EFFECT OF INTEGRATED HIGH-FIDELITY SIMULATION IN KNOWLEDGE, PERCEIVED SELF-EFFICACY AND SATISFACTION OF NURSE PRACTITIONER STUDENTS IN NEWBORN ASSESSMENT

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN HEALTH STUDIES

IN THE GRADUATE SCHOOL OF THE

TEXAS WOMAN'S UNIVERSITY

COLLEGE OF HEALTH SCIENCES

BY

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MAY 2007

TEXAS WOMAN'S UNIVERSITY
DENTON, TEXAS

April 3, 2007

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I am submitting herewith a dissertation written by Mindi Anderson entitled "Effect of Integrated High-Fidelity Simulation in Knowledge, Perceived Self-Efficacy and Satisfaction of Nurse Practitioner Students in Newborn Assessment." I have examined this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy with a major in Health Studies.

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ACKNOWLEDGEMENTS

I want to thank so many people without whom this dissertation would not have been possible. I would first like to thank my dissertation co-chairs, Dr. Jimmy Ishee and Dr. Anna Love, for reading my dissertation and giving me valuable feedback. I would also like to thank my other committee members, Dr. Jody Ooman-Early and Dr. Kristen Wiginton, for all of their support and encouragement. A special thank-you also goes the Center for Nursing Research at UT Arlington for help with making teleforms.

Next, I would like to thank all of my friends and family, including my sister-in-laws, brother-in-law, and brother. I appreciate the support and love, even when I did not have time to "go out and play." I want to thank all of the friends I met during the program, specifically Shelley, Leslie, Shalah, Lynne, and Jason, although there are many more. I also want to give a special thank-you to my mentor and friend, Dr. Judy Leflore, who helped me understand and love the research process. I also want to thank my mother-in-law, Leslie, my father-in-law, John, and my mother, Nancy, who helped watch my children while I worked on schoolwork. Additionally, I want to thank my Nana for helping fund my education, and encouraging me to reach for the stars.

Finally, I want to thank my wonderful husband, Tim, and my beautiful children, Chase and Tiffany, for encouraging me and understanding when I needed to work on assignments for school. I appreciate all they did to help at home with laundry, cleaning, and cooking. I love and appreciate you more than you can imagine.

ABSTRACT

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EFFECT OF INTEGRATED HIGH-FIDELITY SIMULATION IN KNOWLEDGE, PERCEIVED SELF-EFFICACY AND SATISFACTION OF NURSE PRACTITIONER STUDENTS IN NEWBORN ASSESSMENT

MAY 2007

This quasi-experimental non equivalent control-group research study compared knowledge, perceived self-efficacy, and satisfaction between nurse practitioner (NP) students enrolled an advanced health assessment course who received traditional didactic lecture (n = 23) compared with NP students who received lecture integrated with a high-fidelity simulator for the newborn assessment content (n = 49). Additionally, the principles regarding knowledge, self-efficacy, and satisfaction, were related to the present body of knowledge in the field of health education. The following instruments were used: Newborn Assessment Knowledge Tool regarding newborn assessment, at 3 time points: before lecture, after lecture, and 4 weeks later; Perceived Self-Efficacy Tool for Newborn Assessment, regarding how confident the student felt about performing a newborn assessment at the same 3 times; and a Educational Session Satisfaction Tool post-lecture. Data analysis included: descriptive statistics, chi-square, t-tests, MANCOVA, repeated measures, and Pearson's correlation. Statistically significant differences were observed between the knowledge pre-test and post-test 1 ($p < .001$) and between the knowledge pre-test and post-test 2 ($p < .001$), but not between the knowledge post-test 1 and post-test 2 ($p = .59$). When controlling for confounding variables, there were statistically significant differences in knowledge scores on both the knowledge pre-test ($p = .04$) and post-test 1 ($p < .001$) between the groups. There were statistically significant differences within each group between the self-efficacy pre-test and post-test 1 ($p < .001$) and between the self-efficacy pre-test and post-test 2 ($p < .001$), but not between self-efficacy post-test 1 and post-test 2 ($p = 0.9$). Between the groups, there were no significant differences in perceived self-efficacy scores before lecture (pre-test), after lecture (post-test #1), or at the 4 week follow-up (post-test #2). No statistically significant differences were noted between the groups on satisfaction ($p = .27$). High-fidelity simulation integrated within lecture content may be used to help bridge theory and practice, however, demonstration alone may not be enough. Additionally, integration of simulation into lecture takes additional lecture time. Further research into this method of instruction needs to be explored for those in health education professions.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

According to Lowenstein and Bradshaw (2001), "creating an effective learning environment is not an easy task in today's world, and is even more complex in nursing education" (p. 1). Some of the reasons for this include: the diversity of the students, including age and experience; and different learning styles and needs. Therefore, different teaching strategies are necessary (Lowenstein & Bradshaw).

