moment and care that is responsive to the patient's needs. A faculty with experience using SLS with VR illustrates how students can engage in dynamic clinical situations:

> *"[Students] can practice care for complex patients without being in direct care situations. Anaphylactic shock scenario was an example. Students learned first-hand what can happen if you recognize signs and symptoms quickly, and the quicker their reaction, the better off the patient. If they didn't act quickly, then the patient condition declined, but they felt safe in the environment to have time to think about what they needed to do in a stressful situation."*
>
> — Nursing Faculty

3. **Multiple skill development:** Clinical readiness includes developing students' clinical judgment competencies, which involve a series of cognitive processes that guide nurses' thinking and problem-solving (National Council for State Boards of Nursing, n.d.). The processes governing clinical judgment also rely heavily on knowledge, skills, and attitudes (KSA) needed for therapeutic communication with patients and their caregivers, effective collaboration with members of the care team, and the adoption of safety measures and evidence-based practices (Quality and Safety Education for Nurses, n.d.). Thus, nursing students need systematic, dynamic, and repeatable experiences for scaffolding the multiple skills needed for patient care and wellbeing.

VR simulations can promote nursing students' practice of cognitive-psychomotor-social skills across multiple scenarios and provide them with immediate feedback on their decisions, and mimicking what learners will encounter in the real workplace. Below are some relevant quotes from students who used SLS with VR to practice multiple skills:

> *"I enjoyed the experience of working with a patient (and family member) while working as a team with my partner. It helped us work as a team while caring for a patient and interacting with family as well, which I feel is a huge aspect in patient care."*
>
> — Nursing Student
>
> *"[VR] was more interactive than what we have been doing in sim lab. Our instructors have been playing the patients. It was more enjoyable to have a real patient and see the wound and be able to perform an actual assessment on a patient."*
>
> — Nursing Student

4. **Heightened learner engagement:** While still in the early stages of use for nursing educational delivery, immersive VR simulations are quickly becoming a viable option for higher education (EDUCAUSE, 2020). Facilitating untethered VR simulations where educators and learners can be in physically remote locations is also gaining momentum. However, the promise of these developments rests on the fact that VR simulations provide students with a clear sense of presence (Servotte, et al., 2020).

The fidelity of experiences in VR simulations offered through multi-sensory interfaces generates a strong feeling of being and performing in a 'real' clinical environment. Additionally, VR simulations make suspension of disbelief easier. In other words, students feel less self-conscious about participating than they do in manikin-based and live role-play simulations. These benefits could make a significant difference in clinical education and student engagement. Both students and faculty find this beneficial, as illustrated in the quotes below from users of SLS with VR describing heightened engagement:

> *"VR allows more interdisciplinary interaction than simulation in the lab can offer. For example, even if students play multiple roles with a high-fidelity simulation case, and even if they have 'cues' they do not always play the roles well OR their peers have a hard time imagining that the 'actors' are real members of the interdisciplinary team. In VR, students frequently reported that they felt they were 'really interacting' with other health care professionals. The students stated they even felt 'nervous' at times in regard to their responses to the other professionals."*
>
> — Nursing Faculty
>
> *"It was nice to be able to have such a realistic environment that reacted back to your choices and movements. Being able to feel pulses and hear lung sounds and have the patient respond to your actions was really nice."*
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> — Nursing Student
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> *"The environment was very surreal. I felt the patient's true existence and to care for her."*
>
> — Nursing Student

5. **Cost-effective curricular solution:** The widescale adoption of VR for training and recreation makes the technology affordable, especially when compared to the price of high-fidelity manikins. While manikins can give students an opportunity to simulate discrete psychomotor competencies, the expense can be prohibitive, especially when giving students sufficient simulation time to receive the benefit of repeated practice.

VR simulations can be cost-effective to integrate within the curricula at scale (Pottle, 2019). For instance, a single instructor can be trained to moderate VR simulation scenarios based on where students are in a program or course.

VR simulations can also be used exclusively for clinical training, saving institutions the cost of the simulation equipment and lab space. Alternatively, VR simulations can be used in conjunction with hands-on/lab-based simulations, allowing faculty to leverage the design affordances of a range of simulation modalities. These affordances could make a significant difference in educational delivery and student engagement. Below are some relevant quotes from users of SLS with VR describing the cost benefit:

> *"VR allows the instructor to focus activities on objectives associated with the course content and clinical. For example, we covered skin integrity and wounds in class, and then students were assigned a patient with a wound. Students could directly apply concepts they learned about in class. In live clinical, it is unlikely that there is a patient for each student who has a wound."*
>
> — Nursing Faculty

> *"I think that VR would allow students more time in the clinical setting providing care along with therapeutic communication, especially with the variety of case choices. Simulation choices can be purposeful and chosen based on the content being learned for the week and tied to VR, allowing the students the hands-on experiences soon after learning the theory. Tying up all the necessary information for students in such a manner could be beneficial with many of learners [needing hands-on experiences]."*
>
> — Nursing Faculty

GROWING EVIDENCE IN SUPPORT OF VIRTUAL REALITY SIMULATIONS

The educational benefits of VR simulations described in this paper will hopefully be useful for nursing educators considering how this innovative technology can complement their teaching. At the same time, it is important to highlight the growing evidence in support of using VR simulations related to these benefits and beyond:

- Nursing educators' use of VR simulations to facilitate clinical judgment and quality and safety education for nurses' competencies (Shah, Siebert-Evenstone, Eagan & Holthaus, 2021).

- Development of Quality and Safety Education for Nursing (QSEN) knowledge, skills and attitudes (KSAs) in VR simulations. A focus on patient centered-care, teamwork and collaboration, and safety (Shah, Siebert-Evenstone, Moots & Eagan, In Press).

- Design and impact of VR simulations in educational settings. A focus on students' mastery of specific skills and application of relevant knowledge for improved patient care (e.g., Bayram & Caliskan, 2020; Chen, et al., 2020; Ramakrishnan, Lleva & Okupnia, 2020).

- Impact of interactive engagement, the fidelity of experience, and practice-based learning opportunities afforded by VR simulations on students' knowledge, attitudes, and empathetic understanding (Formosa, Morrison, Hill & Stone, 2017).

- Motivational and cognitive benefits of training in immersive VR, based on multiple theoretical approaches and assessments (Makransky, Borre-Gude & Mayer, 2019; Parong & Mayer, 2018).

- Burgeoning research on VR head-mounted displays (HMD) in education and training. A focus on HMDs as a medium for learners to experience simulations for acquiring cognitive skills, understanding spatial and visual information, psychomotor and affective skills essential for responses in complex situations (Jensen & Konradsen, 2018).

CONCLUSION

Nursing educators are motivated to adopt viable, effective, and meaningful pedagogical approaches for enhancing nursing curricula and students' clinical readiness. Recent advancements in virtual reality (VR) technology allow individual and multiple learners to engage in simulation experiences that afford authentic role-playing with unparalleled immersion and interactivity. At Elsevier, we have recognized the promise of virtual reality in other fields and embraced the potential of this technology for elevating nursing students' clinical education experiences. The five educational benefits, illustrative quotes from students and faculty using Elsevier's Simulation Learning System with Virtual Reality (SLS with VR), and growing evidence in extant literature strengthen the case that VR can greatly enhance clinical nursing education.

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