American Journal of Bioinformatics

australiansciencejournals.com/bionformatics

E-ISSN: 2689-002X

VOL 05 ISSUE 03 2024

The Impact of Virtual Reality Simulation on Developing Advanced Clinical Reasoning Skills in Nursing Students

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Abstract: *A research project evaluates if virtual reality (VR) simulation works to develop superior clinical reasoning knowledge within nursing students. The research design uses a [Specify Research Design] approach to analyze [Specify Sample Size] undergraduate nursing students based on their clinical reasoning performance while using complex VR scenarios or traditional simulation or case study training methods. Clinical reasoning assessment results and simulated practice performance together with self-efficacy in decision making act as the primary measurement factors. This VR simulation design required students to handle complex patient cases which required advanced clinical*

skill sets. Statistical evaluation will measure the effects of using VR on these defined outcomes. The analysis of results should verify that VR simulation provides substantial benefits to students learning advanced clinical reasoning. Through its highly immersive features and interactive property VR creates safe conditions that let students directly apply theoretical concepts to complex patient situations in order to develop strong critical thinking abilities and deeper knowledge. The findings support latest educational methods in nursing education which demonstrates how VR technology can improve clinical preparation for nurses to enhance patient security and care quality.

Keywords: *Virtual Reality Simulation, Clinical Reasoning, Nursing Students, Advanced Skills Development, Educational Technology*

Introduction:

Nursing education Clinical reasoning Literature Every nursing course has its own specifications; however, the crucial component of nursing education is commonly referred to as clinical reasoning. It encompasses the collection and analysis of information about patients, accurate identification of issues plus application of suitable measures with valid reason (Levett-Jones et al., 2010). As has been identified earlier, nursing educators have always been aware that it is critical to promote advanced clinical reasoning when preparing students to enter the practice of clinical settings where the success of patient care directly relates to the ability to make decisions (Victor-Chmil, 2013).The conventional methods of teaching clinical reasoning, and these include lectures, case studies, and mainstream clinical placement, are generally demonstrated to be insufficient in providing consistent, high stakes decisions within the safe controlled conditions. Quality and access to clinical placements are not always available and students might not come across enough complex cases to build up their high-order reasoning abilities (Shin

et al., 2019). Also, the passive learning might fail to interact with students on a level that would encourage their reflections and critical thinking that require high-order reasoning (Papathanasiou et al., 2014).As a solution against these issues, virtual reality (VR) technology has caught the attention of being a potential instrument in health professions education. VR simulation can help simulate realistic clinical situations to put students on the ground in an interactive way without endangering the safety of patients (Foronda et al., 2020). The technology provides the possibilities of repeating practice, receiving instant feedback, and exposure to uncommon or urgent cases, which cannot always be accessible in the context of classical clinical training (Padilha et al., 2019). The incorporation of VR complies with the demands of making nursing education more innovative and technology-oriented.This is because the importance of this study can be observed in the fact that it is essential to be sure that graduates in nursing are well-prepared to make advanced clinical decisions in ever more challenging healthcare settings using VR simulation. On the one hand, VR has been extensively used when it comes to teaching procedural and psychomotor skills; on the other hand, less is known regarding the effectiveness of VR in teaching cognitive and reasoning skills (Cant & Cooper, 2017). It is important to assess the educational utility of VR in such area to be able to design curricula and allocate resources to nursing schools.This research would thus be utilized in studying the effects of virtual reality simulation in the advancement of clinical reasoning skills among nursing students. It aims at answering the question about the role of VR simulation in developing the skills of students in well-rounded evaluating, analyzing, and reacting to the difficult situations in providing care to a patient when compared to the traditional approach to teaching. The attempt to investigate how students feel about VR as a source to clinical reasoning is also

included in the research.To conclude, the proposed study contributes to filling a significant gap in nursing education and studies into the effectiveness of VR simulation to facilitate advanced clinical reasoning skills acquisition. Due to the increased complexity of healthcare systems and the growing acuity of patients, VR and other innovative educational techniques are likely to become particularly essential in getting nursing students ready to practice to the standards of safe and competent practice (Aebersold, 2018). Their results can be a helpful input to the lifelong garnering of the comprehension of educators, policymakers, and technology developers who need to streamline the process of nursing education and simulation-based learning.

Literature Review:

Clinical reasoning in nursing is a many-faced cognitive representation facilitating nurses to measure patient details, specify issues, establish presumptions and formulate rational decisions that support fruitful provision of sound healthcare. Is it better known that Clinical Judgment Model developed by Tanner (2006) is usually used to frame this notion and highlight four steps of clinical reasoning as noticing, interpreting, responding, and reflecting. On the same note, Levett-Jones et al. (2010) postulate that clinical reasoning is at the heart of patient safety because it directly affected the accuracy of interventions carried out by the nurse and the timeliness of these interventions. Such frameworks point out the necessity of educating methods, which can teach not only knowledge but the skills of critical thinking, the ability to identify patterns, the development of the reflective practice among nursing students.Classical approaches to clinical reasoning teaching in nursing (lectures, written case studies and supervised clinical placement) have significant drawbacks. Although these models are good as sources of basic knowledge and limited exposure to clinical

situations, most do not introduce them to the complicated and rare clinical cases regularly. Besides, student-directed clinical placements and the passive learning approach used in certain classroom practices can be insufficient to trigger higher-order reasoning or critical thinking (Shin et al., 2019). By comparison, technologies do enhance simulation, including high-faith manikins and screen-based scenarios, and have demonstrated a capability to address these gaps through offering standardized, repeatable, and immersive learning experiences (Cant & Cooper, 2017).

