Abstract: The purpose of this study was to investigate the impact of high-fidelity human patient simulation (HFPS) on nursing student learning outcomes which focus on preoperative preparation of a client. This quantitative, randomized, experimental, pre-test/post-test study was implemented with five groups of undergraduate nursing students enrolled in their first year, second semester Medical-Surgical nursing course. The control group (n=47) received a pre-test prior to their PowerPoint presentation of the topic. The following week they were then given the post-test. The experimental group (n=50) also received a pre-test prior to receiving the same power point handout along with a simulated scenario of preparing a patient for surgery. They were given the post-test following the simulation experience. The findings support the use of high fidelity patient simulation as an adjunct to traditional lecture styles.
There has been no extramural funding or commercial financial support for this research. There has been a poster presentation on the results. It was conducted on April 5th 2013 through the Ohio League of Nursing Educational Summit. The same poster has also been accepted for a presentation at 12th Annual International Nursing Simulation/Learning Resource Centers Conference: Hit the Jackpot with Evidence Based Simulation June 2013. This manuscript has not been submitted to any other journal for review. There was no funding/commercial associations related to this research.

Theresa L. Benzel, MSN, RN, DNP Student: conception and/or design of the study, acquisition of data, or analysis and/or interpretation of data

Karen Gehring, PhD, RN, Professor and Director, Graduate Nursing Program: drafting or revising the manuscript

Sharon L. Oetker-Black, PhD, RN, Professor and Director of Nursing Research: drafting or revising the manuscript

Martha Conrad MSN, RN, Director, Interprofessional Simulation: drafting or revising the manuscript
High Fidelity Simulation in the Classroom:
Not Just for the Lab Anymore

Theresa L. Benzel, MSN, RN, DNP Student
Walsh University
2020 East Maple Street North Canton, Ohio 44720
TBenzel@aultman.com, (330)363-4269 Office, (330) 363-7490 Fax

There has been no extramural funding or commercial financial support for this research.

Karen Gehrling, PhD, RN, Professor and Director, Graduate Nursing Program
Walsh University
2020 East Maple Street North Canton, Ohio 44720

Sharon L. Oetker-Black, PhD, RN, Professor and Director of Nursing Research
Walsh University
2020 East Maple Street North Canton, Ohio 44720

Martha Conrad MSN, RN, Director, Interprofessional Simulation
Akron University
Akron, Ohio 44325
Abstract

The purpose of this study was to investigate the impact of high-fidelity human patient simulation (HFPS) on nursing student learning outcomes which focus on preoperative preparation of a client. This quantitative, randomized, experimental, pre-test/post-test study was implemented with five groups of undergraduate nursing students enrolled in their first year, second semester Medical-Surgical nursing course. The control group (n=47) received a pre-test prior to their PowerPoint presentation of the topic. The following week they were then given the post-test. The experimental group (n=50) also received a pre-test prior to receiving the same power point handout along with a simulated scenario of preparing a patient for surgery. They were given the post-test following the simulation experience. The findings support the use of high fidelity patient simulation as an adjunct to traditional lecture styles.
Introduction

Simulation has been utilized outside of healthcare for decades. Aviation, transportation, nuclear power industries and the social and behavioral sciences have all used simulation to teach concepts, to allow for risk-free practice, and to teach, practice, and/or evaluate critical thinking skills. Models of anatomical parts, whole body mannequins and various computer-based simulators have been incorporated into nursing education curriculum (Rauen, 2004, p. 46).

Nursing education has long been utilizing simulation to demonstrate principles and skills of nursing care.

The development of nursing competency requires practice in the clinical environment. Unfortunately, clinical opportunities for nursing students vary across different health care settings. It is difficult to ensure that all students obtain the clinical experiences needed to meet their learning objectives because of the limited access to the clinical unit. Clinical simulation offers a way to provide safe, structured learning experiences consistently to all students (Larew, Lessans, Spunt, Foster & Covington, 2009, p. 21). The use of simulation can allow for exposure to the clinical environment with no harm to patients.