Simulation is a teaching strategy currently being utilized in medical education (Dunn, 2004b), including that of nurse practitioners. It has been postulated that simulation aids in active learning (Cioffi, 2001; Fletcher, 1995; Hawke, 2002; Hravnak, Tuite, & Baldisseri, 2005; Jeffries, 2005a; Johnson, Zerwic, & Theis, 1999; Lupien & George-Gay, 2001; Medley & Horne, 2005; Morton, 1997; Rauen, 2001), increases critical thinking (Cioffi; Hawke; Hravnak et al.; Jeffries, 2005a; Medley & Horne; Rauen), and allows the student to learn safely without compromising the patient (Cioffi; Cooper, 2004; Feingold, Calaluce, & Kallen, 2004; Flanagan, Nestel, & Joseph, 2004; Fletcher; Hravnak et al.; Jeffries, 2005a; Koerner, 2003; Maran & Glavin, 2003; Medley & Horne; Morgan, Cleave-Hogg, DeSousa, & Lam-McCulloch, 2006; Morton; Nehring, Lashley, & Ellis, 2002; Rauen).

The use of simulation is being researched as a teaching strategy within health care education. Often, simulation is an event which replicates the clinical environment

(Rauen, 2001), and this is often done after the students receive lecture content. No research studies were found that evaluated the use of simulators integrated within the lecture content. According to Murray (2004), simulators can be used in the "look here, see this" approach in which "trainees are shown the physiological changes associated with a known disease" (p. 30).

For nurses, assessment is considered the initial and most crucial component of the nursing process (Weber & Kelley, 2003); therefore, the skills learned within a physical assessment course profoundly affect nursing practice (Mahoney, 2002). According to Mahoney, courses in advanced health assessment skills within advanced practice nurse programs, such as those for nurse practitioners, should build upon skills learned in basic undergraduate health assessment courses. At the completion of the advanced health assessment course, "participants should have the knowledge and skills needed to demonstrate sound critical thinking and decision making" (Mahoney, 2002, p. 85).

Statement of the Purpose

The purpose of this study was to compare knowledge, perceived self-efficacy, and satisfaction between nurse practitioner (NP) students enrolled in N5418 Advanced Health Assessment in Nursing Practice at the University of Texas at Arlington School of Nursing (UTASON) who received traditional didactic lecture compared with those NP students who received lecture integrated with a high-fidelity simulator for the newborn assessment content. A secondary purpose was to apply the principles regarding knowledge, self-efficacy, and satisfaction, and relate them to the present body of knowledge in the field of health education in order to improve health outcomes.

Hypotheses

The following null hypotheses were examined in this study:

1. There will be no statistically significant difference in knowledge scores concerning newborn assessment, as measured by the Newborn Assessment Knowledge Tool, before lecture (pre-test), after lecture (post-test #1), and at the four week follow-up (post-test #2) within and between NP students who received traditional didactic lecture and NP students who received lecture integrated with a high-fidelity simulator.
2. There will be no statistically significant difference in perceived self-efficacy scores, as measured by the Perceived Self-Efficacy Tool for Newborn Assessment, before lecture (pre-test), after lecture (post-test #1), and at the four week follow-up (post-test #2) within and between NP students who received traditional didactic lecture and NP students who received lecture integrated with a high-fidelity simulator.
3. There will be no statistically significant difference in satisfaction scores, as measured by the Educational Session Satisfaction Survey, between NP students who received traditional didactic lecture and NP students who received lecture integrated with a high-fidelity simulator.

Delimitations

Only the students involved in the Advanced Health Assessment course at the School of Nursing during fall, 2006, and spring, 2007, were eligible to participate in the study. Additionally, only one institutional setting was used. The time of instrumentation was also a delimitation. In the fall, students received the lecture and measurement tools toward the end of the semester. The spring group received the lecture and measurement tools in the beginning of the semester. However, no other content regarding newborn assessment was given during either semester. Changes in measurement from pre-test to post-tests were decreased by using the same unaltered measures before and after lecture (Newborn Assessment Knowledge Tool and Perceived Self-Efficacy Tool for Newborn Assessment) (McDermott & Sarvela, 1999).

