Original Article

Designing Virtual Patients for Education of Nursing Students in Cancer Course

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Abstract

Background: One of the best approaches to promote clinical reasoning in nursing education is Virtual Patient (VP). The purpose of this study was to design and implement VPs for nursing student's education in caring for cancer patients. **Materials and Methods:** In the first stage, through a descriptive-exploratory qualitative study using a focus group method, topics with higher priority in cancer nursing were identified. Then, based on the VP Nursing Design Model (VPNDM) for each of these topics, a scenario and then an interactive VP was designed and implemented in the Open Labyrinth application. The content validity of VPs was evaluated by eight experts and then the face validity was examined in the pilot group including 15 nursing students. **Results:** Topics with higher priority in cancer nursing courses were mastectomy, chemotherapy, radiotherapy, hypercalcemia, spinal cord compression, cardiac tamponade, and superior vena cava syndrome. For five scenarios based on the nursing process in three sequences (signs and symptoms, diagnosis and interventions) the VPs were designed. In this process, learning objectives, determining the critical path, adding branches at the decision point, adding feedback, completing the clinical course and related data, and adding multimedia were considered. VPs were revised based on the proposed modifications following face and content validity. **Conclusions:** This article presents VP design steps for use in a nursing student training course. The researchers were able to provide and validate five VPs to care for cancer patients based on the VPNDM.

Keywords: *Neoplasms, Iran, education, nursing, qualitative research, simulation training, virtual patient*

Introduction

Clinical reasoning is one of the priorities of the nursing education program and it includes all thoughts and decision-making processes that are related to clinical practice to identify and diagnose the patient's actual and potential problems.[1] Simulation is one of the best approaches to promote clinical reasoning that can solve the problems and limitations of clinical education by expanding students' knowledge, skills, and performance.[2] Simulation imitates the real clinical environment and increases nursing students' learning, improves clinical skills, and reduces errors in the real clinical environment.[3] Therefore, it can be used at all levels of nursing education.[4] One of the most suitable simulators of educational programs is the Virtual Patient (VP) computer simulation.

VP is an interactive computer simulator application that enables the simulation of real clinical scenarios according to clinical cases.[5] VP interacts with the learner, strengthens clinical thinking skills, and develops decision-making skills in the learner.[6] The goal of VP is to expose students to virtual scenarios that provide appropriate feedback to increase the depth of learning, train specialist students, and strengthen clinical skills without harming the real patient.[2,5,7] Findings of studies show that the VP might improve the clinical reasoning of nursing graduates.[2-7] Studies have also shown that design plays an important role in the effectiveness of virtual learning technologies that can be implemented in different ways.[8] For example, McGee (2015) and Urbanova *et al*. (2018) used an eight-step method to design and develop a VP. These methods include choosing an interactive scenario-based on learning objectives, setting rules and expectations, determining the critical path, creating a branch structure, adding feedback, completing scenarios and clinical data, adding multimedia, and VP testing and validation.[9,10] In the field of

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nursing, Georg (2019) designed, implemented, and evaluated a VP Nursing Design Model (VPNDM) for the design of a VP in nursing care.[11]

Our base for creating a VP in this study is established on the VPNDM. This model includes three layers of patient information collection, clinical reasoning, feedback and assessment (measurable outcomes) that emphasize the nursing process.[11] This model depicts the meanings in the patient scenarios for the nursing student and it causes the student to make the best clinical decision based on the situation (appropriate nursing care based on the specific needs of the patient) while considering the relationships between the data, according to evidence-based nursing.[11] The results of a study showed that VPs based on the VP design model might be suitable for teaching, learning, and evaluating the clinical reasoning skills of nursing students.[11] Considering that a study based on virtual education of nursing students was not found in Iran, a study was conducted to design a VP in cancer nursing education.

