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HAO BIN YUAN

Macao Polytechnic Institute, China

NURSING STUDENTS' INTERACTION WITH A COMPUTER-CONTROLLED HUMAN PATIENT SIMULATOR

Abstract:

Active learning by caring for patients has been the preferred method of achieving competency. Simulation learning provides the opportunity for the learner to practice and learn in an environment as close to reality as possible. Students interact with the simulator, discovering critical assessment information in the same manner they would with real patients. High-fidelity simulation was conducted at one nursing school in Macao. All scenarios were designed using a computer-controlled human patient simulator (HPS, SimMan Laerdal Sales Office, New York, USA). 113 Chinese baccalaureate nursing students (77 in year 2, 36 in year 3) completed all simulation sessions. Their age ranged between 19 and 26 years (mean = 21.24, S.D. = 1.26). Students received an orientation to the simulation laboratory to familiarize them with technology and learning process one week before simulation. Students worked with five scenarios during a four week block with nine hours per week. They were voluntarily divided into different tutorial groups. Each group consisted of 5 or 6 students with two tutors. The learning process includes case clarification, health assessment, nursing intervention and debriefing. This paper described the simulation design and students' interaction with a computer-controlled human patient. The Simulation Design Evaluation Questionnaire was used to evaluate students' views on simulation design in terms of realism, transferability and arrangement. The content validity Index (CVI) was reported as 0.91. The internal consistency reliability was evaluated to assess the internal consistency of the Simulation Evaluation Scale were shown as 0.832. Students had positive feelings about the simulation design. The scenarios used with the simulator recreate real-life situations. The learning objectives were clear. Students considered that the interaction with the simulator improved their clinical competence. Simulation experience increased their confidence about going into the actual clinical setting. The clinical decision-making skills taught in the simulation are valuable. The knowledge they gained from the simulation could be used in nursing care. Integrating simulation into existing curriculum structures requires faculty commitment to enhance their own teaching skills and redesign existing programs. Organizational commitment is also essential for this innovative teaching method due to the significant resources required for program implementation and ongoing financial support. Additional studies to test the impact of this teaching method on learner performance, patient safety, clinical outcomes, faculty perceptions and cost efficient will provide valuable support for using high-fidelity simulation in nursing education.

Keywords:

high-fidelity simulation ; design; Nursing student; Interaction

JEL Classification: I20, I23, I00

Introduction

Nursing is a practice profession and active learning by caring for patients has been the preferred method of achieving competency (Sportsman et al., 2009). It is crucial to bridge the gap that exists between what students learn in the classroom and how they apply what they learn in their clinical practice. The major focus of clinical education is facilitating the development of knowledge application, accurate clinical judgment and skill development. Educators are challenged to find adequate clinical experiences for their students (Hennenman & Cunningham, 2005). The complexity of the health care systems makes it difficult to provide nursing students with sufficient clinical experiences to ensure their competency.

Simulation learning provides the opportunity for the learner to practice and learn in an environment as close to reality as possible and allows students to construct knowledge, explore assumptions, and develop psychomotor skills in a safe environment (Sinclaire & Fergusion, 2009). Students interact with the simulator, discovering critical assessment information in the same manner they would with real patients. Once the simulator's medical condition is identified, learners then proceed with treatment options in an effort to correct the simulator's condition. A simulator is a training device that closely represents reality but in which the complexity of events can be controlled. Simulation using physical models, computer programs or combinations of the two offers learners the opportunity to gain and assess skills through repeated practice within a safe environment. The emphasis in simulation is on the application and integration of knowledge, skills, and critical thinking (Haidar, 2009).

High-fidelity simulation (HFS) is an approach to experiential learning using life size manikins with actual physiological and pharmacological responses, and sophisticated interactive capability in realistic scenarios. These devices replicate many human physiological functions and anatomical features and provide a very realistic situation both in psychological and engineering technology. Students can make, detect and correct patient care errors without negative consequences. HFS has been proposed as a novel supplemental teaching-learning strategy to enhance the transfer of student confidence and competence from the classroom to the clinical nursing environment (Nagle et al., 2009). This paper described the simulation design and students' interaction with a human patient simulator (the SimMan).

Simulation Design

All scenarios were designed using a computer-controlled human patient simulator (HPS, SimMan Laerdal Sales Office, New York, USA). The SimMan is a full-body manikin with a realistic upper airway, chest movement, variable cardiac and breath sounds and a palpable pulse. It can be mask-ventilated, intubated, cannulated, given fluids and medications and defibrillated. Five different simulated patients were used: Patient A: A 42 year-old man with appendicitis; Patient B : a 68-year old man, with Chronic obstructive pulmonary disease ; Patient C a 73-year-old man with Gastrointestinal bleeding; Patient D: a 72-year old man with Myocardial infarction; Patient E: a 32-year old man with critical trauma. The cuing questions were given to motivate students to probe for deeper understanding of patient condition. Students were assigned to take part in five separate immersive high- fidelity simulation scenarios

one after another, beginning with Patient A and ending with Patient E over 36 learning hours. Each learning package was completed within 6 to 8 learning hours.