Currently, high-fidelity simulation in nursing education has become a progressively popular educational instrument (Kardong-Edgren, Starkweather, & Ward 2008, para. 1). Lasater (2005) recognized with the advances in technology, high-fidelity simulation offers a new alternative to contextual learning (p. 269). Fidelity, or ability of the clinical simulation to mimic reality or a close approximation, promotes better learning outcomes (Swanson et al., 2011, p. e82). Nursing educators are challenged to educate future nurses to think critically, to go beyond the simple task of just “knowing,” and advance to synthesis and application of knowledge.
Simulation gives educators an alternative to traditional teacher-centered approaches to education with an emphasis on learning needs for the technologically confident student.

High-fidelity patient simulators (HFPS), also known as human patient simulators, provide a realistic outward appearance (e.g., proportionate limbs), known as *cosmetic reality*. These HFPS’s can mimic physical findings, including breath sounds and pulses throughout the body, and have the capability to respond to interventions (Bond & Spillane, 2002, p. 1295; Seropian, Brown, Gavilanes, & Driggers, 2004, p. 165). They offer the chance to learn how to be an effective observer, to think critically, and to prioritize patient care in a non-threatening arena without harm to an actual patient (Reilly & Spratt, 2007, p. 546). High fidelity patient simulators offer a number of advantages for students, both as a participants and observers within the simulation scenario.

The use of these HFPS’s has been, for the most part, in a simulation/skills lab. These simulators might be employed for teaching technical skills. Some examples include inserting an indwelling urine catheter, inserting a chest tube, tracheostomy suctioning, and performing cardio-pulmonary resuscitation. These are all types of simulation, and what they all have in common is that they are performed under a “mock” situation so the students can practice in a nonthreatening environment. This type of environment allows students to be more confident when they are performing the task later in a “real” situation.

What is not clear in the research is whether HFPS’s would benefit students in a classroom setting. Would bringing a simulator into the classroom enhance learning by incorporating a more
hands-on approach? Would students, having used these simulators in a classroom setting, be able to recall information easier than current conventional methods of lecture?

**Review of Literature**

There is much established and emerging literature concerning the use of high-fidelity patient simulators. The literature ranges from teaching clinical skills to nurses (Rauen, 2004), maternity nursing (Partin, Payne, & Slemmons, 2009), decision-making (Lasater, 2005; Burns, O’Donnell, Artman, 2010; Bambini, Washburn, & Perkins, 2009; Dillard et al, 2009), and leadership (Conrad, Guhde, Brown, Chronister & Ross-Alaolmolki, 2010; Thomas, Carlton, & Ryan 2011). Willhaus (2010) looked at the benefits of using simulation to incorporate interdepartmental collaboration. Gore, Hunt, Parker, & Raines (2010) investigated the use of simulation in regards to student anxiety. Results found that students who attended a pre-clinical simulation scenario had significantly lower anxiety levels on an actual clinical floor as compared to students who did not participate in the pre-clinical simulation scenario.

Hauber, Cormier & Whyte (2010) looked at the relationship between knowledge and performance-related variables in high fidelity simulation (p. 244). Cognitions and performance-based variables were measured in an effort to offer the most complete picture of performance. The knowledge base of participants was determined by using common knowledge-related measures, including grades from previous completed nursing courses, and scores on standardized tests. The authors realized that with the study being a pilot, no generalizations regarding the findings would be appropriate. Despite the limitations of the study, the authors contend that findings do provoke thought. Hauber, et al. (2010) recommended that further research be done
utilizing high-fidelity patient simulators to study cognitive load theory (CTL) and expert-performance approach (EPA) within the nursing profession (p. 245).

Examination of research into the use of simulation and the connection with student outcomes was conducted by Swanson et al. (2011). They performed an experimental post-test only design to evaluate the effects of three active-learning methodologies (case-based learning, simulation, and simulation with narrative pedagogy). They found no significant differences in the three teaching strategy groups. They further concluded that nursing education needs to incorporate high-fidelity simulation as a teaching strategy to create a learning environment that encourages active student participation in educational opportunities.

