Beginning and advanced students' perceptions of the use of low- and high-fidelity mannequins in nursing simulation

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ARTICLE INFO

SUMMARY

Background: There is little research evidence that demonstrates the difference between the use of low- and high-fidelity mannequins in assisting students to acquire their skills when students are at different points in their nursing education experience.
Objectives: Our study examined differences between the use of low- and high-fidelity mannequins on student outcomes with both beginner and advanced students.
Design: A quasi-experimental investigation.
Settings: Participants performed two simulations, one simulation using a low-fidelity mannequin and the other simulation using a high-fidelity mannequin.
Participants: First and fourth semester pre-licensure students from a Bachelor of Science in Nursing program and an accelerated nursing entry program participated in this study.
Methods: A Students' Satisfaction and Self-confidence Scale and Simulation Design Scale were used to obtain data. Statistical analysis was performed using the Statistical Package for the Social Sciences for Windows version 17.0. The results obtained from scales were compared using Wilcoxon sign test and Mann–Whitney U test. A p value of <0.05 was considered statistically significant.
Results: The student satisfaction score of the students in the low-fidelity mannequin group was 3.62 ± 1.01, while that of the students in the high-fidelity mannequin group was 4.67 ± 0.44'dir ($p = 0.01$). The total score of the simulation design scale in the low-fidelity mannequin group was 4.15 ± 0.63, while it was 4.73 ± 0.33 in the high-fidelity mannequin group ($p = 0.01$).
Conclusions: Students' perceptions of simulation experiences using high-fidelity mannequins were found to be higher in contrast to their perceptions of experiences using low-fidelity mannequins.

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Introduction

Advances in technology have had a significant effect on the development of teaching and learning methods used in educational settings. In nursing education, simulation training involves extensive use of such technologies to prepare students for clinical practice in a risk-free environment. The World Health Organization (WHO, 2011) recommends the use of simulation-based education to improve the security of patients. Students who are prepared for clinical practice using simulation decrease the risk to patients associated with a novice's lack of experience.

As a result of the need for nurses internationally, the number of nursing students has been increasing, increasing the need for clinical practice sites and experiences. Since real experience in practice is limited, students cannot always be provided with sufficient opportunities to practice the number and variety of skills necessary for competent entry into professional nursing practice. Nursing faculty must employ innovative techniques to improve students' clinical skills and support their practice experience. Simulation-based training can provide students with rich learning experiences (Parr and Sweeney, 2006). Nursing students often report that they experience anxiety when they try to transfer their theoretical knowledge to practice (Sinclair and Ferguson, 2009). Simulation training is used as a significant teaching-learning strategy to improve nursing students' clinical skills, to integrate theory and practice and to overcome students' negative experiences (Cannon-Diebl, 2009). Simulation can be employed to create experiential student-centered training environments (Jeffries, 2012).

Simulation-related technologies have been expanding from low-fidelity technologies to high-fidelity technologies. In low-fidelity simulation training, task-trainers and mannequins are usually static

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with minimal replication of physiological responses, whereas in high-fidelity simulation training, full-scale, computer-integrated and physiologically responsive mannequins are used to replicate a full range of clinical experiences (Jeffries, 2005; Ballangrud et al., 2014; Kathleen and Kuznar, 2007). High-fidelity simulation has been promoted as an innovative teaching strategy that can be used in transferring students' self-confidence and competence into clinical settings (Bambini et al., 2009).

Some research suggests that simulations which involve high-fidelity mannequins improve students' clinical skills, communication, decision-making, critical-thinking, and has a positive effect on their self-confidence and teamwork (Brannan et al., 2008; Kameg et al., 2010; Ackerman, 2009; Shared et al., 2013; Kardong-Edgren et al., 2007). However, high-fidelity mannequins are costly and require extensive training to program and maintain. Furthermore, developing and executing simulations using high-fidelity mannequins can require much more faculty time and expertise (Kardong-Edgren et al., 2007). In addition, two previous studies have shown that there is no statistically significant difference between low-fidelity, moderate and high-fidelity simulation on student performance (Chang et al., 2002; Kardong-Edgren et al., 2007). Therefore, it is not clear that the significant investment in time, money, and expertise developing high-fidelity simulation experiences pays off in improved student outcomes.