Materials and Methods

This study was a descriptive-exploratory qualitative research which was a part of a large mixed-methods study entitled "design, implementation, and evaluation of a VP-based educational assistance program in the cancer course of undergraduate students". The study was conducted in 2020 in three stages. In the first stage, the essential topics of the cancer nursing course were listed according to the learning objectives of the educational curriculum. Then the researchers formed a focus group consisting of eight cancer nursing specialists. The member of focus group had more than 5 years of teaching experience in cancer nursing education and practice, with at least an Assistant Professor degree or higher from prestigious nursing schools in the country. The researchers then gave them list of essential topics. Necessary topics were identified and prioritized based on participants' clinical reasoning, the importance of the topic, and the frequency of the topic in caring for cancer patients. As a result of this stage, 15 essential topics were identified to prepare the scenarios. In the second stage, the researchers designed five scenarios considering four elements of content, inputs, processes and results that were more suitable to the real clinical environment according to researchers' clinical experiences in the cancer department and using case studies in reliable scientific sources such as Oncology Nursing book, and the NCLEX-RN questions. Then the researchers used a six-item checklist of Goba *et al*. (2012) with scales (Yes-No) to validate the scenarios. [12] It should be noted that the format of the questions in the scenarios was Key Features (KF). Designed scenarios were then given to eight experienced nursing professors to test the content and face validation (according to the checklist) and match them with learning objectives. Criteria for entry of experts included being a lecturer of cancer nursing course, willingness to participate in the study, and familiarity with the concept of clinical reasoning.

In the third stage, VPs were designed based on the VPNDM in three layers (patient information, clinical reasoning, and feedback to student reasoning) and using the Open Labyrinth (OL) application. The OL application is an open-source online activity modeling system that allows users to create interactive educational activities such as VPs. The designed VP was validated by eight specialists. Also, these cases were validated by 15 nursing students that they be modified if necessary. Inclusion criteria for students included nursing students of the fifth semester and passing the cancer nursing. Exclusion criteria for students included the unwillingness to cooperate in any stage of the research and not doing practice with more than one VP.

Ethical considerations

This research has been approved by the ethics committee of the Isfahan University of Medical Sciences (IR.MUI.RESEARCH.REC.1398.431). The objectives of the project were explained to the participants and their written informed consent was obtained.

Results

Table 1 shows the priority topics obtained from the focus group. The titles were prioritized based on educational goals, the importance of the subject in education and clinical practice, the needing for critical thinking and clinical reasoning (first stage).

Five scenarios were prepared based on prioritization topics by researchers. Comments and suggestions of eight experts were used to modify and complete the educational content of the scenarios; for example, using cancer patients in accordance with learning objectives, appropriate content to continue the scenarios, adding questions at the level of memorization and understanding, analytical questions and reducing the options of analytical questions. It should be noted that the questions in each sequence consisted of an average of 8-10 options that the student could make the best clinical decision based on the evidence by thinking about each option. The questions were designed based on the KF format which is a standard for clinical reasoning tests[13] (second stage).

In the VP design, researchers first designed five VPs using linear nodes and links. Then information about each problem was provided to learners in three steps (signs and symptoms, diagnosis, planning and implementation) in VPNDM. To challenge the student's learning, researchers included decision nodes (alternating or branching paths) in the linear structure. Also, for better understanding and deeper learning, learners mentioned their feedback on whether it was right or wrong and its cause at the end of each option. The researchers tried to complete and integrate the designed VP by adding and subtracting nodes and adding multimedia

(images, animations, videos as well as audio files). The animations were designed with the help of Crazy talk animator 8, Camtasia Studio 8, and Adobe Photoshop cc software. Figure 1 shows an example of a nursing diagnosis of pain (implementation step) in the VPNDM in the original language (Persian).

Finally, the designed VP was validated by the experts and their comments, including putting educational objectives at the beginning of each VP, adding educational content related to educational goals, adding educational video clips in some VPs, including sports training clips after the mastectomy, elimination of questions (including nursing interventions in nausea, skin integrity disorder) that were repetitive in some patients. The integration of some questions (including nursing interventions in malnutrition due to drug side effects and nursing interventions in malnutrition due to anorexia) that were closely related in nursing care was applied to improve the quality of work. The researchers also tested and validated the VPs designed by the pilot group (15 students) for face validity, and their suggestions were reflected in the group of experts, including correcting the test image for pancytopenia, eliminating duplicate options in one of the VP questions related to the superior vena cava syndrome, the correction of some incomprehensible options in some VPs. The VP reformations were made with the expert's approval (third stage).

