Original Article

Optimizing Clinical Reasoning: Unpacking the Impact of Virtual Patient Educational Duration in Cancer Care and Nursing Students' Experiences

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Abstract

Background: Teaching clinical reasoning to nursing students is essential for professionalizing and improving cancer patient care. This study investigates how training duration with Virtual Patients (VPs) impacts clinical reasoning and learners' evaluation of their experiences. **Materials and Methods:** The present semi-experimental study was conducted with a pretest–post-test design and a control group. Through the census sampling method, 74 nursing students from Isfahan University of Medical Sciences, Iran, (in their 4th and 5th semester) who had taken the cancer course were selected (2019-2022) and, upon obtaining their consent, were enrolled in the study. The study began with a pretest, followed by engagement in five VP scenarios over 6 weeks, which was followed by the post-test phase. Data were collected via 23-item tests and the Huwendiek Questionnaire. The collected data were analyzed in SPSS software using correlation tests and *t*-tests. **Results:** The outcomes revealed a noteworthy disparity between the mean scores recorded in the pre-test and post-test stages after training, for both the 4th and 5th semester cohorts ($p \leq 0.001$). Moreover, a notable discrepancy surfaced between the duration of training with VPs and the average post-test score ($p \leq 0.001$). The correlation coefficient, for the 4th semester, stood at 0.65, while for the 5th semester, it was 0.213. Notably, the participants exhibited contentment with the learning experience through VPs. **Conclusions:** The survey found that 85.60% of participants prefer using VPs for clinical reasoning education. Our study underscores the link between the duration of VP interaction and improved clinical reasoning skills in nursing students.

Keywords: *Clinical reasoning, computer simulation, educational, nurses*

Introduction

Considering the growing trend of cancer in Iran and the world and the challenges in the education of cancer nursing, it is necessary to empower nursing students in this field focusing on clinical reasoning development and assessment.[1] In clinical nursing education, challenges include insufficient feedback, incomplete student understanding of situations, gap between learning and practice, limited patient availability, student confidence issues, patient safety concerns, and crowded clinical settings.[2] A pivotal agenda within nursing education is the cultivation of clinical reasoning abilities. Clinical reasoning, based on information, scientific evidence, experience, and professional skills, enables healthcare professionals to make evidence-based decisions, thus improving patient care quality and treatment outcomes.[3] Clinical reasoning entails discerning the essence of clinical issues and offering suitable solutions.[4] Amid the various methods to enhance nursing students' clinical reasoning, simulation-based training, particularly with Virtual Patients (VPs), shines. This approach overcomes clinical education challenges, enhancing students' knowledge, skills, and performance. Through diverse exercises, it boosts critical thinking and clinical reasoning, equipping students with new skills while ensuring patient safety.[3,5] Prominent in nursing education are VPs in simulations, mirroring real-life scenarios for enhanced learning. This method strengthens clinical cognition, reasoning, and content retention.[6]

Lioce *et al*.[7] showed that VPs enhance nursing education, thus training skilled nurses for safer, superior patient care. In their systematic review, Duff *et al*.[8] indicated that VPs match or surpass traditional methods in teaching diagnostic reasoning and assessment skills and boost learning, satisfaction, and

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student engagement. In their 2019 study, Padilha *et al*.[9] emphasized that clinical VPs in nursing education enhance students' clinical reasoning and satisfaction. Bahrami *et al*.[10] have confirmed that VPs effectively improve nursing education's clinical reasoning skills, establishing a basis for nursing instruction advancement and skilled professional preparation.

Notwithstanding these advances, VPs are still in the nascent stages of educational development worldwide and warrant further exploration.[6] Currently, researchers are investigating the impact of training duration on clinical reasoning improvement, particularly in the context of nursing education in Iran. The researchers did not find any similar study in their online search. This inquiry seeks to tackle the challenges inherent in clinical education, especially pertinent to the domain of cancer clinical education, through the integration of virtual patients, to leverage the findings for the expansion of this pedagogical approach to other nursing subjects. This study aims to delve into the impact of the duration of training with VPs on clinical reasoning and the learners' assessment of their learning experiences.