Limitations

Due to the sample being one of convenience, the generalizability of the study is limited. Typical enrollment for the course varies per semester (L. Penuel, personal communication, September 19, 2006). In the fall, a total of 25 students were enrolled in the course (A. Schram, personal communication, January 3, 2007). In the spring, 51 students were enrolled (L. Taylor, personal communication, January 25, 2007). Therefore, there were an unequal number of participants per group. Another limitation was that the Perceived Self-Efficacy Tool for Newborn Assessment and the Educational Session Satisfaction Survey were self-report questionnaires.

Assumptions

It was assumed that all students enrolled in the study were able to read, write, and understand English. It was also assumed that all students attended the assigned lecture, and that they read the appropriate content on newborn assessment prior to lecture as a standard requirement set by the lead teacher of the course. Another assumption was that students were attentive and listened while the lecture content was given. Finally, it was assumed that the students read the questionnaires thoroughly, and that they answered honestly.

Definition of Terms

The following terms were defined as the following in the study:

- *Traditional Didactic Lecture*- Lecture by an instructor familiar with the content on newborn assessment. PowerPoint slides and images were shown during lecture, which were available to students in handout form via WebCT. No other in class activities were utilized for this content. The lecture lasted a total of two hours.
- *Lecture Integrated with a High-Fidelity Simulator*- Lecture by an instructor familiar with the content on newborn assessment. PowerPoint slides and images were shown during lecture, which were available to students in handout form via WebCT and were the same ones used in the traditional didactic lecture. In addition, where appropriate, the instructor demonstrated assessment techniques, such as assessment of the fontanel, heart sounds, and lung sounds, on a high-fidelity infant simulator during the didactic content. No structured time with the high-fidelity simulator with students was given. The lecture lasted a total of two hours.
- *Simulation*- Defined as ". . . artificial replication of sufficient elements of a real-world domain to achieve a stated goal-and typically includes training individuals and teams to deal with the domain, or testing the capacity of personnel to work in the domain" (Gaba, 2004, p. 7). It may include different

strategies such as "... role plays, games, and computer programs; it encourages the student to become an active participant, to think more deeply and to become a part of the educational environment" (Conrick, Dunne, & Skinner, 1996, p. 1). In other words, simulation is replicating something seen in the real-world in order to achieve a goal. Simulation includes a variety of methods.

- *Patient Simulator*- Defined as "... a full-body computerized mannequin that provides real-time physiological and pharmacological measurements programmed to immediately reflect persons of different ages, both genders, with a variety of health conditions" (Nehring et al., 2002, p. 131).
- *Fidelity*- In regards to simulation, "... how closely it replicates the selected domain and is determined by the number of elements that are replicated as well as the error between each element and the real world" (Gaba, 2004, p. 8). Therefore, the higher the fidelity, the more closely it resembles a human.
- *Static mannequin*- Full body mannequin that is not computerized.
- *Standardized patient (SP)*- "An SP is a person trained to portray a patient scenario, or an actual patient using their own history and physical exam findings, for the instruction, assessment, or practice of communication and/or examining skills of a health care provider" (Gliva-McConvey, 2006).

- *Self-efficacy*- Defined as "... the conviction that one can successfully execute the behavior required to produce the outcomes" needed in a given situation (Bandura, 1977, p. 79)

Importance of the Study

Simulation, in the medical field, has been called the "wave of the future" (Cohen, 1999, p. 557). Results of this study have the potential to influence the way NP students are educated and how lecture content is given. If shown to increase knowledge, self-efficacy, and satisfaction over traditional lecture, training NP students using simulation integrated within lecture may be supported by faculty. This method of instruction, which utilizes constructs from health education theory, such as modeling (Bandura, 1977, 1986), and active learning (Knowles, 1970, 1973, 1978, 1984), can also be applied to teaching health educators.

CHAPTER II

LITERATURE REVIEW

This chapter will review the literature related to simulation, in general, and patient simulation more specifically. The following major topics will be discussed: overview, learning and education, and simulation effects. The review of literature will then be summarized.