For example: Learning package 2: Chronic obstructive pulmonary disease (COPD) Scenario description: Mr. Wang, a 68-year old man, was diagnosed with COPD 10 years ago. He has a 40-year smoking history (is still smoking) and has been hospitalized twice due to chest infections during the last 12 months. He complained he has trouble getting his breath. His FEV1 is 26% and FEV1/FVC is 38%. The arterial blood gases are reported as pH 7.25, bicarbonate (HCO3-) 23 mEq/L (norm 22~26 mEq/L), $PaCO_2$ 55 mmHg (norm 35~ 45 mmHg), PaO_2 56 mmHg (norm 80~100 mmHg). The physician prescribed the low-flow oxygen therapy.

The cuing questions: (1) What are the meanings of FEV1, FEV1/FVC, and SpO2?;(2) What does the report of arterial blood gases mean?;(3) What kinds of problems are there in the scenario?;(4) What additional data would you collect? Why?;(5) How will you manage the patient when he is admitted?; (6) How will you manage the hypoxemia?(7) How will you monitor the patient during oxygen therapy?

Initial settings for the human patient simulator (just admission): T 36.8 ºC, heart rate (HR) 100/min (regular), respiratory rate (RR) 26 /min, BP 130/75mmHg. SpO2 is 83 %; Patient is coughing and wheezing, and said :“I felt bad, please help me”

Second settings for the simulator (two hours later): RR is 30 /min, HR is 120/min. Patient is coughing, wheezing, and vomiting. SpO2 is 80 %, said: “I felt really bad.”; “I cannot breath.”; “ I am thirsty.”

Required student action and intervention: (1) Health assessment: introduction and patient identification, symptom assessment, physical examination, explanation for patient conditions, medical history inquire; (2) Management for breathless and vomiting; (3) Oxygen therapy for the patient.

Students’ Interaction with the SimMan

Purposive sampling was used to recruit year 2 and year 3 baccalaureate nursing students who passed course learning in nursing assessment and medical-surgical nursing. Although 118 students voluntarily participated in this study, 113 students (77 in year 2, 36 in year 3) completed all simulation sessions. Their age ranged between 19 and 26 years (mean = 21.24, S.D. = 1.26). Second-year students had 20 weeks of clinical experience while third-year students had 30 weeks of experience. Students received an orientation to the simulation laboratory to familiarize them with technology and learning process one week before simulation. Students worked with five scenarios during a four week block with nine hours per week. They were voluntarily divided into different tutorial groups. Each group consisted of 5 or 6 students with two tutors. Students acted registered nurses, patients, family members or friends. As a family member, the student was expected to stimulate critical thinking by asking appropriate questions of those in the role of nurse. The patient was expected to display the appropriate symptoms through answering questions from the nurses, thus indicating their comprehension of the disease process and clinical manifestations involved in the scenario. Tutors acted as facilitators and controlled the sequence of events. The learning process includes case clarification, health assessment, nursing intervention

and debriefing (see Figure 1).

