12-2013

Effects of High Fidelity Simulation on Knowledge Acquisition, Self-Confidence, and Satisfaction with Baccalaureate Nursing Students Using the Solomon-Four Research Design

Rachel M. Hall
East Tennessee State University

Effects of High Fidelity Simulation on Knowledge Acquisition,

Self-Confidence, and Satisfaction with Baccalaureate Nursing Students

Using the Solomon-Four Research Design

A dissertation

presented to

the faculty of the Department of Nursing

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Doctor of Philosophy in Nursing

---

by

Rachel Mattson Hall

December 2013

Dr. Joellen Edwards, Chair

Dr. Wendy Nehring

Dr. Sally Blowers

Dr. Francis Otuonye

Keywords: High Fidelity Simulation, Knowledge acquisition, Nursing students, Education

ABSTRACT

Effects of High Fidelity Simulation on Knowledge Acquisition,

Self-Confidence, and Satisfaction with Baccalaureate Nursing Students

Using the Solomon-Four Research Design

by

Rachel Mattson Hall

High Fidelity Simulation is a teaching strategy that is becoming well-entrenched in the world of nursing education and is rapidly expanding due to the challenges and demands of the health care environment. The problem addressed in this study is the conflicting research results regarding the effectiveness of HFS for students' knowledge acquisition after participating in simulation exercises. Specifically this researcher determined the effects of a formatted simulation scenario on knowledge acquisition among nursing students and the students' satisfaction and self-confidence with the simulation learning activity. Kolb's Experiential Learning Theory (1984) provided the framework for this study.

This study used a quantitative quasi-experimental design, specifically, the Solomon Four Research Design with 43 first semester senior nursing students enrolled at a baccalaureate nursing program at a state university in the southeastern United States.

The results of the study found that there was not a statistically significant difference between the experimental group (E1) who received HFS ($z = -1.47$, $p = 0.143$) in cognitive gains when compared to the students who did not receive the intervention of HFS (C1) ($z = -1.78$, $p = 0.75$).

The students' overall perception of HFS was very positive and the simulation activity increased their self-reported level of self-confidence.

The results of this study imply that simulation should not be used with the exclusive goal to increase knowledge but rather for students to increase their confidence and to demonstrate their ability to care for a patient at the bedside. It is our duty as nurse educators to systematically evaluate new teaching efforts such as simulation to determine the effectiveness of this remarkable but expensive technology to ensure that we are providing the best learning opportunities possible for our nursing students.

DEDICATION

First and foremost, I would like to thank my wonderful husband Grant for his love and unfailing support and dedication to me throughout this process. All the countless hours that he assisted me in brainstorming ideas and editing my papers! I could not have succeeded without his encouragement and belief in me. You are my rock and we make an excellent team. I also know that this would not be possible without the Lord God Almighty. Without him, none of this would be possible.

ACKNOWLEDGMENTS

I am pleased to have this opportunity to thank the many colleagues, friends, and faculty members who have helped me with this research project. I am most indebted to Dr. Joellen Edwards, the chairperson of my dissertation committee, for sharing her research expertise and wisdom regarding quantitative research and the dissertation process. I would also like to thank all of my committee members: Dr. Sallie Blowers, Dr. Wendy Nehring, and Dr. Francis Otuonye for their invaluable suggestions, inspiring questions, and support throughout the dissertation process. I also want to thank Dr. Jan Cupp for his assistance with the statistical analysis and SPSS. I would like to thank Dr. Judy Duvall for her support and participation with the simulations throughout this process.

This research would not have been possible without the support of my friends, coworkers, fellow graduate students, and my family who never stopped encouraging me to persist. I want to especially thank my cohort at ETSU for all their support and encouragement throughout the entire coursework, competency exams, and dissertation process. Finally, I would like thank all of the senior 1 nursing students who participated in this research study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure Page

CHAPTER 1

INTRODUCTION

Simulation is a teaching strategy that complements the traditional teaching experience by enabling students and healthcare professionals to learn in an environment that eliminates risks to actual patients. The major documented advantages of patient simulations for nursing students have been the ability to learn interactively, to practice newly developed skills in a risk-free environment, and to have immediate feedback from an experienced faculty member (Feingold, Calaluce, & Kallen, 2004; Nehring, Ellis, & Lashley, 2001). A major disadvantage is the mixed results using simulation as a teaching method to increase cognitive gains (Brannan, White & Bezanson, 2008; Cooper et al., 2010; Griggs, 2002; Howard, 2007; Jeffries & Rizzolo, 2006; Liaw, Scherpbier, Rethans, & Klainin-Yobas, 2012; Linden, 2008; Parker et al., 2011; Piscotty, Grobbel, & Huey-Ming, 2011; Shepherd, McCunnis, Brown, & Hair 2010; Shinnick, Woo, & Evangelista 2012; Yuan, Williams, & Fang 2012a).

Simulation occurs across a continuum ranging from low to high-fidelity (Jeffries & Rizzolo, 2006). Fidelity is the term used to describe the accuracy or degree of realism of the simulation system (Seropian, Brown, Gavilanes, & Driggers, 2004). Low fidelity simulation refers to the use of strategies such as basic written case studies, role playing, and administration of injections using partial task trainers (Bezyack, 2007; Hovancsek, 2007). According to Bezyack (2007) medium fidelity simulation involves the use of more realism but without the automatic cues associated with high fidelity simulation (HFS) such as the rise of the chest on inspiration or pupillary constriction from an administered medication that provide increased realism.

There are mixed evidence on cognitive gains with simulation as indicated by Griggs (2002), Jeffries and Rizzolo (2006), Parker et al. (2011), and Shepherd et al. (2010); whereas, Brannan et al. (2008), Cooper et al. (2010), Howard (2007), Liaw et al. (2012), Linden (2008), Piscotty et al. (2011), Shinnick et al. (2012), and Yuan et al. (2012a) concluded that there is a significant difference in knowledge gains with undergraduate nursing students after participation in a simulation exercise. The empirical evidence around simulation as a teaching method to increase cognitive gains indicates that more substantive studies are needed to determine the effectiveness of HFS as a reliable method to increase cognitive gains with baccalaureate nursing students.

A number of factors have encouraged the use of simulation including increased student enrollment, fewer faculty members, competition for clinical sites, greater need for interdisciplinary education, and patient populations that present with higher illness acuity and shorter lengths of stay (Rhodes & Curran, 2005). Simulation training can be modified or tailored to the individual level of student knowledge, which enables students to increase their knowledge and critical thinking in a safe manner (Rhodes & Curran, 2005). Development of safe nursing practice through the use of simulation for entry-level baccalaureate nursing students requires nurse educators to carefully consider the use of this strategy.

The safety and quality issues identified in the United States healthcare system have resulted in a call to transform healthcare education (Institute of Medicine, 2000), preparing graduates to work in teams and within systems that promote patient safety. The use of HFS allows nursing faculty to actively engage with students enabling them to learn and develop safe practices for patient care. The Institute of Medicine (IOM) (2000) report *To Err Is Human:*

Building a Safer Health System recommends the use of simulators to assist in preventing errors in the clinical setting.

Simulated experiences with HFS provide students the opportunity to engage in critical thinking activities, practice assessment skills and interventions, and receive immediate feedback. A simulated experience with computerized mannequins provides nursing students the opportunity to engage in critical thinking activities and to bridge the traditional classroom lecture and the clinical setting within a realistic clinical simulation scenario. Experiential learning and simulation can and will help bridge the theory- practice gap between the classroom and the hospital environment.

Theoretical Framework

The theoretical framework for this study is Experiential Learning (Kolb, 1984). There are a number of educational truisms related to the rationale for experiential education. For example "Give a person a fish and they can have a meal, teach the person to catch fish and they can eat fish for a lifetime" (Ancient Chinese proverb*)*. The rationale for the use of experiential education is based upon the purpose for the teaching or learning experience. Simulation is an ideal method to incorporate experiential learning into nursing education.

Experiential Learning

The transition from school to work is problematic in many professions. The gap between school and work was identified for nurses in the 1970s (Hulsmeyer, 1994). At that point apprenticeships were used for the transition from school to the hospital setting (Hulsmeyer, 1994). Dewey (1933) introduced the thought that experience plus reflection equals learning. This process of experience plus reflection equals learning has been adapted by Kolb (1984), and he introduced what is now known as the experiential learning cycle. The “experience” is the student nurse practicing the skills learned and applying the knowledge that they have gained in the classroom in the simulation lab on a patient simulator. The “reflection” aspect is the debriefing session that occurs after the simulation. This period allows the student, peers, and academic instructors to reflect on what occurred during the simulation. As a group they can identify strengths and weaknesses and determine how they can improve their patient care and apply their knowledge to different patient situations.

Kolb (1984) determined that the learning process is created through experience. Kolb observed that learning occurs when knowledge is achieved through the transformation of experience. This experience is intentionally directed learning through facts learned, active participation, constant reflection and observation, and by forming abstract concepts about the experience (Kolb, 1084). This progression of learning is an ongoing process that is repeated throughout the learning experience.

Experiential learning is an experience of learning through practice. The effectiveness of this thought process is determined by the learners’ willingness to engage and participate in the learning experience (Fowler, 2008). Kolb’s model (see Figure 1) includes a four-phase cycle of learning consisting of concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). The learner may begin at any stage but subsequently must follow the sequence: concrete experience, the doing phase; reflective observation, the observation phase; abstract conceptualization, the thinking phase; and active experimentation, the planning phase (Hartley, 2010).

Concrete experience is when the learner gains knowledge from specific experiences or experts (Kolb, 1984). This stage is considered the “feelings” stage and for the purposes of this study, the concrete experience is the classroom lecture where the students will gain didactic knowledge from experts. Abstract conceptualization consists of understanding the theory and having a clear grasp of the concept (Kolb, 1984). Students in this phase will "think" about what they have learned during the didactic portion of the class. The students will be able to think through case studies and actively participate with classroom questions to think about and apply their knowledge.

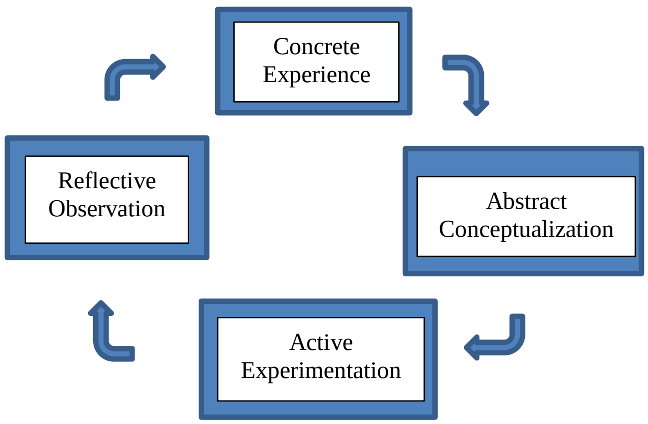

Figure 1: Kolb's Experiential Cycle (adapted by Rachel Hall, 2013)

Active experimentation involves getting things done by influencing people and events through action (Kolb, 1984). The active experimentation is the "doing" phase where the students will actually apply their knowledge gained from the didactic lecture in the simulation lab by working on a HFS patient. Reflective observation consists of watching others or developing observations about one's own experience (Kolb, 1984). Reflective observation is the "watching" phase when the students will 'watch-back' their simulation time during a debriefing session to discuss strengths and weaknesses to allow the students to move through the cycle by reflection on the situation.

Successful learning has the potential to promote student satisfaction, so the students will also complete the *Student Satisfaction and Self Confidence in Learning Scale* (National League for Nursing, 2005) developed by the National League for Nursing (NLN) to measure student satisfaction with the simulation activity and their perceived self-confidence in learning (NLN, 2005). When experiential learning is used in a controlled educational setting, the learning experience is enhanced. Learning is constructed and knowledge is created through the transformation of the experience (Kolb, 1984).

Experiential learning is a lifelong process resulting from continual person-environment interaction and involves feeling, perceiving, thinking, and behaving (Ferguson, 2006). Gentry (1990) noted that experiential learning is participative, interactive, and applied. The holistic nature of experiential learning is a natural fit with simulation in that it allows student nurses to work through the four stages of Kolb's cycle at their own pace.

Environments that are based on experiential learning have higher scores in terms of satisfaction, perception of knowledge gains, and skills acquisition (Huerta-Wong & Schoech, 2010). Experiential learning is an effective teaching strategy that has shown improvements in the ability to retain information (Breland, 2001; Fowler, 2008; Galbraith & Cohen, 1995; Hulsmeyer,1994; Ti et al., 2009), increase work performance (Fowler, 2008; Huerta-Wong & Schoech, 2010; Retallick 2010; Ti et al., 2009), increase retention **(** Kemeny, Boettcher, DeShon, & Stevens, 2006; Spence-Laschinger, 1990) and show positive attitudes in the workplace environments (Hartley, 2010; Pugsley & Clayton, 2003; Ryan, Goldberg, & Evans, 2010; Sewchuk, 2005). When experiential learning is used in the hospital setting with new graduate nurses, they have a sense of ownership in their learning (Huerta-Wong & Schoech, 2010). Once the student nurse feels this sense of ownership and begins to actively participate in his or her educational process, the knowledge gains and confidence will be enhanced for that student (Hulsmeyer, 1994). Simulation allows the students to practice in an environment where the simulated patient care experience enables them to use knowledge gained from the traditional classroom lecture and apply it to a patient scenario in a safe environment (Hulsmeyer, 1994).

Problem Statement

The problem to be addressed in this study is the conflicting research results regarding the effectiveness of HFS for students' knowledge acquisition after participating in simulation exercises. The purpose of this study is to focus on the effects of high-fidelity simulation. Specifically this study will show the effects of a formatted simulation scenario on knowledge acquisition among nursing students. It will also show the students' satisfaction and self-confidence with the simulation learning activity. The use of HFS in a controlled environment where safety and learning are at no detriment to an actual patient makes for the ideal environment for learning. The results of this research will address the mixed findings around the effectiveness of HFS and contribute to scientific foundations for teaching methodologies in undergraduate nursing education.

Objectives

The objectives of this study are to:

(1) Develop and implement a respiratory HFS scenario to augment the traditional didactic respiratory lecture to allow for the concrete experience according to Kolb's Experimental Learning Cycle (1984);

(2) Test the effectiveness of the traditional didactic lecture augmented with HFS versus the traditional didactic lecture alone on increasing knowledge gains among Baccalaureate Student Nurse (BSN) students;

(3) Determine if the pretest results influence the posttest results when comparing the students who received the intervention against the comparison group;

(4) Determine the satisfaction and self-confidence of the students with the simulated learning experience;

(5) Discover relationships among knowledge gains, satisfaction, and self-confidence in learning;

(6) Use the findings from this study to develop recommendations for the use of HFS in undergraduate nursing education.

Hypotheses

The hypotheses of this study are:

Hypothesis 1: Students who receive traditional classroom lecture, take the pretest, and receive the educational intervention of HFS will have greater knowledge acquisition of respiratory content as measured by an exam score from the Health Information Systems Incorporated (HESI) examination when compared to the students who only received the traditional classroom lecture, take the pretest and then take the posttest without having the HFS.

Hypothesis 2: The students who take the pretest and receive the HFS will score higher on the posttest than the students that receive only the HFS and the posttest.