The National League of Nursing (NLN)/Laerdal research examined Educational Practices, and found that students in the high fidelity simulation groups reported a greater sense of being involved in diverse ways, and a greater appreciation of active learning. These students rated active learning as being more important than did students in the case study group (as cited in Jeffries & Rizzolo, 2006). Traynor, Gallagher, Martin, and Smyth (2010) looked at how students performed with HFPS’s in three different patient scenarios (p. 1424). A large number of students (85.6%, n=77) felt that the simulator helped them to develop their organizational skills. The majority of the students (96.7%; n=87) reported that simulation helped them to test clinical skills. Research also revealed that the same percentage of students felt as though the “real-life” scenarios, in conjunction with the simulator, enabled them to safely participate in the assessment of an acutely-ill patient. This was also a useful way to not only test their diagnostic skills but also their clinical judgment. One of the limitations identified by the study was that it was conducted in a single institution using a convenient sample, thus the findings can only be
interpreted within this context. It was also acknowledged that since it was a descriptive study, the subjective opinions may not constitute scientific proof.

There is no doubt that research is being done in regards to HFPS’s. What this author is more interested in specifically, is how, or if HFPS’s would benefit students in a classroom setting. Research in the area of classroom simulation assessment is lacking. Further research in this area needs to be conducted to evaluate the usefulness of this teaching method.

Theoretical Framework

Miller’s (1956) Informational –Processing Theory served as the theoretical framework guiding this study. This theory provides a cognitive perspective on both learning and teaching. Explicit attention is given to how information is encountered, taken in, stored and remembered. This theory is especially useful in trying to understand what is going on within each learner, how to structure a learning situation to facilitate retention, and why distortions and errors occur in faulty learning behavior.

Method

Design, Setting and Sample

This study was composed of an experimental, pre-test/post-test design. It was conducted at a private college in Northeast Ohio during the summer semester of 2012 and spring semester of 2013. All first-year, second-semester nursing students enrolled in the Medical-Surgical I, courses were eligible to participate in the study. The groups were randomly assigned. One group participated in simulation (experimental group) while the other received the PowerPoint supported lecture (control group).
A convenience sample of N=97 was obtained from those students enrolled in the Medical Surgical I course over the summer semester of 2012 and spring semester of 2013. There were five students who did not complete the post-test. Therefore, their scores were not used during data analysis. See Table 1 for further descriptions of the demographic characteristics of the participants in the study.

For the control group, the classroom was set up with desks and chairs facing the front for easy view of the drop-down overhead screen. The students received a 90-minute lecture that was in a PowerPoint format. During the 90 minute simulation scenario, the desks were moved into five groups. The high fidelity simulator was stationed near the middle of the classroom for an overall easy visualization. Two nursing instructors were present for the simulation scenario. One was the investigator; the other instructor was needed to run the simulator. The instructor running the simulator offered no additional support to the scenario. Her sole responsibility was to run the simulator. Neither the pre- nor post-test results for either group counted toward the students’ course grade. All data collected is maintained and secured under strict anonymity through the use of alphanumeric identification for each student. Data will be kept for seven years.

**Measures**

The independent variable in the study was the HFPS. The simulation experience was provided in conjunction with the traditional PowerPoint lecture on preoperative patient care. Simulation was provided with the use of i-Stan®, a computerized manikin used by nurse educators. The simulation scenario utilized a simulated preoperative patient. The dependent variable was the students’ scores obtained on the post-test following the scenario.
Instrument

Knowledge regarding preoperative nursing was measured with both pre-tests and post-tests, composed of 10 multiple-choice questions referenced to standardized resources and designed to evaluate students’ knowledge and understanding of preoperative nursing skills. These questions met content validity to the extent that customized test questions match the learning objectives written for the course (Ignatavicius & Workman, 2010). Refer to Table 2 for further information obtained from the pre-test that would give demographic data to the researcher (age, sex, previous history in healthcare, and past use of simulation).

Procedure

Prior to the initiation of the study, approval from the researcher’s University’s Human Subject’s Review was granted along with approval from the College’s review board where the research was conducted. A letter explaining the purpose of the study was given to each eligible nursing student at the first class meeting. Student participation was voluntary and the pre-test/post-tests scores did not affect class grades.