Materials and Methods

In this study, a semi-experimental pretest–post-test design was adopted with a control group. The present study was a component of a larger mixed-methods study entitled 'Designing, Implementing and Evaluating Virtual Patient-Based Assisted Learning Program in Cancer Course of Bachelor of Nursing Students,' which was conducted in 2019–2021. The study included nursing students in the 4th (intervention group) and 5th (control group) semesters at the School of Nursing of Isfahan University of Medical Sciences, Iran, totaling 74 participants. The sample was obtained through a census approach, considering the defined inclusion and exclusion criteria. A total of 16 participants were excluded due to missing two or more VP sessions, resulting in comparable groups in terms of Grade Point Average (GPA) and gender distribution. The inclusion criteria involved the active participation of nursing students in oncology clinical rotations, while the exclusion criteria encompassed withdrawal from the course or missing over two VP sessions.

In this study, two sets of key point tests, each containing 23 questions featuring 10–15 options, were utilized for pretest and post-test assessments. These tests were designed after identifying essential oncology nursing topics, including the selection of clinical issues, presentation of relevant problem information, creation of scenarios, and formulation of guiding questions. They included brief scenarios followed by multiple-choice questions (15–20 options) related to the scenarios. Content validation by nursing experts and specialists ensured the reliability of the question sets, given their extensive coverage of clinical issues and a relatively high number of questions (10–15 options).[11] Question scoring was based on the correct answers for individual questions and the total score of the test. A pilot group of 33 students evaluated the alignment of pretest and post-test question sets. A correlation coefficient of 0.94 ($p \leq 0.001$) confirmed their alignment and the consistency of questions between the two tests.

A previous qualitative study has shown that VP scenarios encompassed a variety of medical conditions, including cardiac tamponade, chemotherapy-related side effects, mastectomy, and more.[10] To adapt to the COVID-19 pandemic, dedicated virtual channels were established for remote testing, accompanied by clear instructions. Each student had a confidential assessment account. Both intervention and control groups accessed the pretest link through the Virtual Learning Management System for Students. After 6 weeks of training and practice with VPs by the students, the examination was conducted according to the specified protocol. It is worth mentioning that VPs were used for both groups in the cancer education course, but the intervention group had no limitations on using VPs, while the control group had restrictions. Furthermore, students' learning experiences while interacting with VPs were evaluated using the Huwendiek Questionnaire. This questionnaire consists of seven items scored on a 5-point Likert scale (ranging from strongly agree to strongly disagree), with the final item primarily gauging the experience of VP engagement. This questionnaire's validity was validated, yielding a Cronbach's alpha of 0.80. Higher scores indicate greater satisfaction with the learning experiences.[12,13]

A brief 5-minute instructional video was developed to guide students on using VPs during the pandemic. Students in the intervention group received this video, which explained platform navigation and self-assessment. Confidential accounts were created for students on the VP platform. A coordinated schedule was communicated for pretests, VP interactions, and posttests. The study began with pretest activation for all 4th and 5th semester students. VP cases were introduced sequentially, and students were encouraged to seek help. After a set timeframe, VP cases were deactivated, and the post-test link was activated for both groups, lasting 120 minutes.

After data collection, SPSS software (version 20; IBM Corp., Armonk, NY, USA) was employed for statistical analysis. The collected data underwent analysis using correlation coefficients, paired *t*-tests, and independent *t*-tests.

Ethical considerations

The study obtained ethical approval (IR.MUI.RESEARCH.REC.1398.431) from Isfahan University of Medical Sciences. Participants were informed about the project's goals, and written consent was collected.

Results

The participants had a mean (SD) age of 25.60 (2.76) years. Their mean Grade Point Average (GPA) was 15.14 (2.41), and their mean work experience was 2.87 (3.34) years. Additionally, 54.05% of the participants were women. The mean and standard deviation of the pretest scores for semester 4 and semester 5 groups showed no significant difference ($p > 0.05$), but the post-test score for the semester 4 group after the intervention 35.27 (4.07) was higher than the post-test score for the semester 5 group 29.18 (2.88) ($p < 0.05$). The mean and standard deviation of the pretest and post-test scores for the groups are presented in Table 1.