Discussion

The purpose of this study was to design VPs based on VPNDM. It can be said that setting priorities according to the needs of learners and learning objectives is effective as a first step in designing a VP. In this study, the essential topics of the cancer nursing course (mainly the major treatments and common cancer emergencies) that were based on clinical reasoning were identified during the focus group session. Inadequate training in some important and necessary topics may occur, and therefore, prioritization can reduce this problem. Batman *et al*. (2013), Midik and Kartal (2015), and Moule *et al*. (2015) in their studies emphasize the importance of choosing content that is consistent with the educational goals of learners, as an external precondition in VP design.[14-16]

The second step in VP design was to create a scenario. Determining the content of the scenario is the main part of VP design, which should be related to learning objectives, student population, and level of expertise of learners.[17] Because of the proximity of the content of the scenario to the real patient, clinical experience and the use of specialized resources are the reason why a scenario for education is attractive and scientific. Therefore, in this study, scenarios were designed based on these criteria. In this study, researchers designed the scenarios by considering

Table 1: List of topics and educational content related to scenarios

Educational content	Scenario subject
superior vena cava syndrome, chemotherapy, mucositis, nursing interventions related to them.	Superior vena cava syndrome
chemotherapy, pancytopenia, diarrhea, cardiac tamponade, related nursing interventions.	Cardiac tamponade
chemotherapy, neutropenia, hypercalcemia, related nursing interventions.	Hypercalcemia
Interpretation of biopsy, determination of tumor grade and stage, chemotherapy, types of surgeries, types of prostheses, complications of mastectomy surgery, nursing care before and after mastectomy	Mastectomy
Spinal cord compression, pain, radiation therapy, anxiety, nausea, related nursing interventions.	Spinal Cord Compression

Figure 1: An example of a nursing diagnosis related to pain in the implementation step in the VPNDM in the original language (Persian)

the main elements of cancer nursing and then validated them in terms of content by experts. Moule *et al*. (2015) have used specialized clinical nurses in designing and validating VP scenarios.[16] From the researchers' point of view, the designed scenarios may be suitable for learners in terms of structure, content and educational goals while they may not be true. Therefore, validation is of great importance in scenario design. Owing to the lack of a standard guideline in designing a VP scenario, experts need to be involved in their design and validation.

The third step in this study was to design a VP with an eight-step method based on the VPNDM. McGee (2015) and Urbanova *et al*. (2018) have also used it in VP design due to the clarity of the steps in the 8-step method.[9,10] However, some studies, including Wagner-Menghin *et al*. (2018), have used the four-step method (basics and general principles of VP design).[18] Researchers in VP design such as George *et al*. (2019) used the VPNDM[11] because this model is for nurses and emphasizes the latest version of the nursing process. The final step was the content and face validity of the designed patients. In the study of Batman *et al*. (2013) and Moule *et al*. (2015), it has been stated that content and face validity by students is one of the main steps in the VP design to help their development.[14,16] In this study, experts suggested some changes to more fit the VP educational content with educational goals. Students also played a significant role in the virtual validity of VPs in VPs. This stage leads to the development and promotion of the designed VP.

The findings of the study should be considered along with its limitations. Lack of sufficient familiarity of some faculty members with clinical reasoning might have an effect in the selection of clinical priorities. Lack of general feedback on each question in the current version of OL, upload restriction for multimedia, insufficient application support for Persian contents, inability to activate some options for users and lack of standard guidelines for designing scenarios in nursing might also be considered as the limitations of this study.

Conclusion

This article presents VP design steps for use in a nursing student training course. The approach to scenario design, VP design, and validation described here is an efficient, inexpensive way of integrating multilingual virtual simulation technology into nursing education. There is, however, a need for additional development, implementation, and evaluation of VP technology designed for use within nursing education. Researchers were able to design five VPs to improve students' clinical reasoning skills. VPs presented the nursing care plans to care for cancer patients. They were designed based on the VPNDM because this model is for nursing education.

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Conflicts of interest

Nothing to declare.

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