During the first week of class an unannounced 10-item multiple-choice pre-test to assess knowledge and understanding of preoperative nursing care was given to both groups (Ignatavicius & Workman, 2010). Following the pre-test, the students in the control group participated in a typical 90 minute lecture on preoperative nursing. The lecture comprised of a PowerPoint that accompanied the medical surgical textbook. The PowerPoint focused on assessment of the patient, education needed for a surgical patient, consent requirement for surgery, laboratory and diagnostic testing needed prior to surgery, and medication involvement with patients having surgery. One week later a post-test was given.
The experimental group received the same PowerPoint lecture handout in conjunction with a simulation scenario lasting for a total of 90 minutes. During the simulation scenario, the experimental group was divided into five subgroups: an assessment, education, consent verification, laboratory and diagnostic analysis, and medication involvement subgroup. These subgroups worked together to gather information that related to the preparation of a patient required for surgery. Some subgroups needed to gather information from other groups to complete their assigned tasks. Upon completion the subgroups presented their findings to the entire experimental group.

The scenario was to provide the students with the ability to care for a patient who was preparing to have surgery. The patient Chase Tyler, 50-year-old, white male who comes to the hospital for a colectomy. He had been hospitalized for two days. This was his OR day.

**State One** – Baseline setup for the purpose of getting the initial assessment of the patient:

Vital signs: T – 37.2C, P – 88, BP – 124/82, R – 16, SPO2 – 97% RA, alert and oriented, nervous about the impending surgery and being put to sleep, skin - pink, warm and dry, lungs sound clear, heart normal sinus rhythm, capillary refill less than three seconds, abdomen bowel sounds present times four with slight distention in left lower quadrant, abdominal pain is a two on the zero to 10 scale. All pulses present with no edema. Has an adapter in his left forearm with an 18 gauge angiocath, site clear. Preoperative checklist is completed during this time.

**State Two** – Morphine administration

Vital signs: T – 37.2C, P – 92, BP – 140/90, R – 22, SPO2 – 98% RA, restless, alert and oriented, skin – pale pink, warm with some perspiration on forehead, lungs clear, heart normal sinus rhythm, capillary refill less than three seconds, abdomen bowel sounds present in all four
quadrants with slight distention in left lower quadrant, pain level now an 8 on the zero to 10 scale. Pulses present with no edema. Complains that “my belly hurts.” Students obtain consent from the patient for surgery and discussions occur in regards to medication reactions with anesthesia.

**State Three** – Preparing for surgery and transport

Vital signs: T – 37.0C, P – 88, BP – 126/60, R – 14, SPO2 – 97% RA, very subdued, still alert and oriented but talks slowly, lungs clear, heart normal sinus rhythm, abdomen bowel sounds present with slight distention, pain level now a three on the zero to 10 scale. Pulses present with no edema. The week following the simulation scenario the experimental group took the post-test.

**Ethical Considerations**

During the study there was a chance of increased anxiety related to test taking. Students utilized in the study were assigned to that course for natural progression in their nursing curriculum. The scores of the pre-test and post-test did not influence the course grades. These scores were used for analysis purposes only. Approval was obtained from the Human Subject Review Committee from this author’s university. Site approval was also obtained from the Nursing Research Council and Institutional Review Board related to the site where the research was conducted.

**Results**

Students not wishing to participate in the study were considered when reporting the final sample number, and those who did not complete the post-test were excluded in the data analysis. No other exclusion criteria were defined. Descriptive statistics reveal that 11% (n=11) of the participants were male with 87% (n=86) of them being female. Average age of the students involved in the study was 27.9, the youngest being 18 and the age of 54 being the oldest. Those
who have had an interaction with simulation was 72% (n=72.4) with 26.5 (n=26) never having had any simulation experience. There were 56.1% (n=55) who stated that they have had experience in healthcare, with 42.9% (n=42) not having any healthcare experience.

An independent-samples t-test was conducted to compare knowledge of preoperative nursing with simulation and without simulation. There was a significant difference in the scores for simulation (M=8.44, SD=1.179) and no simulation (M=7.55, SD=1.779) conditions; t= 2.820, df =90, p < 0.006. These results suggest that simulation does have a positive effect on knowledge pertaining to preoperative nursing. Specifically, our results suggest that when students use simulation in the classroom, their knowledge for preoperative nursing increases.

**Discussion**

The results of this study indicate that an experience with HFPS in the classroom helped with knowledge attainment. The groups were equal on the pre-test. After the post-test, the simulation group scored significantly higher than the control group. Research in the area of simulation in the classroom is limited; however, results from this study support that the use of simulation in the classroom improves knowledge attainment in the content area of preparing a patient for surgery.