Results indicated that the mean and standard deviation of the duration of training and practice with VPs were higher in the intervention group compared to the control group. The mean and standard deviation of the duration of training with 5 VPs in semester 4 (intervention group) and semester 5 (control group) are presented in Table 2.

Findings indicate a strong and positive relationship between the mean test scores and the duration of training and practice in the intervention group ($r = 0.65$; $p < 0.05$). In Table 3, the association between the mean training duration and the mean clinical reasoning scores of students in semester 4 and semester 5 after implementing VP training is presented. The Mean(SD) of participants' experiences from training with VPS were 4.28(0.88).

The students expressed a favorable level of agreement with the experience of learning through VPs. The result of the evaluation of the experience using virtual patients for learning clinical reasoning showed that 85.6% of participants were satisfied with the virtual patient training [Table 4].

Discussion

In this study, emphasis was placed on investigating the impact of the duration of training and practice with VPs in the domain of cancer care on clinical reasoning ability and the experiences of nursing students. This study explored the relationship between the duration of training with VPs and the clinical reasoning ability of nursing students in a manner that has not been extensively explored to date. The results can contribute to the improvement of educational methods and the capabilities of nursing students in the field of cancer patient care.

The study showed a significant improvement in clinical reasoning scores among nursing students who received VP training. The difference in average scores before and after training between the experimental and control groups highlights the effectiveness of the intervention in enhancing clinical reasoning skills in both groups. Our findings are in line with that of previous studies by Kleinert *et al*.[14] and Watari *et al*.[15] VP training improves nursing students' clinical reasoning by offering realistic scenarios, repetition, and skill development. This approach fosters practical skills, decision-making confidence, and competence in complex clinical situations. Virtual experiences solidify skills, expose students to diverse scenarios, and facilitate learning from errors in a safe environment, empowering them for real clinical practice and confident navigation of clinical challenges. However, Sobocan *et al*.[16] contradicted our findings in 2017. VP training enhances nursing students' clinical reasoning, but its effectiveness varies due to factors such as content quality, teaching process, student perceptions, alignment with reality, and individual psychology. In essence, the impact of VP education on clinical reasoning depends on teaching methods, content design, and student experiences.

The higher clinical reasoning score in semester 5 students before education, compared to semester 4 students, is in line with the findings of prior studies by Carvalho *et al*.,[17] Lee *et al*.,[18] and Richmond *et al*.[19] Experience and knowledge play a crucial role in advancing students' clinical reasoning skills. Real-world clinical exposure refines practical skills and decision-making by exposing students to authentic scenarios, thus, fostering confidence in alignment with clinical realities. Theoretical knowledge,

Table 1: Comparison of the mean (standard deviation) of pre-intervention and post-intervention test scores in the study groups

Group	Before Intervention	After Intervention	Paired *t*-test
Intervention group	24.97 (2.71)	35.27 (4.07)	t=9.28; p<0.001
Control group	25.05 (2.32)	29.18 (2.88)	t=10.14; p<0.001
Independent *t*-test (p)	t=0.14; p=0.88	t=8.24; p<0.001	

Table 2: Mean and standard deviation of the duration of virtual patient training

VP	vp1*	vp2**	vp3***	vp4****	vp5*****	Total
Mean±SD						
Intervention group	73.42 (5.43)	48.51 (4.41)	44.71 (3.86)	31.91 (3.65)	22.97 (3.25)	44.30 (4.12)
Control group	73.03 (5.22)	41.92 (4.66)	39.15 (3.58)	31.88 (2.99)	20.02 (3.28)	41.20 (3.94)

*Virtual Patients Number 1, **Virtual Patients Number 2, ***Virtual Patients Number 3, ****Virtual Patients Number 4, *****Virtual Patients Number 5

Table 3: Relationship between mean training duration and mean clinical reasoning scores