Overview

History of Simulation

According to Gaba (2004), simulation has been around for quite some time and may date back to usage in "the rehearsal of hunting activities and warfare. . . " (p. 7). Simulation has been used in a variety of industries, such as the military, aviation, and even nuclear power (Gaba; Lupien & George-Gay, 2001). In the medical field, patient simulators, sometimes referred to as mannequin-based patient simulators, have been developed (Gaba). Patient simulators can be defined as ". . . a system that presents a large set of features and behaviors of a real patient's physiology and pharmacology in a fully interactive way, typically embedded in a relatively complete re-creation of a clinical work environment" (Gaba, 2004, p. 7-8). Other synonyms for mannequin-based simulators include: ". . . full-scale simulator, hands-on simulator, realistic simulator, and high-fidelity simulator" (Gaba, 2004, p. 8). Cioffi (2001) also uses the term integrated simulator.

The first patient simulator, known as Sim One, was built for use in training of anesthetists in the late 1960s (Gaba, 2004; Good, 2003). Use of simulation in anesthesia was originally done to improve education and also to be able to study performance (Lupien & George-Gay, 2001). This original technology eventually disappeared, but was later reinvented in the 1980s (Gaba; Good). During this time period, several different patient simulators emerged (Gaba). Similar to medicine, high-fidelity simulators in nursing were first used by nurse anesthetists (Lupien & George-Gay, 2001). According to Lupien and George-Gay, simulation has now expanded to other nursing areas such as critical and acute care.

Today, patient simulators are applicable in a variety of health care fields (Gaba, 2004). Patient simulators are now used within health care for education and training (Gaba), including technical skills (Comer, 2005); assessment of performance; research; and testing of clinical equipment (Gaba). The Accreditation Council for Graduate Medical Education (ACGME) has even endorsed high-fidelity simulators as a valid educational tool for both teaching and assessment of residents (Wang & Vozenilek, 2005). In nursing, patient simulators are often used to teach nurses how to deal with patients experiencing critical events (Long, 2005). They are also used for both formative and summative evaluation in a variety of nursing programs, including both undergraduate and graduate (Nehring et al., 2002). Use of patient simulators within these health care domains is increasing (Good, 2003).

Types of Simulation

In addition to high-fidelity simulators, simulation may include different strategies such as ". . . role plays, games, and computer programs; it encourages the student to become an active participant, to think more deeply and to become a part of the educational environment" (Conrick et al., 1996, p. 1). Static mannequins (Long, 2005; Ravert, 2002), part-task trainers (Cioffi, 2001; Cooper & Taqueti, 2004; Gaba, 2004; Jeffries, 2005a; Long), virtual reality (Cioffi; Gaba; Long), and haptic devices (Long) are also considered simulation. Task-trainers are used to simulate a particular skill or procedure (Cooper & Taqueti; Gaba; Jeffries, 2005a). Case studies are another type of simulation used in nursing, which allows students to learn how to solve clinical problems within a classroom setting (Vandrey & Whitman, 2001). Henneman and Cunningham (2005) state that one of the problems with simulations, such as case studies, is students are not able to interact with other health care providers, thus, they do not really mimic today's complex health care arena. Simulated patients or "actors" are also often used, particularly to teach skills related to communication (Cioffi). Often, simulated patients are called standardized patients.

Simulators versus Simulation

The terms simulators and simulation are often confused. Cooper and Taqueti (2004) discuss that a "'simulator' refers to a physical object or representation of the full or part task to be replicated" (p. i11). On the other hand, simulation refers to applying the use of simulation for either the purpose of education or training (Cooper & Taqueti) or reproducing a situation that is seen in real-life (Jeffries, 2005a; Medley & Horne, 2005).

Simulations are used for a variety of reasons including demonstration of procedures and learning of skills, such as "decision-making and critical thinking" (Jeffries, 2005a, p. 97). Additionally, simulations teach us something about the real world (Prensky, 2002).