Hypothesis 3: The students who take the pretest and do not receive the HFS intervention will score higher on the posttest than the students who only take the posttest.

Hypothesis 4: Students who receive the HFS, regardless of pretest experience, will perceive an increase in self-confidence and a higher level of satisfaction after the simulation experience as measured by the *Student Satisfaction and Self Confidence in Learning Scale (NLN, 2005)*.

Definitions

For the purpose of this study, operational definitions for the following concepts were employed: Educational intervention, High Fidelity Simulator, High Fidelity Simulation Scenario, Knowledge acquisition, Nursing Student, Satisfaction and Self-confidence.

Educational Intervention: an innovative, specifically planned instructional strategy used to enhance learning and critical thinking abilities in nursing students. For the purpose of this study the educational intervention that was used was a high fidelity simulation exercise in the area of respiratory content. The simulation experience was the "concrete experience" stage of Kolb's Experiential Cycle (1984).

High Fidelity Simulator: "High-fidelity simulators produce the most realistic simulated-patient experiences. They include details that give the units personality and allow users to more closely identify with the unit as something they might actually encounter in real life" (Seropian et al., 2004, p. 165). For the purpose of this study the Laerdal SimMan 3 high fidelity simulator was used.

High Fidelity Simulation (HFS) Scenario: For the purpose of this study the students in the experimental group participated in four 15-minute respiratory simulation scenarios carefully and specifically designed by the primary investigator (PI) to enhance and correlate with students' traditional respiratory lecture. Each scenario had four students and each student rotated through four different roles (primary nurse, secondary nurse, family member, and nursing assistant). After each scenario, there was a 15-minute debriefing session to discuss the learning outcomes along with the strengths and weaknesses of each student participant.

Knowledge acquisition: Kolb (1984) noted that learning involves the acquisition of abstract concepts that can be applied flexibly in a range of situations. In Kolb's theory the impetus for the development of new concepts is provided by new experiences. Kolb (1984) stated that "Learning is the process whereby knowledge is created through the transformation of experience". For the purpose of this study knowledge acquisition was measured using the HESI exam on respiratory content.

Nursing Student: a person enrolled in a prelicensure baccalaureate nursing program who, upon successful completion of the program is eligible to take the National Council Licensure Examination for Registered Nurses (NCLEX-RN) licensure exam and work in the role of the professional registered nurse.

Satisfaction: Satisfaction can be described as the perception of full explanations and contentment with teaching (Billings & Halstead, 2005; DeYoung, 2003). The Jeffries and Rizzolo (2006) instrument uses a measure of how satisfied students are with different aspects of a simulation activity to classify student satisfaction. For this study satisfaction was measured by the students score on the *Student Satisfaction and Self Confidence in Learning Scale (NLN, 2005)*.

Self-Confidence: Self-confidence can be described as trusting the soundness of one's own judgment and performance (Jeffries, 2005). The Jeffries and Rizzolo (2006) instrument classifies self-confidence as a measure of how confident students are regarding the skill and knowledge presented on caring for patients in a selected simulated experience (Jeffries & Rizzolo, 2006). For this study self-confidence was measured by the students score on the *Student Satisfaction and Self Confidence in Learning Scale (NLN, 2005)*.

Summary

HFS is a teaching strategy that is becoming well-entrenched in the world of nursing education and is rapidly expanding due to the challenges and demands of the health care environment. At this time of patient complexity in the acute care setting where students engage in clinical practice, it is crucial to bridge the gap between theory taught in the traditional classroom and actual clinical practice (Cannon-Diehl, 2009). Experiential learning is a teaching strategy that will allow students to apply the knowledge they have learned during the classroom setting to a patient in the simulation lab.

The IOM (2000) stressed the importance of reforming health professionals' education to achieve national quality and safety goals based on the best available evidence for pedagogical decisions. Simulations are one approach used to develop the best practices in teaching (Tanner, 2006). Incorporating simulation as a method to implement Kolb's Experiential Learning (1984) strategy allows for holistic learning in a safe environment where students can integrate their knowledge and skills and then reflect on their experiences. This study is the first to use Kolb's Experiential Learning Theory (1984) along with high fidelity simulation to address knowledge acquisition, student satisfaction, and self-confidence with the BSN student. High fidelity simulation as part of the Experiential Learning Cycle provides a pedagogical connection between science and practice (Jeffries, 2005; Tanner, 2006), which will help achieve the national quality and safety goals as established by the IOM (IOM , 2000) and bridge the gap in knowledge around the effectiveness of HFS on student knowledge acquisition, satisfaction, and self-confidence in learning.

CHAPTER 2

REVIEW OF THE LITERATURE

A systematic approach to searching and reviewing the state of the science of simulation in the area of nursing education involved the use of primary sources found in referred journals and dissertations. The accessible literature base was identified using the following search strategies: keyword and author search of journals indexed in the following databases: CINAHL, PubMed, ProQuest, and ProQuest Dissertation. In addition to articles retrieved from the databases, other sources were acquired by a manual search of current journals and follow-up of references listed in the papers reviewed. This chapter addresses the history of simulation, the definitions of simulation, measurable outcomes using simulation, and the limitations of simulation.

History of Simulation

One of the first simulators was an aircraft flight simulator invented in1927 by Ed Link. Link had a passion to learn to fly but could not afford the cost of plane rental and lessons. So he spent all his spare time developing a pilot trainer that eventually ushered in the multi-billion industry of simulation (L-3 Communications, 2009). Flight simulators are currently used by the airline industry and the military to maintain pilots' performance skills, especially during emergencies (Hays, Jacobs, Prince, & Salas, 1992). Simulation has also been developed and used by the automobile industry, the space program, and the nuclear power industry to conduct tests that would be too dangerous or too costly to perform in the real world (Bradley, 2006).

In 1911 the earliest patient simulator was put into use for nursing. Mrs. Chase was a life sized mannequin with moveable joints. Over the years the mannequin was updated to include various body orifices and modern hairstyles. She was used to train student nurses in bathing, positioning, and performing nursing procedures (Nickerson & Pollard, 2010).

In the late 1960s Denson and Abrahamson developed the first high-fidelity simulator. The simulator was called "Sim-One" and was designed to be used for anesthesiology. Due to the excessive cost, only one model was produced. In 1974 a partial body simulator that mimicked respiratory conditions was developed. This simulator is called "Harvey" and updated models are still used for teaching heart and lung sounds (Gaba & DeAnda, 1988). Over the next few decades the technology advanced until the current high-fidelity simulators were developed.

Definition of Simulation

Simulation is often used in nursing education and has become a popular term in the healthcare setting; however, simulation is an ambiguous term and has not been clearly defined. Simulation spans a spectrum of sophistication from the simple reproduction of body parts through the complex human interactions portrayed by computer driven high-fidelity simulators (Bradley, 2006). Various types of simulators and terms that refer to simulation have been used in nursing education. These include role playing, standardized patients, partial task trainers, complex task trainers, integrated simulators (human patient simulators or high fidelity simulators), and full mission simulation (Bradley, 2006). The various terms used for simulation can lead to a lack of understanding and confusion related to this educational learning strategy.

According to the Concise Oxford English Dictionary (2008), the verb 'simulate' means to 'imitate or reproduce the appearance, character or condition of' (p.7631). The use of cost effective high fidelity simulators in nursing has only been available since the year 2000 (Gaba, 2002). Fidelity is the term used to describe the accuracy or degree of realism of the simulation system (Seropian et al., 2004). The realistic computerized simulator can be used to create a learning environment that is safe and interactive for students to receive practical experience.

Galloway (2009) defined integrated simulators as "whole body mannequins (adult, child, or infant) that are capable of responding to certain medications, chest compressions, needle decompression, chest tube placement, and other physiologic interventions and subsequent responses" (p. 4). Integrated simulation occurs across a continuum from low to high fidelity (Jeffries & Rizzolo, 2006). Low fidelity simulation is traditionally used to teach physical assessment and psychomotor skills. According to Bezyack (2007) medium fidelity simulation involves more realism than the low fidelity trainers but not as much realism as the high fidelity simulators. HFS is a lifelike computerized mannequin that can be programmed to respond to real-world inputs in an effort to mimic the reality of a human patient in a clinical environment.

Simulation allows students the opportunity to practice assessment and fundamental nursing skills and receive immediate feedback from their instructors. This feedback can be from the HFS in the form of the simulators' heart rate dropping due to a medication error or the simulator status deteriorating or improving based upon the actions or lack thereof from the student nurse (Jeffries & Rizzolo, 2006). The faculty member also has the opportunity to provide immediate feedback by providing assistance or to help the students develop their critical thinking abilities.

HFS allows students to engage in the assessment process by auscultating realistic heart, lung, and abdominal sounds that may be programmed as either normal or abnormal; experience bedside respiratory monitoring; administer simulated medications; and observe physiological effects in real time. The content of the HFS session may include assessment, management of critical events, technical skills, care of patients with specific diseases or surgical conditions, nursing interventions, pharmacology, and physiology, as well as advanced skills (Nehring et al., 2001; Nehring & Lashley, 2004). These sessions allow the students to 'perform' in a safe environment, and it also allows faculty to identify gaps in the students' knowledge and correct the knowledge gaps without delay.

Measurable Outcomes Using Simulation

Simulation-based learning is an educational intervention that creates an environment conducive to experiential learning. Despite the prevalence of research on the influence of simulation on nursing education, there is a scarcity of literature on the effectiveness of simulation-based learning (Griggs, 2002; Jeffries & Rizzolo, 2006; Parker et al., 2011; Shepherd et al., 2010). The following measurable outcomes were identified from the research articles reviewed and are addressed: cognition and confidence.

Cognition

Simulation is often used to help students become familiar with patient care; however, there is little research available that demonstrates the effectiveness of simulation on knowledge gains for the undergraduate nursing student. A literature review on HFS by Ravert (2002) revealed a positive effect on knowledge in 76% of the cases, but none of the articles in the review used baccalaureate nursing students in their studies. There is conflicting research as to the effectiveness of HFS and students' knowledge gains; therefore, both significant and nonsignificant results are addressed to determine if simulation is an effective learning strategy to help undergraduate nursing students increase knowledge before caring for an actual patient.

Brannan et al. (2008) conducted a prospective, quasi-experimental study with undergraduate nursing students (N=107) to compare the effectiveness of two instructional methods on cognitive knowledge. They concluded that there is a positive difference in cognition after simulation when comparing the group that did not receive simulation to the group that received it. Cooper et al. (2010) determined that the students had positive cognitive gains after a simulation experience.

Howard (2007) determined that the students in the human patient simulation group scored significantly higher than those in an interactive case study group on the posttest HESI examination. Liaw et al. (2012) concluded that the students who received simulation had a significantly higher posttest mean score than the control group for knowledge and, therefore, concluded that simulation does have a positive impact on cognitive gains.

Linden (2008) noted that there was a statistically significance increase in cognitive learning with the group that participated in simulation compared to the group that received only traditional teaching methods. Piscotty et al. (2011) concluded that a student-led simulation had a positive effect on knowledge gains for the participants. Knowledge scores in both the traditional (knowledge: $p < .001$) and accelerated (knowledge: $p = 0.027$) groups increased significantly after the simulation exercise. Shinnick et al. (2012) sought to identify whether HFS would be an independent predictor of heart failure knowledge gains in prelicensure nursing students. The hypothesis in this study was supported in that simulation use was associated with heart failure knowledge gains.

Yuan, Williams, Fang, and Ye (2012b) sought to determine the effects of high-fidelity simulation on knowledge and skills in nursing and medical education. Twelve nursing research articles were identified for this study. Ten of those articles specifically looked at knowledge gains after the simulation acticity. Eight of the 10 articles (80%) showed a significant increase in posttest knowledge gains after a high fidelity simulation experience. This meta-analysis supports the findings from the above studies.

Griggs (2002) determined that HFS did not have any effect on medical surgical knowledge with undergraduate nursing students. Jeffries and Rizzolo (2006) conducted a multisite study with 798 nursing students to determine if students who participate in simulation have better learning outcomes. They concluded there were no significant differences in knowledge gains among the study groups as measured by pre- and posttesting in all three groups (Jeffries & Rizzolo, 2006). These results are not surprising because this study was related to increased knowledge after simulation-based learning (SBL). However, SBL was used to help synthesize and apply knowledge not to gain new knowledge.

Parker et al. (2011) found similar results when measuring outcomes related to knowledge after exposure to a pediatric simulation learning exercise. The mean final course grade was 79.7 for the study group and 80.2 for the comparison group; this difference was not statistically significant. Shepherd et al. (2010) determined that there was not a significant difference in cognitive gains after comparing the performance of two groups of nursing students exposed to simulation.

Parker et al. (2011), Shepherd et al. (2010), Jeffries and Rizzolo (2006), and Griggs (2002) all concluded that simulation was not significant in increasing knowledge with BSN students. On the other hand, Brannan et al. (2008), Cooper et al. (2010), Howard (2007), Liaw et al. (2012), Linden (2008), Piscotty et al. (2011), Shinnick et al. (2012), and Yuan et al. (2012a) concluded that there is a significant difference in knowledge gains of undergraduate nursing students after participation in a simulation exercise. Although the empirical evidence identified mixed results with HFS as a teaching method to increase cognitive gains, more substantive studies are needed to determine the effectiveness of HFS as a reliable method to increase cognitive gains with baccalaureate nursing students.

Confidence

Simulated experiences offer the opportunity for accommodating diverse styles of learning not offered in the traditional classroom environment. When students perceive satisfaction with the simulation experience, this realization may carry over and increase their confidence and ability to care for actual patients (Jeffries & Rizzolo, 2006). As posited by Bandura (2004), self-efficacy is an indicator of a person's perception of how well she or he is prepared to successfully accomplish a task. Bambini, Washburn, and Perkins (2009) noted that simulation had a positive effect on self-efficacy in providing care for patients in postpartum settings. Results of studies measuring self-confidence and self-efficacy gains through high-fidelity human simulation have been consistent in showing a positive effect (Bambani et al., 2009; Bremmer, Aduddell, Bennett, & VanGeest, 2006; Brown & Chronister, 2009; Cardoza & Hood, 2012; Garrett, MacPhee, & Jackson, 2011; Jeffries & Rizzolo, 2006; Kaddoura, 2010; Kameg, Howard, Clochesy, Mitchell, & Suresky, 2010; Moule, Wilford, Sales, & Lockyer, 2008; Parker et al., 2011; Ricketts, Merriman, & Stayt, 2012; Rush, Firth, Burke, & Marks-Maran, 2012; Slager, Feenstra, Ayoola, Flikkema, & Bartels, 2011; Smith & Roehrs, 2009; Wagner, Bear, & Sander, 2009).

Bambani et al. (2009) conducted a quasi-experimental study with students participating in a 3-hour postpartum simulation exercise. The students reported an increase in confidence levels when caring for the postpartum patient. Ricketts et al. (2012) found similar results in that students can learn from their mistakes and gain confidence through simulated practice before providing direct care in the practice setting.

Bremmer et al. (2006) conducted a mixed methods study to determine if using HFS had an impact on confidence levels. Sixty-one percent of the participants stated that the simulation helped them gain confidence in their assessment skills. The qualitative data suggested that the simulation helped the students gain confidence in touching patients prior to going into the clinical setting with actual patients. Jeffries and Rizzolo (2006) determined that students in both the low- and high-fidelity simulator groups reported significantly greater confidence levels in their ability to provide care for their patients than the students in the paper-and-pencil case study group.