Relationship between Mean Test Score and Training Duration	Pearson Correlation	*p*
Intervention group	0.65	<0.001
Control group	0.21	<0.001

Table 4: List of strengths and weaknesses regarding the design of virtual patients in bachelor's level students (intervention group) after implementing virtual patient training

Items	Experience of learning
Strengths	Enhanced confidence and proficiency in dealing with real patients in clinical settings Encouragement of critical thinking and problem analysis Increased engagement and enthusiasm in the learning process
Weaknesses	Lack of synchronization between the timing of virtual patient presentation and classroom teaching Incorporation of complex and extensive concepts within virtual patient scenarios Insufficient visual appeal and engagement in virtual patient modules
Suggestions	Using this educational method as a suitable and effective supplement for other courses in the bachelor's degree nursing program Integrating this type of education into theoretical and clinical instruction

encompasses disease comprehension, nursing care, and therapeutic methods, and augments clinical reasoning. This knowledge enables logical decision-making within clinical contexts, ultimately improving patient care and outcomes. However, the findings of Kaur contradict these findings, suggesting that while experience and knowledge generally enhance clinical reasoning, certain situations may lead to regression due to factors like incomplete information recall, complexity, inadequate learning opportunities, and discrepancies with real clinical environments.[20] Thus, achieving heightened clinical reasoning requires a balanced integration of experience, knowledge, suitable learning, and alignment with authentic conditions.

The present study reveals a decline in the average duration of VP interaction, accompanied by a statistically significant positive correlation between mean clinical reasoning scores and interaction duration. These outcomes are in accordance with the findings of Kononowicz *et al*.,[21] who attributed reduced engagement time from initial to later cases to scenario complexity. The decreasing case interaction duration can be attributed to improved student skills, including clinical reasoning.

Al-Dosari *et al*.[22] have found that longer engagement with VPs is linked to higher average clinical reasoning scores among students, which supports our findings. VP training aims to stimulate critical thinking and exploratory problem-solving and provide students with repeated exposure that enhances their comprehensive understanding of instructional subjects. Nevertheless, the research by Middeke *et al*.[23] suggests that although longer case interaction durations may lead to higher test scores for individual VPs, the correlation is not statistically significant. The weak link between intervention duration and post-test scores may result from external factors affecting VP engagement, including concurrent textbook learning, distractions, or slow internet connectivity. Moreover, distinguishing dedicated learning time from note-taking or personal tasks proves challenging.

The survey indicated strong support for VPs in clinical reasoning education, with 85.6% of participants favoring their use. This is in line with the findings of Forsberg *et al*.[24] and Jeimy *et al*.[25] High satisfaction in VP training arises from interactive, controlled experiential learning resembling clinical scenarios, repeatability, extensive learning opportunities, flexibility, and risk-free assessment, skills enhancement, clinical reasoning, confidence, motivation, and performance. However, its limitations include the absence of genuine patient emotions and physiological responses, potentially impacting immersion and comprehension, along with potential confusion and misconceptions due to insufficient content and design.

The present study's limitation was solely relying on interaction time with VPs, which can be influenced by external factors. Accurately distinguishing learning time from other activities is complex. Researchers took measures during the study design to accurately measure and record interaction time, thus minimizing the impact of irrelevant activities during online interactions. Future research should investigate the impact of external factors on VP interaction duration and outcomes. Enhanced control in studies can provide deeper insights into the genuine influence of interaction duration on clinical reasoning and learning, advancing our understanding of the role of time allocation in learning outcomes.

Conclusion

This study explored the relationship between the duration of VP training and its impact on nursing students' clinical reasoning skills and experiences. The findings emphasize the importance of integrating VP training into clinical education. Extended engagement significantly enhances clinical reasoning, practical skills, and decision-making. Longer interaction periods provide ample opportunities for comprehensive learning and diverse clinical exposure, elevating practical nursing skills. In summary, extended VP training improves clinical reasoning and enhances nursing education, warranting recognition as a valuable pedagogical tool.

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Conflicts of interest

Nothing to declare.

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