Background

The National League for Nursing/Jeffries Simulation Framework was developed through the NLN/Laerdal simulation study to guide clinical simulation in nursing. It has five components—facilitator, participant, educational practices, simulation design characteristics and expected student outcomes. The aim of the framework is to prepare faculty for their role in developing, implementing and evaluating the use of clinical simulation in nursing curriculum (Jeffries, 2012). This framework guided the design of this study and study simulation design.

When planning simulation-based educational experiences, it is important to make sure that the method and simulation equipment to be used is congruent with the learning goals of the simulation (McGovern et al., 2013). There is evidence to support the assertion that simulation experiences using high-fidelity mannequins allows students to make connections between theory and practice (Kidd and Kendall, 2006; Shepherd et al., 2007; Butler and Veltre, 2009). In addition, such simulations are argued to be an effective educational strategy to teach nursing process and can enhance critical thinking (Burns et al., 2010).

Educational experiences using high-fidelity mannequins employ the principles of active learning and provide valuable opportunities for students to improve both psychomotor skills and critical thinking (Childs and Sepples, 2006). There are many advantages offered by high-fidelity mannequins in teaching clinical skills. Such advantages include the planned and gradual improvement in problem solving, opportunities for unlimited repeating of skills, provision of immediate feedback and allowing students to learn at their own pace. In addition, research suggests that nursing students became less anxious in clinical settings following the use of clinical scenarios with high-fidelity mannequins (O'Brien et al., 2001; Childs and Sepples, 2006). Also, it potentially offers nursing students varied clinical experiences with high-risk events and events rarely seen thus reducing their discomfort and unfamiliarity with these important care situations. Simulations with high-fidelity mannequins play a significant role in improving nursing students' self-confidence and ability to cope with such difficult patient care situations. (Prentice and O'Rourke, 2013).

There has been an increase in the use of high-fidelity mannequins in nursing education in recent years. More than 40% of nursing education programs reported the use of high-fidelity mannequins in the training of novice students (Hayden, 2010). The National Council of State Boards of Nursing recently performed a study to examine whether time and activities in a simulation laboratory could effectively substitute for traditional clinical hours in the nursing curriculum. They found no difference in nursing knowledge, clinical competency and perception of learning needs being met among undergraduate students when traditional clinical hours are substituted with 25% and 50% of simulation hours. They came to the conclusion that simulation expeiences, when well structured, with adequately prepared faculty and appropriate resources, dedication, foresight and vision can produce excellent student outcomes in pre-licensure nursing programs (Hayden et al., 2014).

Beginner students can increase their expertise in technical skills when they participate in scenarios with high-fidelity mannequins, while more advanced students may improve their evaluative and critical thinking skills in the same educational setting (Maas and Flood, 2011). However, research on the use of high-fidelity mannequins in early periods of nursing education is very rare. The difference between the use of high- and low-fidelity mannequins in simulation-based education have been compared in only a few studies (Wang et al., 2013.)

There is little research evidence that demonstrates the difference between the use of low- and high-fidelity mannequins in assisting students to acquire their skills when students are at different points in their nursing education experience. Our study examined differences between the use of low- and high-fidelity mannequins on student perceptions of satisfaction, confidence and evaluation of simulation experience with both beginner and advanced students. The investigators wanted to see if student perceptions of satisfaction, confidence and evaluation of simulation experience varied when using different levels of fidelity, and if there was also a difference by level of nursing student.

Research Questions

The research questions used to guide this study were:

1. Is there a difference in student satisfaction, confidence and evaluation of simulation design when experiencing simulation using low or high-fidelity mannequins?
2. Is there a difference in student confidence, satisfaction and evaluation of simulation design between beginner and advanced students in simulations using low- and high-fidelity mannequins?

Methodology

Study Design

The study was designed and carried out as a quasi-experimental investigation. The study was conducted in a large school of nursing in the southeastern United States. Approval to conduct the study was obtained from the organization's Institutional Review Board (IRB) and each student provided informed consent prior to participation.

Participants

First and fourth semester pre-licensure students from a Bachelor of Science in Nursing (BSN) program and an accelerated nursing entry program participated in this study. The beginner group consisted of first semester BSN students, the advanced group consisted of fourth semester BSN and third semester accelerated nursing students. After all students were informed about the study, 66 volunteer students (34 beginner; 32 advanced) agreed to participate in the study.

Data Collection

The participants were asked for a convenient time that would not conflict with the participants' school schedule to complete the study simulations. The students were divided into subgroups consisting of 3 students. Each subgroup performed two simulations, one simulation