Brown and Chronister (2009) demonstrated the effect of simulation activities on confidence in an experimental comparative correlational design. The results showed that HFS positively affects the confidence of nursing students and that this may translate into the clinical setting. Cardoza and Hood (2012) examined senior nursing students' reported self-efficacy in providing patient care using HFS at the beginning of the course, at two additional points throughout the semester, and at the completion of the course. The results showed that self-efficacy scores dropped at the second scoring but then began to increase at the third and final self-reporting. Overall, the students' perception of self-efficacy increased over time, which is consistent with the use of simulation.

Garrett et al. (2011) concluded that students felt more confident in their ability to care for their patient after participating in the simulation activity. Kaddoura (2010) found similar results with an exploratory descriptive study that focused on the students' perceptions of simulation. This study found that the simulations helped the students feel more confident in their ability to care for critically ill patients. In a study by Slager et al. (2011), it was apparent that students grew less apprehensive and more confident with their patient care after participating in simulation exercises.

Kameg et al. (2010) conducted a nonrandom quasi-experimental study designed to compare the effectiveness of HFS to traditional lecture in relation to self-efficacy. The results support the use of HFS to assist with increasing undergraduate nursing students' self-efficacy levels. Moule et al. (2008) conducted a qualitative study and concluded that simulation can contribute to developing confidence prior to practice. Rush et al. (2012) noted that by repeating skills in the simulation environment confidence can increase.

Rush et al. (2012) described the implementation of a peer assessment scheme for clinical skills using simulation. A qualitative evaluative study using questionnaires was used to determine the role of simulation on skills and confidence. The results concluded that the students had an increase in confidence due to repetitive practice with the simulators. Smith and Roehrs (2009) determined that 94% of the students felt confident in their ability to care for a patient with a respiratory issue after participation in the respiratory simulations scenarios. Wagner et al. (2009) and Slager et al. (2011) found similar results in that nursing students strongly agreed that simulation increased their confidence in their nursing abilities after spending time in the simulation environment.

Brannan et al. (2008) found no significant difference in confidence levels between the experimental group who received the simulation and the control group who received a lecture teaching approach. Feingold et al. (2004) also noted in a descriptive study that less than half of students who participated in simulation over 2 semesters stated that their level of confidence increased.

Liaw et al. (2012) found similar results in a prospective randomized controlled trial to determine whether self-reported confidence and knowledge measures are indicators of clinical performance. While both groups had improvements in their confidence levels, the control group had a significantly higher confidence score on the posttest without receiving the intervention. This study revealed no association between student nurses' self-reported confidence and simulation performance before and after the educational intervention (Liaw et al., 2012). Parker et al. (2011) conducted a quasi-experimental, posttest design to determine the learning outcomes of students participating in the simulation experience. Of the 19 students who participated in the simulation, only half of the students reported an increase in their confidence levels.

Yuan et al. (2012a) conducted a systematic review of the literature relating to simulation and confidence levels. They examined 24 studies that addressed confidence and competence as outcomes of simulation. The qualitative studies showed positive results; however, the quantitative studies showed mixed results as to whether simulation increased confidence levels in nursing students. It was noted that more quantitative studies need to be conducted using validated instruments to determine the effectiveness of simulation on confidence levels.

While four studies (Brannan et al., 2008; Feingold et al., 2004; Liaw et al., 2012; Yuan et al., 2012a) found that simulation had no effect on confidence or self-efficacy, the remaining studies (N=15) overwhelmingly support the use of simulation to help increase students confidence and self-efficacy levels (Bambani et al., 2009; Bremmer et al., 2006; Brown & Chronister, 2009; Cardoza & Hood, 2012; Garrett et al., 2011; Jeffries & Rizzolo, 2006; Kaddoura, 2010; Kameg et al., 2010; Moule et al., 2008; Parker et al., 2011; Ricketts et al., 2012; Rush et al., 2012; Slager et al., 2011; Smith & Roehrs, 2009; Wagner et al., 2009). According to Bandura's (1986) self-efficacy theory, self-efficacy is enhanced by four main factors: successful performances (competence), vicarious experience, verbal persuasion (including praise and encouragement), and arousal. Simulation can be used to enhance all four of these components to increase students' confidence. This study also used a sample of baccalaureate students.

Conclusions

The available literature on simulation and nursing education supports that simulation is useful in creating a learning environment that contributes to an increase in confidence, satisfaction with learning, and self-efficacy. The literature indicated mixed results surrounding cognitive gains. Due to the limitations of those studies it is difficult to determine if the simulation experience was the sole variable to impact students' knowledge gains.

Limitations of Simulation

While there are mixed outcomes related to HFS, there are some factors that need to be considered when using simulation as a teaching method. Factors to consider when using simulation as an instructional strategy in higher education include the costs of the equipment, space, and training of faculty (Bremmer et al., 2006; Feingold et al., 2004) and the lack of studies examining the cost-benefit ratio in higher education (Bremmer et al., 2006; Feingold et al., 2004; Lapkin & Levett-Jones, 2011). The lack of clear evidence indicating that the knowledge gained during the simulation transfers to the clinical setting (Cardoza & Hood, 2012; Cooper et al., 2010; Feingold et al., 2004) and the lack of incentives for the faculty to learn the technology and develop scenarios for simulation are also some major limitations to simulation (Bremmer et al., 2006; Feingold et al., 2004). It is also necessary to determine the best size of student groups to promote effective student learning using simulation (Bremmer et al., 2006; Brown & Chronister, 2009; Feingold et al., 2004; Gaba, 2002; Kaddoura, 2010; Lasater, 2007, Nehring & Lashley, 2004; Radhakrishnan, Roche, & Cunningham., 2007; Rauen, 2004; Scherer, Bruce, Graves, & Erdley, 2003;).

Students criticized simulation by not having enough time to work with the simulator and their discomfort in the simulation setting (Bremmer et al., 2006; Gaba, 2002; Radhakrishnan et al., 2007). Students also noted that they would rather work alone with the simulator rather than working together in groups (Bremmer et al., 2006; Gaba, 2002; Radhakrishnan et al., 2007). Lasater (2007) noted that simulators have their own inherent limitations. Patient simulators have no visual or nonverbal communication, such as grimaces or smiles, and certain kinds of assessments were not possible, such as a neurological examination. Simulators also cannot develop swelling or color changes (Kameg et al., 2010; Lasater, 2007; Ravert, 2008). Another criticism from students was that the simulator always had a female voice, as the laboratory staff playing the patient roles was almost entirely comprised of women (Lasater, 2007).

Students did not feel that the skills learned with the HFS would transfer to clinical situations (Feingold et al., 2004; Nehring & Lashley, 2004; Radhakrishnan et al., 2007). However, researchers seeking to examine transfer of learning noted that the method used to draw this conclusion was that of self-report from students. Research needs to be conducted to see if simulation has an impact on transfer of learning to the clinical environment; however, transfer of knowledge is difficult to measure. Valid and reliable instruments need to be developed and used to determine the impact of simulation on transfer of knowledge.

Discussion of the Limitations

Contamination of the study content may have occurred with students discussing content of the simulation among themselves (cross talk) despite confidentiality agreements (Shinnick et al., 2012). Contamination can occur either inadvertently or intentionally as students discuss their experiences. The cost to internal validity is that individuals in the control condition receive part of the intervention.

There was an assumption that all students began the experience with the same level of knowledge (Kirkman, 2011). This is not always the case and variables need to be controlled as much as possible. Students may also have had different and unequal clinical experiences that can alter the results of the study (Brown & Chronister, 2009; Howard, 2007; Ironside, Jeffries, & Martin, 2009; Kirkman, 2011; Pike & O'Donnell, 2010; Sears, Goldsworthy, & Goodman., 2010; Shinnick et al., 2012). Outcomes may also be influenced by extraneous variables such as the course load of students, outside employment or previous work in the healthcare setting, and life experiences (Brown & Chronister, 2009; Ironside et al., 2009; Kirkman, 2011).

Several studies used participants from a single site (Baker et al., 2008; Bambini et al., 2009; Cordeau, 2010; Kaddoura, 2010; Kirkman, 2011; Morrison & Catanzaro, 2010; Piscotty et al., 2011). It would be advantageous to carry out a comparative study among two or more nursing programs and higher education institutions. Convenience sampling and a small sample size was also a limitation that occurred in the majority of the studies (Brannan et al., 2008; Brown & Chronister, 2009; Cardoza & Hood, 2012; Cooper et al., 2010; Griggs, 2002; Kameg et al., 2010; Kirkman, 2011; Leonard, Shuhaibar, & Chen, 2010; Liaw et al., 2012; Pike & O'Donnell, 2010; Radhakrishnan et al., 2007; Ravert, 2008; Reese, Jeffries, & Engum, 2010; Rush et al., 2012; Shepherd et al, 2010; Smith & Roehrs, 2009; Unsworth, Mckeever, & Kelleher, 2012; Wagner et al., 2009; Wagner, Liston, & Miller, 2011). If the sample size is limited, it will be difficult to determine significant relationships from the data. It would be useful to replicate these studies with more participants and at various schools of nursing to determine measurable outcomes of simulation.

Another limitation that was noted among several studies was that the participants were not selected randomly for inclusion in experimental or control groups (Brannan et al., 2008; Cardoza & Hood, 2012; Cooper et al., 2010; Cordeau, 2010; Griggs, 2002; Kameg et al., 2010; Kirkman, 2011; Kyrkjebø, Brattebø, & Smith-Strøm, 2006; Liaw et al., 2012; Moule et al., 2008;

Parker et al., 2011; Pike & O'Donnell, 2010; Piscotty et al., 2011; Sears et al., 2010; Wagner et al., 2009; Wagner et al., 2011). Studies are needed that randomize participants to their respective groups.

Howard, Ross, Mitchell, and Nelson (2010) and Kameg et al. (2010) reported bias on the part of the primary investigator because the HFS scenarios used by Howard et al. (2010) and Kameg et al. (2010) were created by the primary investigator, who acted as the faculty facilitator for the students who participated in the HFS group. Such bias can be corrected if someone other than the primary investigator conducts the simulations. The primary investigator also has the option to use the National League for Nursing, "METI" or Laerdal preprogrammed simulations to reduce bias.

Several of the studies used a pre- and posttest design and it is possible that students may have been improving over time as a result of multiple factors including lectures, practice, and self-initiated learning rather than as a result of the simulations (Brannan et al., 2008; Griggs, 2002; Howard, 2007; Howard et al., 2010; Jeffries & Rizollo, 2006; Linden, 2008; Mould, White, & Gallagher, 2011; Piscotty et al., 2011; Ravert, 2002; Ravert, 2008). The pretest itself could lead to actual improvement on the posttest; therefore, it is difficult to tell if the intervention (simulation) had an impact on the posttest results. Recommendations would be to use a more rigorous method such as the Solomon Four Design to decrease the risk of the pretest influencing the posttest results.

Summary

As the use of simulated learning continues to increase, more research is needed to identify the 'hallmarks' of effective simulation (Jeffries, 2005). The use of technology is increasing rapidly in nursing education. The National League for Nursing (NLN) in a 2005 position statement identified that nurse educators must create “learning environments that facilitate students’ “critical thinking, self-reflection” and prepare “graduates for practice in a complex, dynamic health care environment” (p.1-2). Simulation is one tool that has the potential to help educators prepare our future nurses to practice in this complex environment.

Nurse educators must address the challenge of educating and ensuring the competence of new graduate nurses and using simulators can be an integral part of this process. Simulation using the high fidelity simulators offers unlimited opportunities to address patient safety issues and to aid collaboration between education and practice. There is an absolute need to conduct substantive research that includes using validated and reliable instruments and rigorous research methods to investigate the best approaches to integrate simulation across the nursing curriculum and to determine its value by using high-fidelity computer-based human patient simulators.

CHAPTER 3

METHODS

The researcher examined the effectiveness of HFS as an educational strategy with baccalaureate nursing students. The purpose of this study was to focus on the effects of high-fidelity simulation learning using a formatted simulation scenario to increase knowledge acquisition, satisfaction with learning, and self-confidence in nursing students and to develop recommendations for the use of HFS in the undergraduate nursing environment. This chapter describes the methods used to carry out the study.

Study Design

This study used a quantitative quasi-experimental design, specifically, the Solomon four research design (Holdnak, Clemons, & Bushardt, 1990; Van Engelenberg, 1999). This design (Table 1) was chosen to measure the effect of the HFS educational intervention versus the traditional lecture-only approach upon basic respiratory nursing knowledge, while controlling for the potential effects of a pretest. Holdnak et al. (1990) proposed that the pretest, intervention, and a posttest be given to experimental group one (E1), whereas experimental group two (E2) will only receive the intervention and a posttest. Control group one (C1) will receive the pretest and posttest and control group two (C2) will receive only the posttest (Holdnak et al., 1990). Hypotheses 2 and 3 will be tested to determine if the pretest had an influence on posttest results.

Table 1
The Solomon Four Research Design

	Pretest	HFS Intervention	Posttest
E1	X	X	X
E2		X	X
C1	X		X
C2			X

Van Engelenburg (1999) concurs with Holdnak et al. (1990) in that the Solomon four-group design is a useful experimental design tool that tests the influences of independent variables upon dependent variables when a pretest, intervention treatment, posttest design is used. Walton Braver and Braver (1988) indicated that the Solomon four-group design added a higher degree of external validity as well as internal validity when compared to the simple pretest-posttest design. The Solomon four group design controls for the effect of the pretest on knowledge acquisition.

Setting

This study was conducted at a public university in the southeastern United States. Permission was granted for this research by the university to conduct this study with first semester senior baccalaureate nursing students (see Appendix A). The primary instructor for the Medical Surgical Nursing II course conducted the clinical simulation with oversight by the researcher.

Research Design

Sample. The convenience sample (N=43) for this study consisted of first semester senior level nursing students enrolled in a baccalaureate nursing program at a state university in the southeastern United States. The baccalaureate nursing curriculum is a 4-year program. The first 2 years consist of a strong science foundation in addition to courses needed to fulfill the university general education requirements. The third and fourth years focus on fulfilling the baccalaureate nursing requirements. The baccalaureate senior students enroll in a medical-surgical nursing course during their first and second semesters of their first year of the nursing program. This course emphasizes chronic and acute-care medical-surgical theory and introduces the student to common teaching and learning concepts for clinical practice. Additionally, the students are introduced to chronic and acute medical-surgical nursing concepts as applied to individuals, families, and community groups. The medical-surgical content provides a basis for responding to complex health patterns and specific pathophysiological processes. These students attend 135 hours of clinical experience in each of their first and second semesters of the nursing program as a corequisite to this didactic course, where the students directly apply their knowledge in the acute care setting.