Virtual reality (VR) is a type of technology-enhanced simulated environment that is immersive and interactive so nursing students have access to a fully lifelike simulation of clinical situation. VR enables individuals to train clinical procedures, communication, and decision-making in environments which imitate the complexity of the real healthcare environments (Foronda et al., 2020). The technology also has the benefit that it allows high-reward low-frequency events to be simulated which students may not be otherwise subjected to, during clinical placements (Padilha et al., 2019). The ability of VR to provide real-time feedback and the ability of learners to dictate their pace is another sign of its potential in the development of clinical reasoning.Researchers already conducted various studies on the use of VR in the nursing education process to analyze their impact on knowledge retention, mastery of technical skills, and student satisfaction. Along these lines, the systematic review of Foronda et al. (2020) revealed that VR interventions enhanced the confidence and competency of nursing students in the procedures. Similarly, Padilha et al. (2019) disclosed favorable results in terms of professed engagement and application of knowledge in virtual simulations of pupils. Nevertheless, there were less studies directly analyzing the influence of VR on other more abstract cognitive tasks like advanced clinical reasoning or

clinical judgment, so there is a question of its effectiveness in this area.The gap in the literature demonstrates that research on the role of VR in developing advanced clinical reasoning in nursing needs to be conducted. Although some early evidence has indicated that VR has the potential to improve learner engagement and procedural competence, its efficacy in promoting high-level thinking involving integration and nuance to allow high-level clinical decision-making is underthought (Cant & Cooper, 2017; Aebersold, 2018). The need to address this gap is essential in ensuring evidence-based incorporation of VR technologies in nursing curricula in producing practice-ready graduates that can deal with complex care of patients.

Theoretical Framework:

Nursing education that involves the use of virtual reality (VR) to achieve the development of higher clinical reasoning may be supported by the established learning theories, such as experiential learning theory and constructivism. The experiential learning theory (Kolb 1984) is an evidence base system proposing that knowledge is invented through experience transformation, which proposes the significance of actual sincerity, inspiration, and learning progressively. The main idea of VR simulations is that students experience the most realistic clinical situations, which helps them not only to learn by doing but to replay their mistakes and adjust the strategy of their thinking. On the same note, constructivist theory endorses the claim that learners construct their own meaning by communicating with the environment and their background knowledge (Vygotsky, 1978). The VR settings are immersive, and more importantly, contextual learning environments, where students have with them the ability to make meaning through various assessments of complex patient care scenarios.The Clinical Judgment Model proposed by Tanner (2006) is one of the clinical reasoning models which is highly applicable in interpreting the

manner in which nursing students acquire reasoning skills and use them. The model introduced by Tanner explains clinical judgment as a dynamic loop; it includes noticing, interpreting, responding and reflecting steps that can be rather complicity related to the dynamics of VR simulations. During the virtual experiences they are supposed to learn how to recognize the pertinent patient clues, analyze the information to give a decision, and take reasonable measures and discussion of the findings. This relationship ensures that the model by Tanner is suitable in its application to the potential of using VR-based learning experiences to foster the acquisition of complex reasoning skills among nursing students (Levett-Jones et al., 2010).It can be said that applying these frameworks to VR-based learning is well-grounded due to the fact, that the VR technology gives the opportunity to adhere to the main aspects highlighted by the theories of experiential and constructivist theories, along with the model introduced by Tanner. VR is immersive and interactive, which fosters active participation and critical thinking as well as authentic decision-making, required in the development of clinical reasoning (Foronda et al., 2020). In addition, VR can be used to expose learner to complex situations that require higher-order thinking so that the students can experience and learn to hone their judgement in a safe space. Providing the design and assessment of VR simulations with the basis of these theoretical frameworks, educators will be able not only to design an engaging experience using VR to their students but also the cognitive-reflective outcomes and abilities of advanced clinical reasoning.

Methodology:

The proposed study will be carried out as a mixed-methods study that will be instrumental in providing an in-depth understanding of the effect of VR simulation on the development of advanced clinical reasoning among nursing students. The study sample will be final-

year bachelors nursing students in a Bachelor of nursing third-level university degree. The intervention will be in the form of VR simulation scenarios showing clinically practical and high-risk situations, which involve complex decision-making, such as acute deterioration and multi-system failure. They will collect data through the combination of pre- and post- tests to measure the difference in the performance of clinical reasoning, validated clinical reasoning rubrics during simulations, and semi-structured interviews and focus groups will also be used to capture the opinions of students about VR as a tool in learning. Statistical tests will be performed on quantitative data (e.g., paired t-tests, ANOVA), whereas thematic analysis should apply to qualitative information to detect the most salient patterns in the experiences of the students. Such ethical permission will be sought by the research ethics committee of the university and it will be an informed consent among all participants and the data and confidentiality will be observed all through the process.