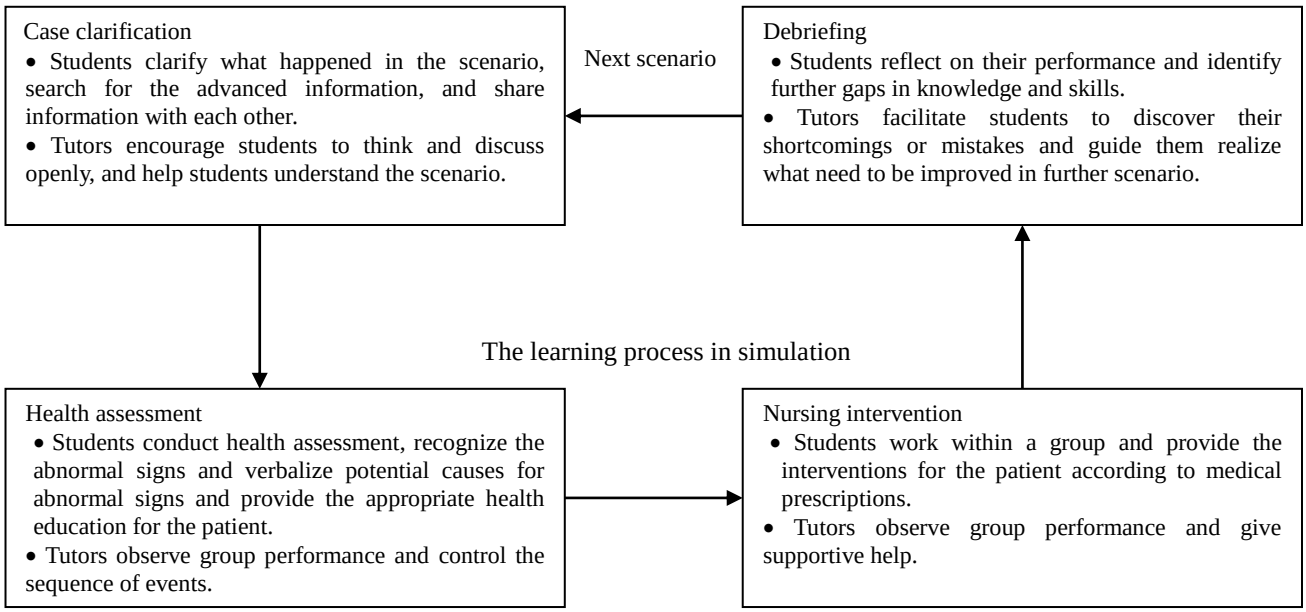

Figure 1: The learning process in simulation

Students are given a brief amount of time to review the scenarios and discuss their approach to care. During the enactment of the scenario, the students were expected to demonstrate an emotional connection and relationship with the patient to enhance realism. They performed assessments and interventions using appropriate techniques and adhering to principles of safety. They concerned main complaints and the provoking and relieving factors, and then they conducted the physical examination and provided appropriate explanation and health education for the patients. They also inquired medical history. In the meantime, they have to manage any complaint of the patients, such as pain, breathless, vomiting, nausea, cough, thirsty and hungry. Based on health assessment and laboratory examination, students defined the problems which need nursing care and their priorities, then they implemented some interventions followed by medical prescription, such as blood transfusion, wound care, urethral catheterization, oxygen therapy, electrocardiogram exam or monitoring, and medicine administration while observing the patients' physiological responses and reassessing the patients. Sometimes they should recognized the sever arrhythmia, and prepared for defibrillation with calling physicians for help. Finally, the debriefing followed each scenario in the simulation laboratory was conducted. It focused on the team's care of the patient in terms of safe practice, priority setting, continuous assessment, communication and resource management. During the debriefing process, the tutor encouraged and allowed students to express their feelings and concerns, which contributed to their comfort with reflection. The students were not given the answer to the problem. The tutor allowed the students to take risks with their learning by letting them discover their own mistakes and explore their abilities. Students learnt from the mistakes and thought about what need to be improved in further scenario. This learning synthesis helped the students to generalize the learning from the specific situation to more general one.

Protection of Human Rights

Approval for the study was granted by the Macao Polytechnic Institute Research Committee and permission to access students was given by the Dean of School of Health Sciences. Participants were provided with a complete explanation about the nature of the study and assurance was given in relation to confidentiality and autonomy of the participants and the freedom to withdraw from the study at any time. Following explanations, written informed consent to participate was obtained. While the risks were minimal to nonexistent, the benefits to the individual participant were also minimal.

The Evaluation of Simulation Design

Based on the theoretical underpinnings of simulation based learning and a literature view, the Simulation Design Evaluation Questionnaire was developed by researchers. It was a 14-item self-report Likert scale with a 5-point response (1 strongly disagree, 2 disagree, 3 Undecided, 4 agree, 5 strongly agree). It was designed to evaluate students' views on simulation design in terms of realism (item 1, 2,3, 4), transferability (item5, 6, 7, 8, 9, 10, 11) and arrangement (item 12, 13, 14). Higher scores indicate more satisfaction with simulation design and a higher degree of effectiveness. The content validity of the Simulation Evaluation Scale was tested by three experts with expertise in simulation, PBL and instrument construction. The content validity Index (CVI) was reported as 0.91. The internal consistency reliability was evaluated to assess the internal consistency of the Simulation Evaluation Scale among 113 Chinese baccalaureate nursing students were shown as 0.832.

Findings

As evident in Table 1, students were satisfied with simulation design (item mean 4.08, S.D. 0.35), especially in transferability (item mean 4.19, S.D.0.42) and arrangement (item mean 4.14, S.D. 0.49). The learning objectives are clear. The scenarios used with the simulator recreate real-life situations. Students considered that the interaction with the SimMan improved their confidence and clinical competence. The knowledge they gained from the simulation could be used in nursing care. The clinical decision-making skills taught in the simulation are valuable.