Sampling Plan. First semester senior nursing students (N = 44) were approached during the first week of class of their senior year by the principal investigator to provide them information about the opportunity to participate in this study. The class was allowed to ask questions regarding the study and all questions were answered. Inclusion criteria consisted of all the students currently enrolled in the first semester of the senior year (N=44). Exclusion criteria included students that were repeating any first semester senior courses (N=1). This student was excluded because she had already received an additional semester of clinical experience and that could skew the data. All participants (N=43) are healthy adults over the age of 18 and no vulnerable populations were included in this study. This class of nursing students was selected due to the appropriateness of the content to HFS and their familiarity with the simulation lab from previous course experiences. Exposure to previous simulation decreases the students' anxiety and makes them feel more comfortable in the simulation setting (Cordeau, 2010; Slager et al., 2011). Participation in the study was completely voluntary.

The Research Methods and Procedures

Following approval of the university Institutional Review Board (IRB), the researcher recruited students during their scheduled Obstetrics Clinical class. These students have successfully completed the first year of the nursing program. Each student was randomly assigned to a treatment or control group. Students were provided with an explanation of the study at the onset of the course prior to implementation. Written consent was not necessary per IRB guidelines. Students were assured that participation was voluntary, results were confidential, and scores and participation would not affect their course grade. No monetary incentive or extra credit was given to the volunteer participants in this research. Eligible students (N=43) who agree to participate in the study were required to sign a confidentiality agreement (Appendix C) to minimize the possibility of cross-contamination between the two groups.

All participating first semester senior baccalaureate nursing students had received their traditional 5-hour respiratory lecture during their second semester of their junior year which was in the spring 2013 semester. The didactic lecture was considered the concrete experience (see Figure 2) of Kolb's Experiential Learning Cycle (Kolb, 1984). After the lecture the students were given case studies and response questions to determine if they understand the concepts of the lecture. This is the abstract conceptualization phase (see Figure 2) of Kolb's Experiential Learning Cycle (Kolb, 1984). The students randomly assigned to E1 (N = 11) and C1 (N = 11) took the HESI pretest to determine their baseline knowledge. Groups E1 (N = 11) and E2 (N = 10) were then randomly divided into smaller subgroups of five or six students each. The smaller groups participated in a 2-hour long respiratory simulation learning experience. The high fidelity simulation experience is viewed as the Active Experimentation phase (see Figure 2) of Kolb's Experiential Learning Cycle (Kolb, 1984). This intervention took place over the course of 1 day with the participants in group E1 participating on day one in the morning and group E2 participating in the afternoon. The components of the study are displayed as components of Kolb's Experiential Cycle in Figure 2.

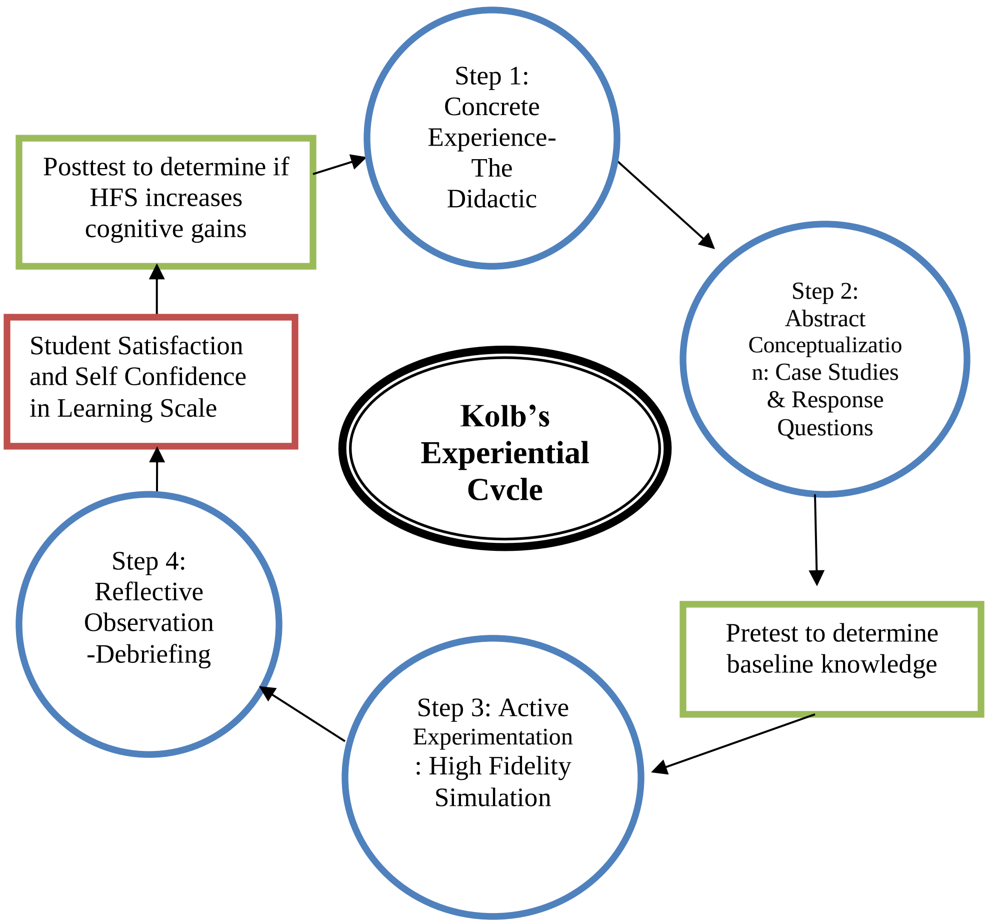

Figure 2: Kolb's Experiential Cycle (adapted by Rachel Hall, 2013)

The simulator that was used in this study is the Laerdal SimMan® High Fidelity Simulator commonly referred to as SimMan®. SimMan® is a full body, adult manikin that allows the simulation of basic and advanced skills. The simulator allows for observation and recognition of vital signs that are displayed on the simulator's bedside monitor. When used correctly these features will support the students' ability to develop their clinical decision process based on active observation and participation as opposed to being prompted by instructor cues. Additionally, this will enable the students to develop and use their critical thinking skills to determine the correct interventions needed to ensure positive patient outcomes based on the simulator's response.

Groups E1 and E2 had four 15-minute respiratory scenarios with 15 minutes for debriefing between each scenario for a total of 2 hours of simulator training. The debriefing session (see Figure 2) was phase four, the reflective-observation stage of Kolb's Experiential Learning Cycle (Kolb, 1984). Hypothesis 1 focuses on HFS and knowledge gains. There are no current standardized published guidelines for conducting simulation training with students; however, brief 15 minute scenarios are very effective when accompanied by debriefing sessions (Brackenreng, 2004; Cantrell, 2008). The scenarios were pulmonary edema, pulmonary embolism, acute asthma, and COPD/emphysema management. The PI adapted scenarios from the National League for Nursing and Laerdal for the asthma and COPD scenarios. The pulmonary embolism scenario was adapted from the Kansas Board of Nursing simulation website. The pulmonary edema scenario was developed by the PI. Four nurses who specialize in respiratory disorders validated the authenticity of the scenario based on their experience. The students randomly choose numbered index cards to determine the "role" they played in the respiratory scenario: primary nurse, secondary nurse, family member, or nursing assistant. The student rotated through the roles within the four different scenarios.

The students had 15 minutes prior to their simulation time to practice with the simulator. This is the same simulator that the students had previously been exposed to in their first and second semester of the nursing program. The instructor gave the students a verbal patient report and the "primary nurse" student assumed care for the simulated patient. Students were expected to interact with the simulator by asking questions to document a patient history, performing a head-to-toe assessment, analyzing and interpreting the data, and intervene with the critically ill "patient." After each scenario a standardized debriefing session took place to reinforce important concepts and clarify difficult issues. After the final debriefing session the students in the experimental group completed the *Student Satisfaction and Self-Confidence in Learning Scale* (NLN, 2005). Once the experimental groups (E1 & E2) completed the simulation learning experience, all four groups of participants (N=43) (E1, E2, C1, & C2) took the HESI posttest. All students (N=43) who consented to participate in the research completed all facets of this research project. To assure equal learning opportunity for all students, the participants that were in the control groups had the opportunity to partake in the respiratory HFS the week following the posttest and then completed the *Student Satisfaction and Self-Confidence in Learning Scale Survey* (NLN, 2005). These survey responses were included with the student responses from the experimental group and analyzed.

Instruments

The initial part of the survey consisted of demographic data collection. Age, gender, traditional or nontraditional student, as well as previous work or experiences in the healthcare setting were obtained for demographic analysis.

The HESI exams were developed to assess students' knowledge and their ability to apply nursing concepts within specific content areas. Brown and Chronister (2009), Howard (2007), and Howard et al. (2010) used the HESI instrument to measure cognitive gains in their respective research studies. Reliability and validity have been established and test validity is an ongoing process with the HESI exam (Morrison, Adamson, Nibert, & Hsia, 2008).

Custom exams are specialty exams that are designed to meet specific curricular evaluation needs. Typically, custom specialty exams consist of 30 test items. Test blueprints for custom exams are developed by HESI nurse educators and include the content domain specified in the syllabus or syllabi that are provided to HESI by the faculty requesting the development of a custom exam (Morrison, Nibert, & Flick, 2006). Test items that best measure nursing knowledge and competencies within the designated content area are selected from the HESI database. Custom exams are completed following consultation between faculty and HESI nurse educators to ensure that the final products are valid for the constructs to be tested (Morrison et al., 2006).

A 30-question exam was created by the HESI Corporation and was used to measure respiratory knowledge gains. The HESI Corporation is a proprietary organization. Therefore, the pretest and posttest blueprints are not provided. Once this study received dissertation committee approval, the nursing research specialist at the HESI Corporation created parallel pre- and posttests with the researcher input based upon the learning objectives related to the respiratory content. The students took the computer based exam in the secure computer lab, and the results were analyzed by the HESI Corporation immediately (Morrison et al., 2006). Parallel exams and the Solomon Four Research Design method were used to help control for the pretest results influencing the posttest results to better evaluate if there were any statistically significant cognitive gains after the simulation experiment. Using parallel exams and the Solomon Four Research Design with this study helped eliminate the pretest having an influence on the posttest results.

Scoring of the HESI exam results in two scores: the HESI score which can range from 0 to over 1,000 and can be as high as 1,500 depending on the difficulty of the exam, and the Conversion Score, which is a weighted percentage score that considers the average difficulty of the exam and the average difficulty of the test items the student answered (Morrison et al., 2006). All test items are weighted according to difficulty. The Conversion Score from the HESI exam was used for the statistical data based upon the possible variation of the individualized HESI exam that each student completed (Morrison et al., 2006).

The *Student Satisfaction and Self-Confidence in Learning Scale* was developed by the NLN (2005) to assess student satisfaction with simulation as an educational strategy and how confident students felt about applying skills learned in the lab to the clinical setting. Originally, these were two separate scales, but they have been combined since the original reliability and validity were measured. This instrument is a 13-item instrument designed to measure student satisfaction (five items) with the simulation activity and self-confidence in learning (eight items) using a five-point scale (NLN, 2005). Reliability was tested using Cronbach's alpha for a satisfaction score of 0.94 and a self-confidence score of 0.87 (Jeffries & Rizzolo, 2006). The instrument was to measure student satisfaction and confidence in skills practiced and knowledge about caring for the type of patient presented in the simulation experience.

Informed Consent

Institutional Review Board (IRB) approval was obtained from East Tennessee State University Office of Research and Sponsored Programs (See Appendix C). IRB approval was also obtained from the participants' university (Appendix A). Potential participants were informed about the details of the study and notified that participation is completely voluntary. The primary researcher explained the purpose and the method of the study to the participants and all questions were answered. Because this is an educational intervention study, the *Family Educational Rights and Privacy Act (FERPA)* applied with the participants. All test scores were confidential and were not shared with other participants.

Specific Risks to Participants

There were no known risks to the participants with this study. This is an educational intervention investigation to determine if simulation is an appropriate method to enhance knowledge acquisition, satisfaction with learning, and self-confidence by bridging the theory-practice gap.

Benefits to Participants

The participants who volunteered for this research study will help to further simulation research and determine how implementing simulation in the curriculum can directly enhance their knowledge acquisition and retention. The participants did not receive any monetary benefits, nor did they receive extra credit for their participation. There was also no cost to the participants for their participation in the study.

Participant Privacy and Confidentiality

Privacy was strictly maintained for each participant. There was no outside discussion of the participants' performance on the exam or in the simulation lab. All students signed the confidentiality forms (Appendix B) that protect the privacy of their peers in the simulation lab Participants were assured that they could withdraw at any point without penalty. None chose to withdraw.

All test scores remained confidential and were not published or shared with other participants. The primary investigator was the only individual with access to the participants' scores. Each participant was given a 5-digit code used for tests, the survey, and demographic data. Only the primary investigator had access to the codes for the participants; these codes were stored in a locked file cabinet until the study was completed then were shredded. The use of codes allowed for anonymity of the students. The scores were entered into a Statistical Package for the Social Sciences (SPSS®) Version 19 and then checked for accuracy and stored on an external hard drive with a back-up on a flash drive that was password protected. The files were physically stored behind two locked doors in the primary investigator's office.

Data Collection Methods and Procedures

Data were collected in the college's testing center with the pretest given during the first week of the fall semester. Group E1 and C1 completed the pretest. The students in the experimental groups (E1 & E2) participated in the simulation learning experience the following day and immediately completed the *Student Satisfaction and Self-Confidence in Learning Scale (NLN, 2005)*. All students (E1, E2, C1, & C2) returned to the testing center for the posttest a day after the simulation was complete to test their knowledge acquisition. Once the posttest was complete, the control groups (C1 & C2) were given the option of participating in the HFS activity and then completing the *Student Satisfaction and Self-Confidence in Learning Scale (NLN, 2005)*. Only two students chose to complete the simulation activity.

Data Analysis

The data were analyzed using SPSS® Version 19. The demographic variables (age, gender, level of education, traditional versus nontraditional students, and previous work or experience in the healthcare setting) were described using frequencies and percentages along with multiple regression tables to determine the effects of demographic factors. Multiple regressions were used to determine: (1) which predictors significantly contributed to the criterion (the HESI exam and the SSSCL survey), (2) how much each predictor contributed to the criterion, and (3) the direction of the contribution to the criterion (Huck, 2012).

Hypothesis 1: Students who received traditional classroom lecture, took the pretest and received the educational intervention of HFS will have greater knowledge acquisition of respiratory content as measured by an exam score from the Health Information Systems Incorporation (HESI) examination when compared to the students who only received the traditional classroom lecture, took the pretest and then took the posttest without having the HFS. This hypothesis was tested using the Wilcoxon matched pairs statistical test. The Wilcoxon matched pairs statistical test is a nonparametric test that was used for this study due to the small sample size and that violated the assumption of normality (Huck, 2012). Wilcoxon matched pairs was used to compare two related samples for data generated by measuring the same people twice (Huck, 2012). The Wilcoxon statistical test was first run on the intervention group to determine if there was a statistical significance from the pretest to the posttest in cognitive gains. The Wilcoxon test was repeated on the control group to determine if there was a statistical significance from the pretest to the posttest scores.

Hypotheses 2: The students who took the pretest and received the HFS will score higher on the posttest than the students who received only the HFS and the posttest. This hypothesis was tested using the Mann-Whitney U test to compare two independent samples (Huck, 2012). This statistical test allowed the researcher to compare two independent samples. When using the Mann-Whitney U test the researcher examined the scores of the research participants on the variable of interest. Initially, the two comparison groups were lumped together so that each person can be ranked to reflect his or her standing within the combined group. After the ranks have been assigned, the researcher reconstituted the two comparison groups. The previously assigned ranks were then examined to see if the two groups were significantly different (Huck, 2012). The Mann Whitney U test was also used to determine homogeneity between the two groups that took the pretest (Huck, 2012).