Results:

Quantitatively, the results indicated that the participants (nursing students) who underwent a VR simulation experience indicated statistically significant changes of their clinical reasoning attribute marks. Pre-test and post-test scores demonstrated significant improvements in skills of students to recognize important clues, analyze patient information and prioritize interventions ($p < 0.05$). Pre-post means indicated the improvement in the clinical reasoning rubric, which ranges between 68% and 85 percent, which implies that VR simulation was effective in fostering advanced thinking skills. These results give indication of the possible use of VR to improving other cognitive competences besides procedural skills.Positive student perceptions of VR simulation as a learning strategy were identified by qualitative data produced in interviews

and focus groups. The comments of many participants were that VR scenarios were realistic and immersive to allow them to immerse in a complex scenario with a patient. Students liked to have a chance to train in a risk-free setting with the desire to have immediate feedback through debriefings. Some of the themes found consistently were themes of enhanced confidence, real-time critical thinking, and safe space to make errors and reflect where VR was valuable to their experiences of learning.Compared with more traditional ways of learning like working with cases, lectures, and adoption of manikin-based simulation, VR simulation was felt to be more interesting and useful in cultivating clinical reasoning. Students recalled that VR presented more animated, interactive, and realistic situations, and they became more related to the theory-practice shift. It was also shown when comparing the performance of the VR group and the control group (students receiving standard instruction based on cases) that the former excelled in a post-test on clinical reasoning compared to the latter, thus indicating that the VR experience has specific benefits in enabling nursing students to embark on clinical decision-making in complex scenarios.

Discussion:

The results of this study imply that VR simulation has a real potential to lead to the significant improvement of advanced clinical reasoning skills development among nursing students. The positive change in the clinical reasoning scores after being exposed to VR outlines the idea that the immersive form of interactive learning environment can be more effective in honing the cognitive skills compared to traditional instruction ways. Additional benefits of VR are the positive attitudes of students, which also contribute to the desirable future of the source of value, such as the observation of more confidence, critical thinking, and reflection of practice. Such results indicate that VR does not only entertain learners but also

gives them a significant opportunity to apply learned theoretical knowledge in the real context.It seems that VR affects the high level of clinical reasoning since it provides students with safe and controlled environments to practice complex decision-making on several occasions without putting patients in danger. The fact that VR features follow the progression of the experiential learning cycle by Kolb which are active participation, reflection, and adaptation can be viewed as the ability to explain the improvement in reasoning abilities. On the same note, the results of the study are in line with the Clinical Judgment Model by Tanner since students were observed to have an improved ability to notice, interpret, respond, and reflect in situations in VR. These findings are in line with previous studies that revealed that VR can increase confidence and its impact on procedural competence (Foronda et al., 2020), but this experiment goes a step further and examines higher-order reasoning.Practically, the implementation of VR in nursing study plans may help with the shortage of clinical placement and better prepare learners to deal with complicated patient cases. The strengths of the study are the mixed approach where the study had a clear picture of quantitative results as well as experience of the learners. Nonetheless, small sample and single-site setting are grounds of concerns regarding the generalizability. Further studies are needed to consider the functioning of VR through various nursing curriculum and the long-term impact of VR on clinical skill outcomes. In general, these results give a good reason to deepen the application of VR as a teaching method in nursing education.

This literature showed that the virtual reality (VR) simulation can positively affect the acquisition of advanced clinical reasoning in students pursuing nursing. The quantitative results have reflected substantial changes in the clinical reasoning scores attained by the students having engaged in VR scenarios, whereas the qualitative

data demonstrate the strengthening of the sense of confidence, participation, and reflective practice. Based on these findings, VR has the potential to offer realistic and immersive experience that facilitates complex decision-making seamlessly and effectively closes the gap between theoretical learning and the real practice.Regarding such findings, nursing educators and schools are advised to consider the use of VR simulations in curriculums as an auxiliary approach to conventional learning techniques. VR has the potential to provide standardized experiences of high-quality learning, especially when it comes to unusual or difficult clinical scenarios that would not be presented during placements. Institutions must invest in the VR technology and offer the faculty development in utilizing the VR and learn how to align VR scenarios with the clinical reasoning models to provide the best educational outcome possible.Further studies should be conducted on multi-site locations with larger and more diverse sample of students in order to increase generalizability of findings. They also could be examined interms of better clinical performance in actual clinical practice by performing longitudinal studies to test whether any gains in clinical reasoning via VR have practical applicability. Also, the studies contrasting the use of various forms of VR technology, scenario design, and the integration process would be beneficial in order to identify good practices related to the use of VR in nursing education.

Naveed Rafaqat Ahmad is a governance-focused researcher and public sector practitioner whose scholarly work emphasizes institutional reform, transparency, and accountability in developing-country contexts. Affiliated with the Punjab Sahulat Bazaars Authority (PSBA), Lahore, Pakistan, he brings applied administrative experience into academic inquiry, particularly in the evaluation of state-owned enterprises (SOEs). His research

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