Patient Simulators

According to Good (2003), patient simulators today are becoming increasingly realistic. "Most simulators use a complete manikin that includes head, neck, trunk, pelvis, and limbs, though a few use only an airway intubation manikin comprising head, neck and upper thorax" (Good, 2003, p. 15). Other features may include: pulses that can be felt (Cioffi, 2001; Fletcher, 1995; Good; Medley & Horne, 2005; Nehring et al., 2002; Scherer, Bruce, Graves, & Erdley, 2003); normal and abnormal heart and lung sounds (Cioffi; Fletcher; Good; Hawke, 2002; Nehring et al.; Scherer et al.; Vandrey & Whitman, 2001); breathing with the rising and falling of the mannequin chest (Fletcher; Good; Medley & Horne; Vandrey & Whitman); realistic airway (Good); multiple output displays that students can visualize on a monitor, such as ECG, blood pressure (Cioffi; Fletcher; Good; Nehring et al.; Vandrey & Whitman), and pulse oximetry (Cioffi; Fletcher; Good; Medley & Horne; Nehring et al.; Vandrey & Whitman). Many of the mannequins allow for and may respond to interventions (Hawke), such as ventilation/intubation (Cioffi; Good; Hawke; Nehring et al.; Scherer et al.; Vandrey & Whitman), cricothyrotomy (Good), medications (Cioffi; Good; Medley & Horne; Vandrey & Whitman), and defibrillation (Good; Vandrey & Whitman). Some patient simulators can even blink with pupils that constrict (Cioffi; Hawke; Nehring et al.; Vandrey & Whitman) and dilate (Cioffi; Hawke; Vandrey & Whitman), while others can be programmed to speak (Cioffi; Medley & Horne; Vandrey & Whitman). Mannequins come in both adult and pediatric forms (Nehring et al.) They can also simulate both genders (Nehring et al.) with use of interchangeable parts and moulage.

Simulation and Patient Safety

One vision for the application of patient simulation is to increase patient safety (Cooper, 2004). This is needed as medical errors are on the rise. According to the Institute of Medicine (IOM), it is estimated that medical errors account for up to 98,000 patient deaths annually (Kohn, Corrigan, & Donaldson, 2000). Practicing of emergency situations and teamwork training are two ways to use simulation to increase safety (Cooper; Fiedor, 2004). Interdisciplinary teams can also be trained with the use of patient simulators (Good, 2003; Long, 2005).

According to Vozenilek, Huff, Reznek, and Gordon (2004), in medicine, "the time honored concept of 'see one, do one, teach one' is no longer tenable" (p. 1149). With high-fidelity simulation, as previously discussed, the student can learn safely without compromising the patient (Cioffi, 2001; Cooper, 2004; Feingold et al., 2004; Flanagan et al., 2004; Fletcher, 1995; Hravnak et. al., 2005; Jeffries, 2005a; Koerner, 2003; Maran & Glavin, 2003; Medley & Horne, 2005; Morgan et al., 2006; Morton, 1997; Nehring et al., 2002; Rauen, 2001). Students are allowed to practice procedures before using them on an actual patient (Cooper). Simulation also provides a consistent way to teach to all students in order to help them meet defined learning objectives (Larew, Lessans, Spunt, Foster, & Covington, 2006; Medley & Horne), as well as, provide a consistent curriculum (Fletcher).

Vandrey and Whitman (2001) stated that there is an increased need for experienced nurses, specifically critical care nurses. The reasons for this are that patients have higher acuities and shorter hospital stays. Schools of nursing must help students learn how to critically think and make appropriate clinical decisions without putting patients at risk (Vandrey & Whitman). Using high-fidelity simulators is a teaching strategy which allows the student to learn safely without compromising the patient (Cioffi, 2001; Cooper, 2004; Feingold et al., 2004; Flanagan et al., 2004; Fletcher, 1995; Hravnak et. al., 2005; Jeffries, 2005a; Koerner, 2003; Maran & Glavin, 2003; Medley & Horne, 2005; Morgan et al., 2006; Morton, 1997; Nehring et al., 2002; Rauen, 2001).

Change has been recommended for schools of nursing and those who teach in them (Maddox, Wakefield, & Bull, 2001). According to Maddox et al. (2001):

> change includes exposure to content and experience ranging from interdisciplinary education in situations that simulate day-to-day realities of patient care and that provide experience among the health care team in communicating and planning for routine patient care situations to those in which system failures and emergencies occur and in which team members must learn to use their collective knowledge and skill to problem solve interventions after an error(s) has produced a compromised situation. (p. 12).

Patient simulators, thus, give schools of nursing one unique way to simulate real life. However, training with simulation must be done appropriately in order to be effective (Salas, Wilson, Burke, & Priest, 2005).