Hypotheses 3: The students who took the pretest and did not receive the HFS intervention will score higher on the posttest than the students who only took the posttest. This hypothesis was tested using the Mann-Whitney U test to compare two independent samples (Huck, 2012).

Hypothesis 4: Students who received the HFS, regardless of pretest experience, perceived an increase in self-confidence and a high level of satisfaction of the learning activity after the simulation experience as measured by the *Student Satisfaction and Self-Confidence in Learning Scale (NLN, 2005)*. This hypothesis was tested using the mean and standard deviation among the SSSCL survey. Spearman's Rho was used to determine if there was an association between *HESI* scores and the *Student Satisfaction and Self-Confidence in Learning Scale (NLN, 2005)* (Huck, 2012).

Limitations of the Study

There was an assumption that all students began the experience with the same level of knowledge (Kirkman, 2011). This is not always the case and variables need to be controlled as much as possible. Students also had different and unique clinical experiences (Brown & Chronister, 2009; Howard, 2007; Ironside et al., 2009; Kirkman, 2011; Pike & O'Donnell, 2010; Sears et al., 2010; Shinnick et al., 2012). Outcomes may have been influenced by extraneous variables such as the students course load, outside employment, previous work in the healthcare setting, and life experiences (Brown & Chronister, 2009; Ironside et al., 2009; Kirkman, 2011). It was necessary to identify extraneous variables when designing this experiment to limit misinterpretation and flawed conclusions. Many of those variables were controlled by limiting the time frame for participant exposure to 4 consecutive days. Another limitation of this study was that the students had previously taken a course with the PI and that may have influenced them to participate in the study. Convenience sampling, a small sample size, and using of a single site are also limitations of this study.

CHAPTER 4

RESULTS

The purpose of this study was to determine the effects of a formatted high fidelity simulation scenario on knowledge acquisition in baccalaureate nursing students. Additionally, this research determined the students' satisfaction and self-confidence with the simulation learning activity. This chapter presents the results of the analysis of the data obtained.

Demographic Data

The population chosen for this study was first-semester senior nursing students (n=44) enrolled in a baccalaureate nursing program. At the beginning of the semester, the senior nursing students were recruited during their Obstetrics Clinical Course time and informed of the research project. The students were given the demographic survey and completion of the survey was counted as consent for their participation in the research. The students were randomly divided into four groups: E1, E2, C1, and C2 by drawing a group number out of a basket (see Table 2). Using the inclusion criteria for the study, one student was excluded from the research due to the repetition of a senior level course resulting in a sample of 43 first semester senior BSN nursing students. All students (n=43) who were eligible for enrollment in the study enrolled and completed the research for 100% participation and completion rate.

Table 2
The Intervention Plan

Groups	**Pretest**	**Intervention HFS**	**Posttest**
E1 (n=11)	X	X	X
E2 (n=11)		X	X
C1 (n=11)	X		X
C2 (n=10)			X

The participants were required to complete a demographic survey (Appendix D) at the beginning of the study. The demographic information is presented in Table 3. The sample consisted of 43 first semester senior nursing students. There were 39 (90.7%) females and four (9.3%) males. The mean age of the participants was 21.97 years old. Twenty-eight students (65.1%) were between the ages of 18-21, 13 (30.3%) students were between the ages of 22-25, no students were between the ages of 26-30, and two (4.6%) students were older than 31. There were two (4.6%) students who reported being nontraditional students while the other 41 (95.3%) reported being traditional students. There were 16 (37.2%) students who responded "yes" to having previous work experience working in health care.

Table 3
Demographic Data (n=43)

Variable	**N**	**%**
Gender		
Male	4	9.3
Female	39	90.7
Age		
18-21	28	65.1
22-25	13	30.3
26-30	0	0
>31	2	4.6
Type of student		
Traditional	41	95.3
Nontraditional	2	4.6
Previous experience working in Healthcare		
Yes	16	37.2
No	27	62.8

A multiple regression test was performed to determine which predictors, including age, gender, traditional or nontraditional student status, and previous experience working in healthcare, significantly contributed to the respiratory HESI posttest score and how much each predictor contributed to the HESI score along with the direction of the contribution to the HESI score (Huck, 2012). The data revealed that gender, previous healthcare experience, age, and traditional versus nontraditional student did not significantly contribute to the HESI posttest score as illustrated in Table 4. There was little variability among the students who participated in this research.

Table 4
Effects of Age, Gender, Previous Healthcare Experience, and Type of Student on HESI Scores

Model	**R Square Change**	**F Change**	**Df1**	**Df2**	**Sig. F Change**
1	.040	.395	4	38	.811
2	.000	.004	1	38	.948
3	-.001	.044	1	39	.834
4	-.002	.063	1	4	.804
5	-.037	1.586	1	041	.215

a. Predictors: (Constant), Student, Gender, Healthcare Exp, Age
b. Predictors: (Constant), Gender, Healthcare Exp, Age
c. Predictors: (Constant), Gender, Age
d. Predictors: (Constant), Age
e. Predictors: (Constant)

The Mann Whitney *U* test was conducted to determine if there was homogeneity between the two independent groups that took the pretest (E1 & C1). The data demonstrated (see Table 5) that there was not a statistically significance difference (p=.158), which resulted in a high level of confidence that the E1 and C1 groups were equivalent. The students were distributed equally across the two groups based on their pretest scores.

Table 5
Mann-Whitney U Test for Homogeneity

Test Statistics	
	Pretest
Mann-Whitney U	39.000
Wilcoxon W	105.000
Z	-1.412
Asymp. Sig. (2-tailed)	.158
Exact Sig. [2*(1-tailed Sig.)]	.171

Data Collection Process

The first semester senior nursing students were approached on the first day of class during the fall semester to inform them of the opportunity to participate in this research. The study was explained in great detail and all questions were answered. The students were given a demographic survey to complete (see Appendix D). The students used a five digit code of their choice for coding purposes on this demographic survey. The primary investigator was the only person to have access to the codes. The students (n=43) completed the survey and agreed to participate in the research. The demographic data were coded and entered into SPSS under their 5-digit number.

The students who were in groups E1 and C1 received the pretest on day 3 of the study. The test was proctored in the school of nursing computer lab by the primary investigator. These students immediately received their grade for the pretest. The primary investigator immediately entered the pretest grades into the SPSS data sheet. The data were double checked for accuracy and then stored on a flash drive.

Groups E1 and E2 received the simulation activity on day 3 of the study time frame. At the completion of each simulation, the groups completed the *Student Satisfaction and Self-*

Confidence in Learning Scale (NLN, 2005).The students used their 5-digit codes for identification purposes on this survey. This data were entered at the end of the day into the SPSS spread sheet.

Day 4 of the research, all students (E1, E2, C1, & C2) entered the secure computer lab to take the posttest HESI exam. Upon completion of the exam, the students were able to review the questions answered incorrectly with rationale and received their grade. The primary investigator immediately entered the posttest scores into the SPSS spread sheet and the grades were double checked for accuracy.

The following week the students in the control group were allowed the opportunity to participate in the simulation activity and then received the *Student Satisfaction and Self-Confidence in Learning Scale (NLN, 2005)*. Only two students contacted the primary investigator to participate in the simulation learning activity. Once they completed the simulation, they were given the *Student Satisfaction and Self-Confidence in Learning Scale (NLN, 2005)*. The results from these two students were immediately entered into the SPSS spread sheet and calculated in the analysis for Hypothesis four.

Data Analysis

This section describes the data analysis process for the research questions.

Hypothesis 1, that students who receive traditional classroom lecture, take the pretest and receive the educational intervention of HFS (E1) will have greater knowledge acquisition of respiratory content as measured by a posttest exam score from the Health Information Systems Incorporation (HESI) examination when compared to the students who only received the traditional classroom lecture, take the pretest, and then take the posttest without receiving the HFS (C1), was not supported.

To address Hypothesis 1, the Wilcoxon Signed Ranks test was used to compare the difference of the mean HESI respiratory scores between the students who took the pretest, participated in the HFS, and received the posttest (E1) to those who took the pretest and posttest but did not receive the HFS (C1). The Wilcoxon Signed Ranks (see Tables 6 & 7) test was used to assess whether the HFS would impact the posttest respiratory knowledge scores. For the students who received the HFS intervention, the mean score on the pretest was 76.95 (SD = 10.87) and the posttest mean was 82.62 (SD = 10.56). The Wilcoxon Signed Ranks test showed the HFS educational activity did not elicit a statistically significant change from pretest knowledge to posttest knowledge gained ($z = -1.47$, $p = 0.143$) between the experimental group that received the HFS and control group that did not receive the simulation.

Table 6

Pre- and Postcomparison of Knowledge Gains in Experimental Groups

	N	Mean	Std. Deviation	Minimum	Maximum
E1.pretest	11	76.9545	10.86834	61.80	91.00
E1.posttest	11	82.6182	10.56000	63.30	97.00

Table 7

Test Statistics for Experimental Group

	E1.pretest – E1.posttest
Z	-1.468
Asymp. Sig. (2-tailed)	.142

The mean HESI score for the students who did not receive the HFS was 70.56 (SD = 9.58) on the pretest and their posttest HESI mean was 76.76 (SD = 8.06) (see Tables 8 & 9). The Wilcoxon Signed Ranks test demonstrated that the students who were in the control group (C1) did not elicit a statistically significant change from pretest knowledge to posttest knowledge ($z = -1.78$, $p = 0.75$).

Table 8

Pre- and Postcomparison of Knowledge Gains in Control Groups

	N	Mean	Std. Deviation	Minimum	Maximum
C1.pretest	11	70.5636	9.58429	58.70	87.50
C1.posttest	11	76.7636	8.06018	65.80	87.80

Table 9

Test Statistics for Control Group

	C1.pretest – C1.posttest
Z	-1.778
Asymp. Sig. (2-tailed)	.075

Furthermore, there was no statistically significant difference between the experimental group (E1) who received HFS ($z = -1.47$, $p = 0.143$) in cognitive gains when compared to the students (C1) who did not receive the intervention of HFS ($z = -1.78$, $p = 0.75$).

Hypothesis 2, that students who take the pretest and receive the HFS (E1) will score higher on the posttest than the students that receive only the HFS and the posttest (E2) was not supported.

To address hypothesis 2, the Mann-Whitney *U* test was used to compare the posttest HESI scores between the students who took the pretest, participated in the HFS, and then received the posttest (group E1) to the students who only received the HFS and took the posttest (group E2). This comparison supports the use of the Solomon Four Research Design in that it determined if the pretest scores had an influence on the posttest scores. The Mann-Whitney *U* was used as a substitute for a Student *t* test due to the small sample size (n=43) (Huck, 2012).

The mean posttest score for the experimental group (E1) was 82.62 (SD = 10.56), which was not significantly higher than the students in experimental group (E2) who did not receive the pretest. The mean for E2 was 80.89 (SD = 10.46). Therefore, E1 was not significantly different (see Table 10) from E2 in regards to the influence of the pretest on the posttest scores (z = -.361, *p* = .718).

Table 10

Comparison of E1 and E2 Posttest Scores

	pretest
Mann-Whitney U	55.000
Wilcoxon W	121.000
Z	-.361
Asymp. Sig. (2-tailed)	.718
Exact Sig. [2*(1-tailed Sig.)]	.748

Hypothesis 3, that students that take the pretest and do not receive the HFS intervention (C1) will score higher on the posttest than the students who only take the posttest (C2) was not supported.

To address hypothesis 3, the Mann-Whitney *U* test was used to compare the posttest HESI scores between the students who took the pretest and the posttest (C1) compared to those that only received the posttest (C2). This determined if the pretest scores had an influence on the posttest scores. The Mann-Whitney *U* test was used as a substitute for a Student *t* test due to the small sample size (n=43) (Huck, 2012).

The mean posttest score for the control group (C1) was 76.76 (SD 8.06). The mean for C2 group was 77.47 (SD 14.55). Therefore, C1 was not statistically significant and did not influence the posttest score when compared to the C2 posttest scores (z = -.282, p = .778), which supports the use of the Solomon Four Research Design.

Table 11

Comparison of C1 and C2 Posttest Scores

	Control.pretest
Mann-Whitney U	51.000
Wilcoxon W	117.000
Z	-.282
Asymp. Sig. (2-tailed)	.778
Exact Sig. [2*(1-tailed Sig.)]	.809

Hypothesis 4, that students who received the HFS (N=24), regardless of pretest experience, would perceive an increase in self-confidence and a high level of satisfaction of the learning activity after the simulation experience as measured by the *Student Satisfaction and Self-Confidence in Learning Scale (NLN, 2005)* was supported.

To address hypothesis 4, the students who participated in HFS completed the *Student Satisfaction and Self-Confidence in Learning Scale (NLN, 2005)*. This survey is a perception survey to rate the students' level of self-confidence and satisfaction with the learning simulation activity. The instrument is a 13-question instrument on a five-point Likert scale. The response scale used is a five-point Likert-type rating scale (1= strongly disagree with the statement to 5 = strongly agree with the statement).

The first five questions specifically address the students' satisfaction with the simulation activity. The other eight questions address self-confidence. The overall mean of the *Student Satisfaction and Self-Confidence in Learning Scale (NLN, 2005)* was 61.36 (SD = 2.65) out of a possible of 65 points. The results from the *Student Satisfaction and Self-Confidence in Learning Scale (NLN, 2005)* can be found in Appendix E. Overall, the students were very satisfied (mean 24.27, SD= 1.03) with the simulation activity and perceived a high level of self-confidence (mean 37.09, SD = 2.07). Reliability of the instrument in this application was determined using Cronbach's alpha for a satisfaction score of 0.48, a self-confidence score of 0.74, and a total score of 0.72.

Summary

The data analysis revealed that HFS was not statistically significant in increasing cognitive gains from the pretest to the posttest as measured by the Wilcoxon Matched Pairs test. However, there was a slight increase in the mean scores from the pretest to posttest after the HFS intervention. The results revealed that the students who took the pretest did not have statistically significant higher scores on the posttest than the students who only had the posttest. The students' overall perception of HFS was very positive and the simulation activity increased their level of self-reported level of self-confidence. These results, in addition to findings, implications, limitations, and recommendations for future studies, are discussed in Chapter 5.

CHAPTER 5

DISCUSSIONS, IMPLICATIONS, AND RECOMMENDATIONS

The ultimate goal for nursing faculty is to produce nursing graduates that think critically and apply technical skills in complex patient care situations. Given the increasing complexity in the health care environment, realistic educational experiences that give students the chance to hone their skills before interacting with real patients are more important than ever. Today's hospitalized patients are complex, with multiple comorbidities that require nursing care. Medical errors, which occur in these complex environments, cost the U.S. 19.5 billion dollars annually and 200,000 Americans die each year due to these errors (Andel, Davidow, Hollander, & Moreno, 2012). Nursing faculty face tremendous stress as they prepare students to safely cope with the increasing complexity of patient care. A HFS laboratory allows students to practice nursing care for patients that have multiple complex illnesses in a zero fault environment, thus increasing the potential that they will avoid life-threatening or costly medical errors during their clinical rotations (Ironside et al, 2006; Sears et al., 2010).

