**Research on applying situated learning in VR-based nursing handover education program**

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**Abstract:** The purpose of this study is to investigate whether a virtual reality (VR)-based situated learning system can enhance nursing students’ learning when conducting a clinical handover. Although previous research has established the value of simulation-based teaching, few studies have focused on nursing students’ practices. This study seeks to reveal the potential for the future use of VR in nursing handover education and propose a possible design solution of VR-based situated learning that is accessible and applicable for more students. An experimental-research design has been developed to compare students’ situated learning experiences of studying nursing handover in VR and in the real world. Both the VR and real-world scenarios contain five stages. Participants will be randomly assigned to go through one scenario and data will be gathered in multiple ways. The envisaged result is that VR will deliver a comparable, if not greater, quality of situated learning experience for nursing handover practices.

**Introduction**

In clinical practice, nursing handover accounts for a substantial component of a nurse’s duties (Rushton, 2010). The goal of a handover is to convey patients’ information and secure the continuity and safety of care (Sabet Sarvestani et al., 2015). Poor-quality nursing handover can severely impact patients and can even be life-threatening (Malone et al., 2016). Thus, it is important for nursing students to receive good handover education. Simulation-based handover and role-playing training have been widely used and have been proven to be effective in improving nursing students’ performance competency, clinical judgment, and self-efficacy in handovers (Gordon et al., 2018; Lee & Lim, 2021; Sabet Sarvestani et al., 2015). A simulation-based program allows students to participate in the dynamic and complex handover process, which not only involves transferring a patient’s care plan and information in oral or written format, but also creates a problem-solving scenario that provides the students with an opportunity to actively evaluate, integrate, and judge. As an example, in Sabet Sarvestani et al.’s (2015) experiment, the simulation-based training was conducted in the simulation-center room equipped with a high-fidelity simulator. Such training environments are too expensive and unlikely to be accessible to all nursing students. Additionally, the authenticity of simulated scenarios is limited. Virtual reality (VR) can be a solution to help overcome these limitations. VR visualizes three-dimensional (3D) data and provides realistic simulation and a real-time interactive environment that enhances the feeling of being immersed in a virtual world (Zhao et al., 2021). VR can construct a virtual learning platform and knowledge integration system for nursing students to learn and use repeatedly, which reduces the cost of capital and human resources. VR-based programs have even been proven to help improve students’ motivation to learn (Sattar et al., 2019).

The purpose of this study is to assess how well a VR-based situated learning system could enhance students’ learning process and outcomes in a clinical handover situation. Specifically, the benefits of VR will be analyzed from two perspectives: (1) the learning process (improve learning motivation and/or efficiency), and (2) learning results (performance ability, self-efficacy, and clinical judgment ability).

**Literature review**

The research is established on two main theoretical bases. One is situated learning theory, and the other is the application of VR in education. The following literature review is to put forward evidence that supports the proposition that nursing students benefit from situated learning and explore how VR can effectively construct situated learning scenarios to promote learning.

Situated learning theory

According to McLellan (1996), situated learning emphasizes students’ knowledge building through social interaction and involvement in real situations. The use of situated simulation in teaching helps students relate what they are learning to real social problems, which is important for practical fields such as nursing and medical treatment (Anderson et al., 1996). McLellan (1996) pointed out that situated learning requires an authentic learning environment, activities, peers, and evaluation, as well as expert guidance, situated mentoring, and legitimate peripheral participation.

In a situated learning environment, nursing students first learn their daily practices through observation and working with experienced nurses. Then, they gradually move from the periphery of practice to central participation. However, given the nature of the nursing profession—that it involves dealing with patients—it is often difficult to allow nursing students to participate. VR simulation provides an alternative to real-life settings, with rich sensory cues and multi-modal feedback, which helps learners gain theoretical knowledge and transfer this knowledge into real-world skills. Much design-based research has shown that by practicing in a simulated setting, nursing students’ communication skills, adaptability, and self-efficacy can be largely improved (Gordon et al., 2018; Lee & Lim, 2021; Sabet Sarvestani et al., 2015).

Benefits of virtual reality

The main characteristics of VR are immersion, imagination, and real-time interaction (Hanson & Shelton, 2008). The 3D interactive interface created by VR enables users to effectively participate in a learning system where the users’ visual, auditory, and haptic devices are associated with the surrounding environment. Many research projects have applied VR in anatomy teaching, simulated surgery, knot tying, and other scenarios, and a large amount of experimental data have indicated that both novice and experienced doctors have significantly improved their skills performance after taking specially designed VR-based courses (Hagelsteen et al., 2017; Li & Liu, 2020; Lucas et al., 2008; Yoganathan et al., 2018).

In addition to the positive impacts of VR on learning outcomes, there is literature showing that applying situational learning in VR systems can improve learning motivation (Lee et al., 2010; Sattar et al., 2019). VR transforms students’ learning process into a process of solving realistic problems, which stimulates students' full participation. Students take the initiative to learn in a real setting and apply what they have learned, which increases their self-efficacy.

**Methods**

This experimental research has been designed to evaluate whether VR holds the potential to benefit situated learning in nursing handover practices. Participants will be recruited from nearby nursing schools. The participants will be separated into two groups for comparative purposes: A VR group that will learn via VR-based scenarios and a non-VR group that will learn via real-world situations. Both groups, we anticipate, will encounter situated learning experiences. The learning process and learning outcomes will be evaluated not only by questionnaire and semi-structured interview but also by capturing logs of in-game actions and observation.