**Limitations**

Although the study supported the use of simulation in the classroom, there is limited research that validates the use of HFPS in this setting. Other limitations include the small sample size. Some of the students were also current students of this author. Some limitations were actually related to the use and movement of the simulator. There was approximately an hour needed before and after for setup and tear down. It was also discovered during this research that
the simulator and cart would not fit on the College’s elevator, so special requests needed to be made in order to have a classroom on the same floor as the simulation lab, for ease of transport.

**Conclusion**

With the current advances in the healthcare field, and particularly the focus on developing nurses who can work within particular specialties, it is imperative that those responsible for nursing education help prepare students for the reality of the clinical environment where cases are increasingly complex (Traynor et al., 2010, p. 1422). The healthcare system is changing so quickly that educators must not rely on traditional education models of content delivery (Bambini et al., 2009, p. 81). In order to meet the high demands of healthcare, educators need to embrace technology in the classroom. Enhancing traditional approaches to education with technology will only increase positive student outcomes. By using HFPS’s, information retrieval for the student should become an easier task. With students’ outcomes being achieved at higher levels there is a lesser chance of student failure. This will have a substantial impact on student finances, as they will not have to repeat courses. Overall, it may be interesting to know if national licensure exam scores are higher for students who utilize HFPS. This could lead to further research topics.

**Acknowledgment**

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References


Dillard, N., Sideras, S., Ryan, M., Carlton, K., Lasater, K., Siktberg, L. (2009). A collaborative project to apply and evaluate the clinical judgment model through simulation. *Nursing Education Research, 30*(2), 99-104.


Partin, J. L., Payne, T. A., & Slemmins, M., F. (2009). Student’s perceptions of their learning experiences using high-fidelity simulation to teach concepts relative to obstetrics. *Nursing Education Perspectives, 32*(3), 186-188.


**Table 1 Demographic Characteristics by Group (N=97)**

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years mean)</td>
<td>28.08</td>
<td>27.72</td>
</tr>
<tr>
<td>Male</td>
<td>4(8%)</td>
<td>7(14%)</td>
</tr>
<tr>
<td>Female</td>
<td>43(91%)</td>
<td>43(86%)</td>
</tr>
<tr>
<td>Experience with Healthcare (yes)</td>
<td>22(46%)</td>
<td>33(66%)</td>
</tr>
<tr>
<td>Experience with Simulation (yes)</td>
<td>35(47)</td>
<td>36(72%)</td>
</tr>
</tbody>
</table>

*The totals are reflective of the 97 possible participants from course NUR103. The final sample size (n=92) was used after 5 students failed to complete the post-test section of the study.
Table 2
Please answer the following demographic questions.

Your age: ____________

Have you or do you work in Health Care? Y N

Have you worked with Simulation before? Y N

Instructions: Please answer the following questions based on your knowledge of Pre-Operative Nursing.

Pre-test/Post-test

ID Number: __________________________

Multiple Choice (For test security, answer options were removed)

1. What is the purpose of teaching leg exercises to a patient prior to surgery?

2. The patient wears dentures and is reluctant to remove them for the surgery. What is the nurse’s best response?

3. The patient is NPO prior to surgery but is required to take a preoperative antihypertensive tablet. The patient should:

4. Prior to obtaining the patient’s signature on the operative permit, the nurse asks the patient if she understands all aspects of the surgical procedure. The patient replies that she is very nervous and does not understand what the surgical procedure is or how it will be performed. The most appropriate nursing action is:

5. The nurse is providing preoperative teaching to her patient. Which of the following interventions provide the patient with the most accurate information?

6. When providing preoperative teaching, the nurse should instruct on the use of deep breathing, coughing, and the use of incentive spirometry. The rationale for these interventions is:

7. A patient has received a preanesthetic medication in the preoperative holding area. The nurse should instruct the patient to:

8. During preoperative teaching, the patient asks the nurse why she must have nothing by mouth for 8 hours before surgery. Which of the following is the most appropriate response for the patient?

9. A patient is scheduled for a colon resection in the morning, and the nurse is to administer a cleansing enema to the patient. The nurse explains the cleansing enema will:

10. A nurse is caring for a preoperative patient who has been administered a preoperative narcotic and is requesting to void. What action should the nurse take?