HFS is potentially an ideal method to help students translate knowledge and skills from the classroom to the actual clinical setting. Simulation allows for immediate feedback for the individual student to optimize her or his personal learning experience. Kolb's Experiential Learning Cycle (Kolb, 1984) supports the combination of the didactic portion of learning with the active learning of simulation to provide a complete learning experience for nursing students.

Many additional factors affect the use of simulation such as increased student enrollment, fewer faculty members, increased competition for clinical sites, and hospitals that have patients with higher level acuity and shorter lengths of stay (Rhodes & Curran, 2005). Nursing programs have replaced some of the traditional clinical experience with HFS (Nehring & Lashley, 2004), yet little is known about the effects of simulation on learning. The purpose of this study was to determine the effects a formatted high fidelity simulation scenario on knowledge acquisition in baccalaureate nursing students and to determine the students' satisfaction and self-confidence with the simulation learning activity. This chapter explores the implications of the findings of this study.

Discussion

Experiential Learning theorist Kolb (1984) posits that experience plus reflection equals learning. This study determined that the theoretical framework, Kolb's Experiential Learning Cycle (Kolb, 1984), can be applied to HFS. The simulation was the Active Experimentation phase of the cycle and the students then participated in the debriefing session and this correlated with the Reflective Observation phase of Kolb's (1984) cycle. Once the students participated in the debriefing or reflective observation phase, they completed the posttest. According to the Kolb's (1984) theory, the cycle would start over and the students would go back to the concrete experience phase. This would allow the students to review content they missed or needed clarification on after the simulation and debriefing period. This allows the cycle of learning to continue.

Testing of the first hypothesis determined that there was not a statistical difference between the pre- and posttest respiratory knowledge results after exposure to simulation; however, there was a small increase from the pretest to the posttest in both the experimental and control groups. This study adds to the body of knowledge by providing information that simulation will not necessarily increase knowledge gains from a pre- to a posttest exam, especially when a parallel exam is used. The lack of statistical significance may be due to the small sample size of both experimental and control groups (discussed further in the limitations section).

The lack of statistical significance in research findings related to the use of HFS is, however, not unusual. The findings of this study are consistent with other published results. Griggs (2002) determined that HFS did not have any effect on medical surgical knowledge with undergraduate nursing students. Jeffries and Rizzolo (2006) concluded there were no significant differences in knowledge gains among the groups in their study as measured by pre- and posttesting (Jeffries & Rizzolo, 2006). Parker et al. (2011) found similar results when measuring outcomes related to knowledge after exposure to a pediatric simulation learning exercise. Shepherd et al. (2010) determined that there was not a significant difference in cognitive gains after comparing the performance of two groups of nursing students exposed to simulation.

Yet, others including Brannan et al. (2008), Cooper et al. (2010), Howard (2007), Liaw et al. (2012), Linden (2008), Piscotty et al. (2011), Shinnick et al. (2012), and Yuan et al. (2012a) concluded that there is a significant difference in knowledge gains noted with undergraduate nursing students after participation in a simulation exercise. Because of the mixed empirical evidence around HFS as a teaching method to increase knowledge, more substantive studies are needed to determine the effectiveness of HFS as a reliable method to increase cognitive gains with baccalaureate nursing students.

Hypotheses 2 and 3 showed that the pretest exposure for experimental group one and control group one did not influence the posttest scores. The mean scores for both groups were very similar. These results concur with the findings of Van Engelenburg (1999) and Holdnak et al. (1990) in that the Solomon Four-Group Design is a useful experimental design that tests the influences of independent variables upon dependent variables – in this case, the results raised confidence that the effect of the pretest on the posttest results was negligible and did not interfere with the effects of the HFS intervention. These results support and reinforce the validity of the research design chosen for this study.

The students who were in experimental group one (E1) were given a respiratory pretest exam prior to their formatted high fidelity simulation scenario activity to establish their baseline respiratory knowledge. The day following the completion of the formatted high fidelity simulation scenario, the students received a parallel exam on respiratory content. Each exam had 30 test questions and they were very similar in respiratory content and level of difficulty; however, the questions on the pre- and posttest were different (Howard, 2007). The findings from this study contrast the results of Lewis and Ciak (2011), who did note an increase in cognitive gains from a pretest to a posttest exam after simulation. However, identical exams were used, which increases the chance that the pretest did influence the posttest scores (Lewis & Ciak, 2011). The Solomon Four Research Design and the use of parallel exams increased confidence that the pretest did not influence the posttest scores and the statistical results confirm this statement.

The researcher investigated whether HFS improved participants' self-confidence and if they were satisfied with the simulation experience. Analysis of the *Student Satisfaction and Self-Confidence in Learning Scale* (NLN, 2005) resulted in a total mean score of 61.36 out of a possible of 65 points, indicating that participants were well satisfied with the experience. The first five questions specifically addressed the students' satisfaction with the simulation activity. Overall, the students were very satisfied with the simulation learning activity with a mean score of 24.27 out of 25 possible points. The next eight questions addressed the students' self-confidence with the respiratory content from the simulation activity. The students overall mean was 37.09 out of 40 possible points on the self-confidence questions suggesting that after HFS, the students perceived a strong level of self-confidence in taking care of patients with respiratory conditions.

Smith and Roehrs (2009) and Parker et al. (2011) used the *Student Satisfaction and Self Confidence in Learning Scale* (NLN, 2005) in their research study. Smith and Roehrs (2009) determined that 94% of the students felt confident in their ability to care for a patient with a respiratory issue after participation in the simulation, while Parker et al. (2011) did not have significant gains in confidence after the simulation experience. The results from this study are consistent with other findings in regards to measuring self-confidence and self-efficacy gains using high-fidelity human simulation (Bambani et al., 2009; Bremmer et al., 2006; Brown & Chronister, 2009; Cardoza & Hood, 2012; Garrett et al., 2011; Jeffries & Rizzolo, 2006; Kaddoura, 2010; Kameg et al., 2010; Moule et al., 2008; Ricketts et al., 2012; Rush et al., 2012; Slager et al., 2011; Smith & Roehrs, 2009; Wagner et al., 2009).

Implications

Lapkin and Levett-Jones (2011) determined that the total purchase average cost of a high fidelity simulator totaled $102,522.00. This cost included the SimMan 3G manikin, installation fees, on-site training, scenario development and programming, and staff set-up time but did not include the cost of a simulation coordinator, maintenance of the simulator, the time that faculty spend using simulation with small groups, or the supplies used for each training scenario such as intravenous catheter start kits, foley catheters, and medications. Given the expense of simulation and its widespread use in nursing education, nurse educators must understand the potential and limitation of simulation as a teaching and learning strategy.

This study suggests that students' confidence levels increased after exposure to simulation with a small increase in knowledge gains that did not reach the level of p=.05 in statistical significance. Therefore, despite the self-reported increase in confidence, there were only small gains in cognition after the simulation experience. The *Student Satisfaction and Self-Confidence in Learning Scale* (NLN, 2005) reported that 82% of the students strongly agreed that the simulation covered critical content necessary for the mastery of medical surgical curriculum and that they were able to obtain the required knowledge from the simulation to perform necessary tasks in a clinical setting. This indicates that the students felt very confident with the hands-on learning activity and felt that they were learning the required knowledge; however, this confidence and perception of knowledge gains did not translate to a significant increase in scores on the written HESI exam.

The participants' HESI scores were not significantly higher after participating in the simulation activity; however, there was a slight increase from the mean scores between the pretest and the posttest scores. This could be due to the small number of participants in the study. The results of this study indicate that HFS does not increase cognitive gains at the significant level of $p = .05$, but the students were satisfied with the learning experience and have a perceived increase in self-confidence.

As the use of simulated learning continues to increase, more research is needed to identify the 'hallmarks' of good simulation (Jeffries, 2005). Future studies with HFS need to include both valid and reliable simulation material as well as valid and reliable instruments (Adamson, Kardong-Edgren, & Willhaus, 2013; Cioffi, 2000; Ravert, 2002). Brown and Chronister (2009), Howard (2007), and Howard et al. (2010) used the HESI instrument to measure cognitive gains in their respective research studies. Reliability and validity have been established for the HESI exams and test validity is an ongoing process (Morrison et al., 2008). The NLN (2005) *Student Satisfaction and Self-Confidence in Learning Scale* was used by Jeffries and Rizzollo (2006) and reliability was tested using Cronbach's alpha for a satisfaction score of 0.94 and a self-confidence score of 0.87. Smith and Roehrs (2009) and Parker et al. (2011) also used the NLN (2005) *Student Satisfaction and Self-Confidence in Learning Scale* but did not test for reliability or validity with their data. Therefore, the NLN (2005) *Student Satisfaction and Self-Confidence in Learning Scale* needs to be further tested for reliability and validity.

Seropian et al. (2004) suggest that although the use of simulation products in nursing education has increased over the past few years, there has been little or no faculty instruction related to its implementation, use, and value to the nursing curriculum. Nursing faculty must address the challenge of educating and ensuring the competence of new graduate nurses and using simulators are often an integral part of this process. With the new high-fidelity computer-based human patient simulators, research is needed to investigate the best ways to integrate simulation across the nursing curriculum. The findings from this study indicated that while the students were satisfied with the simulation activity and they had a perceived increase in self-confidence, the simulation did not increase cognitive gains at a significant level from a pretest to a posttest written exam. The results of this study imply that simulation should not be used with the exclusive goal to increase knowledge but rather for students to increase their confidence and to demonstrate their ability to care for a patient at the bedside.

There are many different learning theories, and simulation in conjunction with Kolb’s Experiential Learning Cycle (Kolb, 1984) allows students that are kinesthetic learners to have active practice with what they are learning in the traditional classroom environment. This active practice can help reinforce the knowledge learned. Simulation should be used for students to practice assessment and fundamental skills, such as calling the physician, giving and receiving a bedside report, delegating, and prioritizing. Students are then able to receive immediate feedback from their instructors during the debriefing sessions. By allowing students to practice in the simulation environment, the students' confidence will increase. This researcher believes that simulation should be used in undergraduate nursing education; however, it is important to understand and delineate that simulation may not necessarily increase cognitive gains. Therefore, setting measurable goals and objectives for each simulation activity are imperative.

Limitations

There are important limitations to the study. One limitation is that this study used only one group of students from one university. Convenience sampling was used because the participants had received the prior respiratory lectures in their first and second semester of nursing school. Participants were not selected randomly for this study; however, they were randomized into groups to help control bias.

This study used a small sample size (N=43) and this could contribute to the lack of significance with the study results. The Solomon Four Research Design was an appropriate method to use with this small group of participants (McGahee, & Tingen, 2009). This study controlled confounding variables by using the Solomon four research design, using parallel exams, limiting the time frame of the study, assuring that all the participants in the experimental group received the same structured simulation experience conducted by the same research assistant, and using a validated HESI exam to measure content knowledge.

The time frame between the pretest, intervention, and posttest was very short, which was another limitation for this study. There is no surprise that no significance was found in increasing knowledge as the time was too short in the study, coupled with the small sample size. Lashley and Nehring (2009) found that it doesn't matter what form of simulation is used across time, students are satisfied with it, but its true quantitative value to learning is mixed. It would have been beneficial to give the students another posttest 2 to 4 weeks after the initial exam to see if the students truly had any cognitive gains.

Another limitation of the study was the NLN *Student Satisfaction and Self-Confidence in Learning Scale* (2005) survey. Reliability of the instrument in this research study was determined using Cronbach's alpha for a satisfaction score of 0.48 and a self-confidence score of 0.74. These scores are significantly lower when compared to the original Cronbach’s alpha scores of 0.94 for satisfaction and a self-confidence score of 0.87 (Jeffries & Rizzolo, 2006). Cronbach’s alpha for this study was low and, therefore, the reliability and validity of the scale needs to be further tested. The *Student Satisfaction and Self-Confidence in Learning Scale* (NLN, 2005) is a self-reported measurement of perception and allows the students to rank their levels of confidence and satisfaction with the simulation activity. Self-reported surveys have some limitations. The most serious issue is the validity and accuracy of the self-reporting (Polit & Beck, 2004).

The final limitation in this study is the inherent limitation of the simulator. The patient simulator had no visual, nonverbal communication such as grimaces or smiles. Certain kinds of assessments were not possible, such as a neurological examination, nor could the simulator elicit swelling or color changes (Kameg et al., 2010; Lasater, 2007; Ravert, 2008). These limitations are consistent with other studies in that using a manikin, there will be limitations with realism (Kameg et al., 2010; Lasater, 2007; Ravert, 2008).

Recommendations for Future Research

Additional research is needed to fully understand the role of simulation in nursing education. Future research recommendations include:

- The sample for this study consisted of 43 first-semester senior baccalaureate nursing students from one university. The researcher suggests repeating this study simultaneously at several universities across the Unites States to generate larger statistical power with a diverse group of students.
- Further research is needed to test the validity and reliability of the *Student Satisfaction and Self-Confidence in Learning Scale* (NLN, 2005).
- The researcher recommends the use of parallel pre- and posttests rather than identical pre- and posttests when attempting to determine if simulation increases cognitive gains with nursing students. The pretest exposes the student to the knowledge that is needed to demonstrate a passing score or grade. By using a posttest parallel exam it allows the identification of knowledge gains rather than test question identification and recall.
- Additional research is needed to fully understand if a formatted high fidelity simulation scenario can reflect an increase in cognitive gain or if test-taking ability is a limitation when attempting to compare different teaching approaches. Rather than focusing on the written tests, how can we develop appropriate application tests to determine competencies?
- Additional research using different assessments of knowledge could compare HFS skills score to the written test scores across the student's academic career in order to understand their relationship. Further studies may determine if our

current method of testing cognitive gains is appropriate for understanding knowledge gains in HFS. The ability to demonstrate when to administer a medication is different from the knowledge of how to administer a medication; cognitive gains in critical thinking about the need for medication have the potential to be measured during HFS.

Conclusions

The technologies available to nurse educators are becoming increasingly sophisticated. With the decreased availability of clinical sites (Commission on Education, 2007), nurse educators need to evaluate available technologies to understand how they can best prepare future nurses for practice. Members of nursing faculties believe that HFS is an effective learning and teaching method. However, researchers have questioned the best methods to measure the outcomes and effectiveness of simulation. Simulation affords students the opportunity to learn new information and problem-solve real-life situations in a safe and structured setting without the risk of harm to real patients. However, developing patient simulations and integrating them into the curriculum is time-and resource-intensive. Therefore, it is not surprising that many nursing educators have very limited time to use controlled research studies to evaluate these simulations. This researcher believes it is our duty as nurse educators to systematically evaluate new teaching efforts such as simulation to determine the effectiveness of this remarkable but expensive technology to ensure that we are providing the best learning opportunities possible for our nursing students. The study presented here used a rigorous quasi-experimental design to test the effects of simulation on knowledge gains in respiratory content, and satisfaction and self-confidence after the HFS experience. Thus, the results of this study will contribute to the body of knowledge around use of HFS in nursing education.

REFERENCES

Adamson, K.A., Kardong-Edgren, S. & Willhaus, J. (2013). An updated review of clinical simulation evaluation instruments. *Clinical Simulation in Nursing*, 9 (9): e393-405.