Participants

All of our participants will be nursing students who are presently enrolled in nursing schools but have had no prior clinical experience in a hospital setting. It is our goal to recruit 100 volunteers to participate in our experiment. During the experiment, study participants will be randomly assigned to two different treatment groups. Half of them will participate in VR nurse handover training, while the other half will study handover in real-world situations.

Experiment setting

Two experimental settings are prepared for the study: A VR setting and a real-world setting. The real-world situated learning scenario will be built within the actual clinical setting and the classroom. Experienced nurses at work in the hospital will participate in the experiment as examples for students to observe. Students may follow the nurses to get in the patient’s room and observe how experienced nurses conduct nursing handovers.

The VR scenarios will be created based on real-life nursing handovers that happened in hospital settings. The virtual settings will be developed within Unity 3D with the help of Steam VR, a free asset package in the Unity asset store that has a collection of tools to support VR content. Considering hardware devices, HTC VIVE headset and controllers will be used to enable students to interact with the VR environment. In the virtual hospital setting, students can walk in a patient room with non-player characters playing experienced nurses. They are going to observe as well as interact with both pre-programmed nurses and patients. Artificial intelligence will be used to empower the communication feature during the virtual nursing handover practices.

Procedure

To control the variables and to ensure every participant has experienced proper situated learning, both created situated learning experiences contain five stages. Participants will experience role-playing-like scenarios of nursing handover during the learning. For the non-VR group, we developed the situated learning process based on Kim et al. (2021). During the first stage, participants will be given a prior lecture introducing nursing handover. The definition, common method, and the influence of nursing handover are all covered to educate students what nursing handover is. In the second stage, students will get into the hospital and observe nursing handover in real-life clinical settings. However, during the practices, they will not be allowed to interact with experienced nurses as well as the patient. In the third stage, students will be divided into groups to role-play handover. While one group is playing, the other groups will listen to their handover practices and record their thoughts. After that, all participants will be encouraged to reflect on their performance to further understand how nursing handover could be. The fourth stage is the same as the second stage where participants will join in the clinical settings to observe experienced nurses at work. Finally, during the fifth stage, participants will present their impressions and findings of handover observations.

 For the VR group, our design fully adopts the legitimate peripheral participation concept as Lave and Wenger (1991) presented. In the first and second stages of the design, participants will be in the peripheral of the virtual community. They will learn by observing the experienced nurses NPC doing clinical handover. At this stage, interactive functions will be disabled, hence students will only be able to observe and listen. As participants gradually gain the concept and knowledge of nursing handover, they will be allowed to interact with the nurses and patients (NPCs). Participants will conduct nursing handover with guidance provided by the VR environment during the third and fourth stages. Then, during the fifth stage, students will take the responsibility as a nurse to participate in the nursing handover simulation without the provided hints.

Data analysis

This study attempts to figure out whether VR could benefit or replicate situated learning for nursing handover practices. To collect data, all participants are expected to complete a prepared questionnaire after the session. Five people from each group will be chosen at random to participate in a semi-structured interview. Furthermore, we intend to capture logs of in-game actions as well as observe students' actions during role-playing. An explanatory mixed technique will be employed to analyze the data. The process begins with quantitative analysis, followed by qualitative analysis, and the outcome is presented.

**Expected results**

Results will be generated from the gathered data and are expected to answer all the research questions presented previously. We anticipate that VR can simulate real-life nursing handover, provide a situated learning experience, motivate students to be engaged in the relevant practices, and improve students’ learning outcomes. To attain this goal, high-fidelity virtual environments must be supplied. Students must be able to learn by observing the experienced nurse NPC and performing clinical handover with the NPCs. As a result, students will then actively engage in the VR simulation experience and learn more effectively using VR.

While VR has the potential to assist nurses in acquiring advanced skills (Kilmon et al., 2012), it is also conceivable that VR may fail to educate participants effectively. For instance, VR might not enhance the learner’s performance even if it is capable of providing a high-quality situated learning experience for nursing handover. Nursing students may be distracted by the new technology and fail to learn effectively within virtual settings. Their cognition load might be too great; hence they might not be able to pay full attention to the learning experience. In this case, participants who have been educated in real-world settings may perform better.

 Moreover, VR might not be able to simulate real-life nursing handover since everything is rigidly preprogrammed. Even with the support of artificial intelligence (AI), students might still not be able to interact with NPCs freely. In addition, due to technical constraints, the immersive experience provided by VR could to some extent be defective. Students might perceive unreal things, and hence be unable to engage in the situated learning experience. In this case, participants who were trained in VR might perform worse than participants who were trained in real-world settings. Additionally, VR may also cause symptoms such as motion sickness, which would prevent participants from learning successfully. To conclude, there are multiple ways that may make VR situated learning for clinical handover less effective; however, we still believe VR to be valuable due to its rich qualities.

**Conclusion**

This study explores the use of a 3D graphic system to provide a simulated scenario of nursing handover and evaluates the effectiveness of a VR-based nursing handover education system. Considering the inherent nature of the nursing industry, the effectiveness and accuracy of handover have direct implications for patients’ health and safety. The use of VR could enhance the scaffolding of situated learning and build a cost-effective alternative to the current handover training program. However, VR technology also has certain contingency problems. For example, VR is inferior to a real-world experience, and there are certain thresholds and learning costs for learners. Some students may get dizzy when confronted with 3D, which is also a barrier to learning in VR. Overall, the use of VR is expected to be further improved in the future, and when used properly, it is bound to have a positive impact on education.

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