Table 1 Description of students' evaluation of simulation design (n=113)

Items	Min ~ Max	Item mean	S.D.
Realism	3.00 ~ 5.00	3.84	0.42
1. The simulator scenarios were realistic.	3.00 ~ 5.00	3.94	0.68
2. The scenarios used with the simulator recreate real-life situations.	3.00 ~ 5.00	3.98	0.53
3. The simulation laboratory resembles an actual health care setting.	2.00 ~ 5.00	3.42	0.64
4. The pace of the simulation reflected the flow of an actual clinical setting.	3.00 ~ 5.00	4.04	0.59
Transferability	3.43 ~ 5.00	4.19	0.42
5. The simulation experience increased my confidence about going into the actual clinical setting	3.00 ~ 5.00	4.12	0.61
6. My interaction with the simulator improved my clinical competence.	3.00 ~ 5.00	4.08	0.69
7. The simulation laboratory experiences gave me confidence in my technical skills.	2.00 ~ 5.00	3.88	0.69
8. The prioritization skills taught by using the simulator are valuable.	2.00 ~ 5.00	4.12	0.63
9. The clinical decision-making skills taught in the simulation laboratory are valuable.	3.00 ~ 5.00	4.24	0.53
10. The knowledge I gained from this simulation could be used in nursing care.	3.00 ~ 5.00	4.45	0.59
11. Simulation is useful for my future work.	3.00 ~ 5.00	4.47	0.57
Arrangement	3.00 ~ 5.00	4.14	0.49
12. The learning objectives and information are clear.	3.00 ~ 5.00	4.26	0.58
13. Simulation provided and maintained an appropriate level of	3.00 ~ 5.00	4.29	0.65

challenge.			
14. The time offered in the simulation laboratory was adequate.	3.00 ~ 5.00	3.86	0.71
Overall score	3.36 ~ 4.93	4.08	0.35

Simulation was considered as experience learning which allows the students to practice in a safe environment that mimics reality by taking theoretical knowledge and applying it in practice (Deifuerst, 2009). This experience can help students to bridge the theory practice gap and enabled students to fill the gap between theory and practice by transferring cognitive learning into practical experience. Students constructed new knowledge through their experiences and previous knowledge and their own ways of learning. Debriefing is structured to promote reflection, encouraging students to analyze their own assumptions and think about how to enhance or develop more skillful nursing practice meanwhile reflective practice may be involved.

The scenarios used in this study was designed to reveal the ability of students to make sense of data, not only in how to set priorities but also in how to respond to the challenge of providing patient education on complex topics. Reflection-on-action offers opportunities for students to integrate their new understanding into their preexisting knowledge base. Students engaged in introspection learn to self-correct and assimilate new experiences with prior ones and thus improve the professional competence which associated with critical thinking, clinical reasoning, and clinical judgment (Deifuerst, 2009). In this case, simulation provides opportunities for students to incorporate what is taught in theory to develop reasoning skills while providing care. Students perceived the great improvement of knowledge and skills after simulation.

Conclusions

Students had positive feelings about the simulation design. The scenarios used with the simulator recreate real-life situations. The pace of the simulation reflected the flow of an actual clinical setting. Students considered that simulation experience increased their confidence about going into the actual clinical setting. The interaction with the simulator improved their clinical competence. The clinical decision-making skills taught in the simulation are valuable. Moreover, integrating simulation into existing curriculum structures requires faculty commitment to enhance their own teaching skills and redesign existing programs. Organizational commitment is also essential for this innovative teaching method due to the significant resources required for program implementation and ongoing financial support. Additional studies to test the impact of this teaching method on learner performance, patient safety, clinical outcomes, faculty perceptions and cost efficient will provide valuable support for using high-fidelity simulation in nursing education.

References

Dreifuerst, K. T. (2009). The essentials of debriefing in simulation learning: A concept analysis. *Nursing Education Perspectives,* 30(2), 109-114.

Haidar, E. (2009). Clinical simulation: a better way of learning? *Nursing Management,* 16 (5), 22-23.

Hennenman, E., & Cunningham, H. (2005). Using clinical simulation to teach patient safety in an acute

care nursing course. *Nursing Educator,* 30 (40), 172-177.

Nagle, B.M., McHale, J.M., Alexander, G.A., & French, B.M. (2009). Incorporating scenario-based simulation into a hospital nursing education program. *The Journal of Continuing Education in Nursing,* 40 (1), 18-25.

Sinclaire, B, & Ferguson, K. (2009). Integrating simulated teaching / learning strategies in undergraduate nursing education. *International Journal of Nursing Education Scholarship*, 6(1), 1-11.

Sportsman, S., Bolton, C., Bradshoaw, P., Close, D., Lee, M., & Townley, N., et al. (2009). A regional simulation center partnership: Collaboration to improve staff and student competency. *The Journal of Continuing Education in Nursing*, 40 (2), 67-73.