Andel, C., Davidow, S. L., Hollander, M., & Moreno, D. A. (2012). The economics of health care quality and medical errors. *Journal Of Health Care Finance*, *39*(1), 39-50.

Baker, C., Pulling, C., McGraw, R., Dagnone, J., Hopkins-Rosseel, D., & Medves, J. (2008). Simulation in interprofessional education for patient-centred collaborative care. *Journal Of Advanced Nursing*, *64*(4), 372-379. doi:10.1111/j.1365-2648.2008.04798.x

Bambini, D., Washburn, J., & Perkins, R. (2009). Outcomes of clinical simulation for novice nursing students: Communication, confidence, clinical judgment. *Nursing Education Perspectives*, *30*(2), 79-82.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior, 31*(2), 143-164.

Bezyack, M. (2007). Simulators help RNs hone skills. *Nursing Spectrum: 2007 Fall Critical Care Specialty Guide,* 68-70.

Billings, D., & Halstead, J. (2005). *Teaching in nursing: A guide for faculty*. St. Louis, MO: Elsevier.

Brackenreng, J. (2004). Issues in reflection and debriefing: How nurse educators structure experiential activities. *Nurse Education in Practice, 4* (4) (2004), pp. 264–270.

Bradley, P. (2006). The history of simulation in medical education and possible future directions. *Medical Education, 40*. 254-262. doi: 10.1111/j.1365-2929.2006.02394.x

Brannan, J., White, A., & Bezanson, J. (2008). Simulator effects on cognitive skills and confidence levels. *Journal of Nursing Education*, *47*(11), 495-500. doi:10.3928/01484834-20081101-01

Breland, S. (2011). Later life decision-making: *Experiential adult learning and successful aging.* Ph.D. dissertation, The University of Southern Mississippi, United States – Mississippi. Retrieved April 21, 2011, from Dissertations & Theses: Full Text. (Publication No. AAT 3416272).

Bremmer, M., Aduddell, K., Bennett, D., & VanGeest, J. (2006). The use of human patient simulators: best practices with novice nursing students. *Nurse Educator*, *31*(4), 170-174.

Brown, D., & Chronister, C. (2009). The effect of simulation learning on critical thinking and self-confidence when incorporated into an electrocardiogram nursing course. *Clinical Simulation in Nursing, 5(1),* e45- e52.

Cannon-Diehl, M.R. (2009). Simulation in healthcare and nursing: state of the science. *Critical Care Nursing Quarterly, 32*(2):128-136.

Cantrell, M.A. (2008). The importance of debriefing in clinical simulations. *Clinical Simulation in Nursing, 4* (2) (2008), pp. e19–e23.

Cardoza, M., & Hood, P. (2012). Comparative study of baccalaureate nursing student self-efficacy before and after simulation. *CIN: Computers, Informatics, Nursing*, *30* (3), 142-147.

Cioffi, J. (2000). Nurses' experiences of making decisions to call emergency assistance to their patients. *Journal Of Advanced Nursing*, *32*(1), 108-114. doi:10.1046/j.1365-2648.2000.01414.x

Commission on Education (2007). Nursing faculty speak up! *Tar Heel Nurse, 69*(2), 12.

Concise Oxford English Dictionary (2008). *The Oxford Dictionary of English* (2nd ed. revised). Accessed online at http://www.oxforddictionaries.com/us

Cooper, S., Kinsman, L., Buykx, P., McConnell-Henry, T., Endacott, R., & Scholes, J. (2010). Managing the deteriorating patient in a simulated environment: nursing students' knowledge, skill and situation awareness. *Journal of Clinical Nursing*, *19* (15-16), 2309-2318. doi:10.1111/j.1365-2702.2009.03164.x

Cordeau, M. (2010). The lived experience of clinical simulation of novice nursing students. *International Journal for Human Caring*, *14*(2), 9-15.

Dewey, J. (1933). *How we think*. Boston: Health.

DeYoung, S. (2003). *Teaching strategies for nurse educators*. Upper Saddle River, NJ: Prentice Hall Health.

Feingold, C.E., Calaluce, M., & Kallen, M.A. (2004). Computerized patient model and simulated clinical experiences: Evaluation with baccalaureate nursing students. *Journal of Nursing Education, 43,* 156-163.

Ferguson, L.M. (2006). *A grounded theory study of the new nurse's journey toward competence in clinical judgment*. Ph.D. dissertation, University of Alberta (Canada), Canada. Retrieved April 21, 2011, from Dissertations & Theses: Full Text.

Fowler, J. (2008). Experiential learning and its facilitation. *Nurse Education Today*, *28,* 427-433.

Gaba, D.M. (2002). Two examples of how to evaluate the impact of new approaches to teaching. *Anesthesiology, 96*(1):1-2.

Gaba, D., & DeAnda, A. (1988). A comprehensive anesthesia simulation environment: Recreating the operating room for research and training. *Anesthesiology,69*(3), 387-394.

Galbraith, M.W. & Cohen, N.H. (1995). *Mentoring: New strategies and challenges*. *New directions for adult and continuing education.* NO. 66. San Francisco, CA: Jossey-Bass

Galloway, S. (2009). Simulation techniques to bridge the gap between novice and competent healthcare professionals. *Online Journal of Issues in Nursing*, *14*(2), 1-9.

Garrett, B. M., MacPhee, M., & Jackson, C. (2011). Implementing high-fidelity simulation in Canada: Reflections on 3 years of practice. *Nurse Education Today*, *31*(7), 671-676. doi:10.1016/j.nedt.2010.10.028.

Gentry, J.W. (1990). What is experiential learning? *Guide to Business Gaming and Experiential Learning*. Retrieved from: http://sbaweb.wayne.edu/~absel/bkl/BG/BGa2.pdf

Griggs, R. (2002). *The effects of the use of a human patient simulator on the acquisition of nursing knowledge in undergraduate nursing students at a university in Illinois* (Unpublished doctoral dissertation). Southern Illinois University, Carbondale, Illinois.

Hartley, M. (2010). Experiential learning using Kolb's cycle of learning. *Journal of Nursing Education*, *49*(2), 120.

Hays, R., Jacobs, J., Prince, C. & Salas, E. (1992). Flight simulator training effectiveness: A meta-analysis. *Military Psychology*, *4*(2), 63-74.

Holdnak, B.J., Clemons, T. & Bushardt, S.C. (1990) Evaluating organization training with the Solomon four-group design: A field study in self-esteem training, *Journal of Managerial Psychology*, *5*,(5):25-31.

Hovancsek, M. T. (2007). Using simulation in nursing education. In P. R. Jeffries (Ed.), *Simulation in nursing education: From conceptualization to evaluation* (pp. 1-9). New York: National League for Nursing.

Howard, V. (2007). *A comparison of educational strategies for the acquisition of medical-*

surgical nursing knowledge and critical thinking skills: Human patient simulator vs. the interactive case study approach (Unpublished doctoral dissertation). University of Pittsburgh, Pittsburgh, PA.

Howard, V., Ross, C., Mitchell, A., & Nelson, G. (2010). Human patient simulators an interactive case studies: a comparative analysis of learning outcomes and student perceptions. *CIN: Computers, Informatics, Nursing*, *28*(1), 42-48. doi:10.1097/NCN.0b013e3181c04939

Huerta-Wong, J.E. & Schoech, R. (2010). Experiential learning and learning environments: The Case of Active Listening. *Journal of Social Work Education*, *46*:85-101.

Huck, S.W. (2012). *Reading statistics and research (6th ed).*Boston, MA: Pearson.

Hulsmeyer, B. S. (1994). *Nurses in transition: First year challenges*. Ed.D. dissertation, University of Kentucky, United States -- Kentucky. Retrieved April 21, 2011, from Dissertations & Theses: Full Text. (Publication No. AAT 9521161).

Institute of Medicine (IOM). (2000). *To err is human: Building a safer health system*. Washington, DC: National Academy Press.

Ironside, P., Jeffries, P., & Martin, A. (2009). Fostering patient safety competencies using multiple-patient simulation experiences. *Nursing Outlook*, *57*(6), 332-337. doi:10.1016/j.outlook.2009.07.010

Jefferies, P.R (2005) A framework for designing, implementing, and evaluating simulations used as teaching strategies in nursing. *Nursing Education Perspectives, 26,* 96-103.

Jefferies, P.R., & Rizzolo, M.A. (2006). *Designing and implementing models for the innovative use of simulation to teach nursing care of ill adults and children: A national, multi-site, multi-method study.* New York: National League for Nursing.

Kaddoura, M. (2010). New graduate nurses' perceptions of the effects of clinical simulation on their critical thinking, learning, and confidence. *Journal of Continuing Education in Nursing*, *41*(11), 506-516. doi:10.3928/00220124-20100701-02

Kameg, K., Howard, V., Clochesy, J., Mitchell, A., & Suresky, J. (2010). The impact of high fidelity human simulation on self-efficacy of communication skills. *Issues in Mental Health Nursing*, *31*(5), 315-323. doi:10.3109/01612840903420331

Kemeny, B., Boettcher, I.F., DeShon, R.P., & Stevens, A.B. (2006). Innovations community-based and long-term care. Using experiential techniques for staff development: liking, learning, and doing.. *Journal of Gerontological Nursing*, 8:9-14.

Kirkman, T. R. (2011). *The effectiveness of human patient simulation on baccalaureate nursing students' transfer of learning* (Doctoral dissertation, The University of Alabama). Retrieved from http://acumen.lib.ua.edu/content/u0015/0000001/0000746/u0015_0000001_0000746.pdf

Kolb, D.A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice Hall.

Kyrkjebø, J., Brattebø, G., & Smith-Strøm, H. (2006). Improving patient safety by using interprofessional simulation training in health professional education. *Journal of Interprofessional Care*, *20*(5), 507-516.

L-3 Communications. (2009). *Link simulation and training: Setting the standard for 80 years.* Retrieved 11/21/2013 from https://www.link.com/about/Pages/history.aspx

Lapkin, S., & Levett-Jones, T. (2011). A cost-utility analysis of medium vs. high-fidelity human patient simulation manikins in nursing education. *Journal of Clinical Nursing*, *20*(23/24), 3543-3552. doi:10.1111/j.1365-2702.2011.03843.x

Lasater, K. (2007). High-fidelity simulation and the development of clinical judgment: students' experiences. *Journal of Nursing Education*, *46*(6), 269-276.

Lashley, F. R., & Nehring, *W.* (*2009*). Clinical simulation and the need for evidence-based policy. In G. L. Dickson & L. Flynn (Eds.), *Nursing policy research* (pp.219-234). New York: Springer.

Leonard, B., Shuhaibar, E., & Chen, R. (2010). Nursing student perceptions of intraprofessional team education using high-fidelity simulation. *Journal of Nursing Education*, *49*(11), 628-631. doi:10.3928/01484834-20100730-06

Lewis, D. Y., & Ciak, A. D. (2011). The impact of a simulation lab experience for nursing students. *Nursing Education Perspectives, 32*(4), 256-258. doi:10.5480/1536-5026-32.4.256

Liaw, S., Scherpbier, A., Rethans, J., & Klainin-Yobas, P. (2012). Assessment for simulation learning outcomes: A comparison of knowledge and self-reported confidence with observed clinical performance. *Nurse Education Today*, *32*(6), e35-9. doi:10.1016/j.nedt.2011.10.006

Linden, L. L. (2008). *The effect of clinical simulation and traditional teaching versus traditional teaching alone on critical thinking of nursing students.* College of Saint Mary). *ProQuest Dissertations and Theses*, n/a. Retrieved from http://search.proquest.com.ezproxy.etsu.edu:2048/pqdtft/docview/304386457/141E12F607A29AA40B/1?accountid=10771

McGahee, T.W., & Tingen, M.S. (2009). The use of the solomon four-group design in nursing research. *Southern Online Journal of Nursing Research*. 9(1).

Morrison, A., & Catanzaro, A. (2010). High-fidelity simulation and emergency preparedness. *Public Health Nursing*, *27*(2), 164-173. doi:10.1111/j.1525-1446.2010.00838.x

Morrison, S., Adamson, C., Nibert, A., & Hsia, S. (2008) HESI: An overview of reliability and validity. *CIN: Computers, Informatics, Nursing*, *22*(4):220-226.

Morrison, S., Nibert, A., & Flick, J. (2006). *Critical thinking and test item writing (2nd ed.).* Houston, TX: Health Education Systems.

Mould, J., White, H., & Gallagher, R. (2011). Evaluation of a critical care simulation series for undergraduate nursing students. *Contemporary Nurse: A Journal for The Australian Nursing Profession*, *38*(1/2), 180-190. doi:10.5172/conu.2011.38.1-2.180

Moule, P., Wilford, A., Sales, R., & Lockyer, L. (2008). Student experiences and mentor views of the use of simulation for learning. *Nurse Education Today*, *28*(7), 790-797.

National League for Nursing. (2005, May 9). *Position statement: Transforming nursing education*. New York: Author.

Nehring, W., Ellis, W., & Lashley, F. R. (2001). Human patient simulators in nursing education: An overview. *Simulation and Gaming*, *32*, 194-204.

Nehring, W., & Lashley, F. (2004). Current use and opinions regarding human patient simulators in nursing education: an international survey. *Nursing Education Perspectives*, *25*(5), 244-248.

Nickerson, M. & Pollard, M. (2010). Mrs. Chase and her descendants: A historical view of simulation. *Creative Nursing*, *16*(3), 101-105.

Parker, R., McNeill, J. A., Pelayo, L., Goei, K. A., Howard, J., & Gunter, M. (2011). Pediatric clinical simulation: A pilot project. *Journal of Nursing Education*, *50*(2), 105-111. doi:10.3928/01484834-20101230-05

Pike, T., & O'Donnell, V. (2010). The impact of clinical simulation on learner self-efficacy in pre-registration nursing education. *Nurse Education Today*, *30*(5), 405-410. doi:10.1016/j.nedt.2009.09.013

Piscotty, R., Grobbel, C., & Huey-Ming, T. (2011). Integrating quality and safety competencies into undergraduate nursing using student-designed simulation. *Journal of Nursing Education*, *50*(8), 429-436. doi:10.3928/01484834-20110429-04

Polit, D. & Beck, C. (2007). *Nursing research: Generating and assessing evidence for nursing practice (8th Ed).* Philadelphia: Lippincott, Williams & Wilkins.

Pugsley, K.E., & Clayton, L.H. (2003). Traditional lecture of experiential learning: Changing student attitudes. *Journal of Nursing Education*, 520-523.

Radhakrishnan, K., Roche, J., & Cunningham, H. (2007). Measuring clinical practice parameters with human patient simulation: a pilot study. *International Journal of Nursing Education Scholarship*, *4*(1), 1-11. doi:10.2202/1548-923X.1307

Rauen, C.A. (2004). Simulation as a teaching strategy for nursing education and orientation in cardiac surgery. *Critical Care Nurse*, *24*:46-51.

Ravert, P. (2002). An integrative review of computer-based simulation in the education process. *CIN: Computers, Informatics, Nursing*, *20*(5), 203-208.

Ravert, P. (2008). Patient simulator sessions and critical thinking. *Journal of Nursing Education, 47*, 557-562.

Reese, C., Jeffries, P., & Engum, S. (2010). Learning together: using simulations to develop nursing and medical student collaboration. *Nursing Education Perspectives*, *31*(1), 33-37.

Retallick, M.S. (2010). A minds-on approach to experiential learning in agricultural education. *The Agricultural Education Magazine*, *83*:9-12.

Rhodes, M., & Curran, C. (2005). Use of the human patient simulator to teach clinical judgment skills in a baccalaureate nursing program. *CIN: Computers, Informatics, Nursing*, *23*(5), 256-264.

Ricketts, B., Merriman, C., & Stayt, L. (2012). Simulated practice learning in a preregistration programme. *British Journal of Nursing*, *21*(7), 435-440.

Rush, S., Firth, T., Burke, L., & Marks-Maran, D. (2012). Implementation and evaluation of peer assessment of clinical skills for first year student nurses. *Nurse Education in Practice*, *12*(4), 219-226. doi:10.1016/j.nepr.2012.01.014

Ryan, A., Goldberg, L., & Evans, J. (2010).Wise women: mentoring as relational learning in perinatal nursing practice. *Journal of Clinical Nursing*, *19*:183-91.

Scherer, K., Bruce, S,A., Graves, B.T., & Erdley, W.S. (2003). Acute care nurse practitioner education. *AACN Clinical Issues, 14*:331-341.

Sears, K., Goldsworthy, S., & Goodman, W. (2010). The relationship between simulation in nursing education and medication safety. *Journal of Nursing Education*, *49*(1), 52-55. doi:10.3928/01484834-20090918-12

Seropian, M.A., Brown, K., Gavilanes, J.S., & Driggers, B. (2004). Simulation; not just a manikin. *Journal of Nursing Education, 43*(4), 164–169.

Sewchuk, D.H. (2005). Experiential learning -- a theoretical framework for perioperative education. *AORN Journal*, *81*: 1311-6, 1318.

Shepherd, C., McCunnis, M., Brown, L., & Hair, M. (2010). Investigating the use of simulation as a teaching strategy. *Nursing Standard*, *24*(35), 42-48.

Shinnick, M., Woo, M., & Evangelista, L. S. (2012). Predictors of knowledge gains using simulation in the education of prelicensure nursing students. *Journal of Professional Nursing*, *28*(1), 41-47. doi:10.1016/j.profnurs.2011.06.006

Slager, D., Feenstra, C., Ayoola, A., Flikkema, M., & Bartels, S. (2011). Synthesis of nursing care across the life span using laboratory simulation: A senior-level course. *Journal of Nursing Education*, *50*(2), 95-98. doi:10.3928/01484834-20101029-08

Smith, S., & Roehrs, C. (2009). High-fidelity simulation: factors correlated with nursing student satisfaction and self-confidence. *Nursing Education Perspectives*, *30*(2), 74-78.

Spence-Laschinger, H.K. (1990). Review of experiential learning theory research in the nursing profession. *Journal of Advanced Nursing*: *15*: 985-993.

Tanner, C.A. (2006). Thinking like a nurse: A research-based model of clinical judgment in nursing. *Journal of Nursing Education, 45,* 204-211.

Ti, L., Chen, F., Tan, G., Tan, W., Tan, J., Shen, L., & Goy, R. (2009). Experiential learning improves the learning and retention of endotracheal intubation. *Medical Education*, *43*(7), 654-660. doi:10.1111/j.1365-2923.2009.03399.x

Van Engelenburg, Gijsbert. (1999). *Statistical analysis for the solomon four-group design. Research report 99-06*. Washington, DC: ERIC Clearinghouse.

Wagner, D., Bear, M., & Sander, J. (2009). Turning simulation into reality: Increasing student competence and confidence. *Journal of Nursing Education*, *48*(8), 465-467. doi:10.3928/01484834-20090518-07

Wagner, J., Liston, B., & Miller, J. (2011). Developing interprofessional communication skills. *Teaching & Learning In Nursing*, *6*(3), 97-101. doi:10.1016/j.teln.2010.12.003

Walton Braver, M.C., & Braver, S. (1988).Statistical treatment of the Solomon four-group design: a meta-analysis approach. *Psychological Bulletin*, *104* (1), 150-154.

Yuan, H. B., Williams, B. A., & Fang, J. B. (2012). The contribution of high-fidelity simulation to nursing students' confidence and competence: A systematic review. *International Nursing Review*, *59*(1), 26-33. doi:10.1111/j.1466-7657.2011.00964.x

Yuan, H., Williams, B. A., Fang, J., & Ye, Q. (2012). A systematic review of selected evidence on improving knowledge and skills through high-fidelity simulation. *Nurse Education Today*, *32*(3), 294-298. doi:10.1016/j.nedt.2011.07.010

APPENDICES

Appendix A

Tennessee Technological University IRB Approval

SWR 6/24/13

APPROVED

FORM A - RESEARCH REVIEW COVER SHEET

TTU Institution Review Board for the Protection of Human Subjects

Exempt Review: Use fill and print forms. Handwritten IRB applications will not be accepted. Submit 1 copy (**unstapled, single-sided**) of Form A, Attachment to Form A, Form C, certificate of completion for human subjects training (1 for each investigator), and, if used, copy of survey or interview questions, consent form (s), letter(s) of permission to conduct research. Documents should be in this order when submitted. If items with an asterisk on page two of Form A are marked, submit 1 copy of Form B as well. If PI is a student, the faculty advisor must sign Form C and page two of Form A; the departmental reviewer must sign in appropriate box on the top of page one of Form A. Once signed, send the IRB application to the Office of Research at Campus Box 5036 or deliver to Derryberry Hall Room 306.

Expedited or Full Review: Same as for Exempt above, however, Form B must also be included in lieu of Attachment A.

NOTE: Neither the Principal Investigator nor the Faculty Advisor can sign in the boxes below. The research described herein is in compliance with ONE of the three available criteria below:		
Certification of Exempt Research	**Requires Expedited Review**	**Requires Full Review**
Signed by Dept. Review, Committee Chair or Designee	Signed by Dept. Review, Committee Chair or Designee	
Name: Bedelia H. Russell	Name:	
Signature: Bedelia H Russell	Signature:	
Date: 6/24/2013	Date:	

Subject recruitment and data collection may not be initiated prior to formal written approval (emailed pdf with approval stamp) from the IRB on Human Subjects.

RECEIVED JUN 24 2013 Research & Grad Studies

Project Title: Effects of High Fidelity Simulation on Knowledge Acquisition, Self-Confidence, and Satisfaction with Baccalaureate Nursing Students Using the Solomon-Four Research Design

Principal Investigator (PI): Rachel M. Hall Faculty ✓ Student ☐ Other ☐

PI's Dept: Nursing PI's Email: rmhall@tntech.edu

If PI is a student:

a. Attach a copy of the certificate of completion from the research ethics training course, Section 6, Human Subjects.
b. Student's Faculty Advisor for this project: ______
c. Student's Faculty Advisor's email: ______

Co-Investigators (If needed, list additional investigators on separate sheet)

1. ______ Faculty ___ Student ___ Other ___ Dept. ______
2. ______ Faculty ___ Student ___ Other ___ Dept. ______
3. ______ Faculty ___ Student ___ Other ___ Dept. ______
4. ______ Faculty ___ Student ___ Other ___ Dept. ______
5. ______ Faculty ___ Student ___ Other ___ Dept. ______
6. ______ Faculty ___ Student ___ Other ___ Dept. ______

Projected Dates of Study Start: Upon Approval or August 26, 2013 End: September 6, 2013

Probable Review Category Exempt ✓ Expedited ___ Full ___

If Exempt, Specify Category for Exempt Research (Check One): 1 ✓ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___

Funding Status Not Funded ___ Funded ✓ Funding Pending ___

Funding Source WH-SON TTU Proposal # or Index # ______

FORM A – Page 1 of 2

Appendix B

Clinical Simulation Laboratory Confidentiality Agreement

Tennessee Tech
UNIVERSITY
Whitson-Hester School of Nursing

Clinical Simulation Laboratory
Confidentiality Agreement

As a nursing student at Tennessee Tech University I will participate in clinical laboratory simulations. I understand that the content of these simulations is to be kept confidential to maintain the integrity of the learning experience for me and my fellow students. I also understand that in working side by side with my fellow students, I will be witnessing their performance. It would be unethical for me to share information regarding student performance with persons outside the laboratory.

I acknowledge that I fully understand that the unauthorized release, inappropriate exchange, or mishandling of confidential information is prohibited, and serious consequences may occur if I violate this agreement. I will exemplify the Tennessee Tech University School of Nursing values of integrity, human dignity, and confidentiality.

Student signature____

Date ____

Appendix C

East Tennessee State University IRB Approval

East Tennessee State University
Office for the Protection of Human Research Subjects Box 70565 Johnson City, Tennessee 37614-1707
Phone: (423) 439-6053 Fax: (423) 439-6060

IRB APPROVAL – Initial Exempt

July 16, 2013

Rachel Hall

RE: Effects of High Fidelity Simulation on Knowledge Acquisition, Self-Confidence, and Satisfaction with Baccalaureate Nursing Students Using the Solomon-Four Research Design
IRB#: 0713.6e
ORSPA#: ,

On **July 16, 2013**, an exempt approval was granted in accordance with 45 CFR 46. 101(b)(Category 1 46.101 (b)(1)). It is understood this project will be conducted in full accordance with all applicable sections of the IRB Policies. No continuing review is required. The exempt approval will be reported to the convened board on the next agenda.

- New exempt submission, Tennessee Tech letter of support, Tennessee Tech IRB letter of exempt approval, CV, Simulation Lab Confidentiality form, Survey, Script

Projects involving Mountain States Health Alliance must also be approved by MSHA following IRB approval prior to initiating the study.

Unanticipated Problems Involving Risks to Subjects or Others must be reported to the IRB (and VA R&D if applicable) within 10 working days.

Proposed changes in approved research cannot be initiated without IRB review and approval. The only exception to this rule is that a change can be made prior to IRB approval when necessary to eliminate apparent immediate hazards to the research subjects [21 CFR 56.108 (a)(4)]. In such a case, the IRB must be promptly informed of the change following its implementation (within 10 working days) on Form 109 (www.etsu.edu/irb). The IRB will review the change to determine that it is consistent with ensuring the subject's continued welfare.

Sincerely,
George Youngberg, M.D., Chair
ETSU/VA Medical IRB

Cc:

Appendix D

Demographic Survey

Circle One

Yes, I agree to participate in this research activity

No, I do not wish to participate in this research activity

If you agree to participate, please complete the bottom section:

Demographic Information

Age_____

Gender (circle one) **Male** **Female**

Traditional or **non-traditional student** (circle one)

Previous work or experience in the healthcare setting (circle one) **Yes** **or** **No**

5 Digit code: _______________

Signature:__________________________________ Date:_____________________

Appendix E

Student Satisfaction and Self-Confidence in Learning Scale

Student Satisfaction and Self-Confidence in Learning

Instructions: This questionnaire is a series of statements about your personal attitudes about the instruction you receive during your simulation activity. Each item represents a statement about your attitude toward your satisfaction with learning and self-confidence in obtaining the instruction you need. There are no right or wrong answers. You will probably agree with some of the statements and disagree with others. Please indicate your own personal feelings about each statement below by marking the numbers that best describe your attitude or beliefs. Please be truthful and describe your attitude as it really is, not what you would like for it to be. This is anonymous with the results being compiled as a group, not individually.

Mark:
1 = STRONGLY DISAGREE with the statement
2 = DISAGREE with the statement
3 = UNDECIDED - you neither agree or disagree with the statement
4 = AGREE with the statement
5 = STRONGLY AGREE with the statement

Satisfaction with Current Learning	**SD**	**D**	**UN**	**A**	**SA**
1. The teaching methods used in this simulation were helpful and effective.	○ 1	○ 2	○ 3	○ 4	○ 5
2. The simulation provided me with a variety of learning materials and activities to promote my learning the medical surgical curriculum.	○ 1	○ 2	○ 3	○ 4	○ 5
3. I enjoyed how my instructor taught the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
4. The teaching materials used in this simulation were motivating and helped me to learn.	○ 1	○ 2	○ 3	○ 4	○ 5
5. The way my instructor(s) taught the simulation was suitable to the way I learn.	○ 1	○ 2	○ 3	○ 4	○ 5
Self-confidence in Learning	**SD**	**D**	**UN**	**A**	**SA**
6. I am confident that I am mastering the content of the simulation activity that my instructors presented to me.	○ 1	○ 2	○ 3	○ 4	○ 5
7. I am confident that this simulation covered critical content necessary for the mastery of medical surgical curriculum.	○ 1	○ 2	○ 3	○ 4	○ 5
8. I am confident that I am developing the skills and obtaining the required knowledge from this simulation to perform necessary tasks in a clinical setting	○ 1	○ 2	○ 3	○ 4	○ 5
9. My instructors used helpful resources to teach the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
10. It is my responsibility as the student to learn what I need to know from this simulation activity.	○ 1	○ 2	○ 3	○ 4	○ 5
11. I know how to get help when I do not understand the concepts covered in the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
12. I know how to use simulation activities to learn critical aspects of these skills.	○ 1	○ 2	○ 3	○ 4	○ 5
13. It is the instructor's responsibility to tell me what I need to learn of the simulation activity content during class time..	○ 1	○ 2	○ 3	○ 4	○ 5

Revised December 22, 2004

VITA

RACHEL MATTSON HALL

Personal Data:	Date of Birth: October 10, 1977 Place of Birth: Cookeville, TN Marital Status: Married
Education:	PhD. Nursing, East Tennessee State University, Johnson City, TN 2013 M.S.N. Advanced Practice Nurse, Vanderbilt University, Nashville, TN 2005 M.S. Health, Middle Tennessee State University, Murfreesboro, TN 2001 B.S. Exercise Physiology, Lipscomb University, Nashville, TN 1999 Public Schools, Cookeville, TN
Professional Experience:	Assistant Professor, Tennessee Technological University; Cookeville, TN, 2008-present Advanced Practice Nurse, Satellite Med Urgent Care Clinic, Cookeville, TN, 2008-present Registered Nurse, Travel Nursing across the United States, 2005-2008

Presentations:

November 2013	Sigma Theta Tau "Rising Star" to represent ETSU CON presenting "Determining Knowledge Acquisition in Nursing Students Utilizing the Solomon-Four Research Design with High Fidelity Simulation" Poster Presentation
May 2012	Quality & Safety Education for Nurses National Forum, Tucson, AZ. Name that Safety Issue: Recognizing Lapses in Safe Care Podium Presentation
February 2011	Human Patient Simulation Network Conference, Tampa Florida Bringing Simulation into the Classroom: An Interactive Experience Using Simulation as a Clinical Capstone Experience Podium Presentation
Fall 2011	Belmont Simulation Conference, Nashville, TN Bringing Simulation into the Classroom: An Interactive Experience Podium Presentation
Fall 2010	Belmont Simulation Conference, Nashville, TN Clinical Learning in the Surgical Setting through Simulation Podium Presentation Using Simulation as a Clinical Capstone Experience Podium Presentation

Honors and Awards:	Vanderbilt Simulation Fellowship 2010-2012 Anne Floyd Koci Faculty Excellence in Research Award 2013