Medical Competence

The health care environment of today is changing (Ravert, 2002). Due to this, educators must make sure their students are competent, and this can often be a difficult task (Ravert; Morton, 1997). Miller (1990) has formulated a framework for clinical assessment for medical professionals, which is shaped in the form of a pyramid. This model is used to describe medical competence (Schuwirth & Vleuten, 2003). On the bottom of the pyramid is knowledge, or "know" (Miller). This means that the person, such as a student, knows something, and this is often measured by an objective test. The second layer is knows how or "competence." The student or graduate must know how to apply the knowledge they have gained. The third layer is shows how or "performance." "The evaluation of this *performance* objective represents a challenge now being addressed most aggressively, even though many clinical teachers still claim that they make such judgments about student performance through encounters on the wards or in ambulatory settings" (Miller, 1990, p. S63). The top layer is referred to as does or "action." According to Miller, this is the component that is the hardest to measure. Schuwirth and van der Vleuten (2003) state "paper-based or computer-based simulations test at the level of the 'knows how' layer, assessments with simulated patients or manikins test at the level of the 'shows how' layer and assessment in health care practice tests performance at the 'does' level (e.g. by using simulated patients)" (p. 66).

Simulation Use

When should simulation be introduced? According to Cooper (2004), simulation should be integrated into health care education regularly and from the very beginning, such as with the learning of basic skills. Additionally, Lupien and George-Gay (2001) discussed that simulation is appropriate for a variety of clinical situations and for all students. It can be before, during, or even replace some of the actual clinical experience (Lupien & George-Gay). Patient simulation can be used not only for basic skills, but also for advanced clinical skills (Fletcher, 1995; Good, 2003). This can be done by varying the specific scenario (Fletcher). Good discusses that patient simulators can help all levels of students and even practicing health care providers not only to recognize, but also to treat, complex patient problems. Patient simulation can be used for learning simple to complex patient problems (Jeffries, 2005a; Medley & Horne, 2005; Nehring et al., 2002). Cioffi (2001) agreed that simulation can be used for simple to complex assessment and decision making. Thus, integration of simulation into the curriculum for students of all levels should take place (Maran & Glavin, 2003).

Components of Simulation

Several authors have tried to describe the components needed in the various stages of simulation: design, implementation, and evaluation. Four key components to learning with simulation were described by Kneebone (2005): "... gaining and retraining technical proficiency, the place of expert assistance in task-based learning, learning within a professional context, and the affective component of learning" (p. 549). In order to be effective, simulation should support and come together with clinical practice (Kneebone).

A framework and model for simulation in nursing education was designed by Jeffries (2005a). "Components of the frameworks include best practices in education, student factors, teacher factors, simulation design characteristics, and outcomes" (Jeffries, 2005a, p. 96). The educational practice factors included in the model are active learning, meaning students must actively participate; feedback; student-faculty interaction; learning collaboratively among participants; high expectations for the student to perform well; meeting diverse learning needs; and spending time on task. During simulation, students should be both motivated and self-directed. Student factors on the model include: program, level, and age. Within the model, teacher factors are also important and include demographics. The teacher's role, within the simulation, should be that of the facilitator. Simulation design characteristics are: having clear objectives; being realistic, also called fidelity; deciding the complexity of the simulation, from simple to complex; providing cues to the student; and debriefing, in order allow reflective learning. Finally, outcomes are included in the model. These include: knowledge, performance of skills, satisfaction of the learner, critical thinking, and self-confidence (Jeffries, 2005a).

Barriers to Simulation

Cooper (2004) stated there are still barriers to usage of simulation. These include the extremely high cost of patient simulators (Cooper; Fletcher, 1995; Good, 2003; Hravnak et al., 2005; Monti, Wren, Haas, & Lupien, 1998; Morton, 1997; Rauen, 2001; Scherer et al., 2004; Vandrey & Whitman, 2001), and cultural barriers to adoption of this type of training, and although the usage of patient simulations is increasing, it is still fairly limited (Cooper, 2004). Costs can vary per simulator model but range from $28,000 to $200,000 (Long, 2005). Costs associated with patient simulators, other than the actual mannequin, include having a facility for the simulator (Good; Rauen), personnel, and other equipment and supplies, such as gases, needed for the simulator and simulated environment (Good; Nehring et al., 2002). Other major disadvantages are that patient simulators can not mimic all human functions, therefore, they are not completely realistic (Cioffi, 2001; Fletcher; Good ; Hravnak et al.; Lupien & George-Gay, 2001; Morton); they are time-consuming for faculty (Gaba, 2004; Hravnak et al.; Nehring et al.; Rauen; Scherer et al.), they require a lot of faculty support/workload (Lupien & George-Gay; Medley & Horne, 2005; Monti et al.); and only a limited number of students can use the simulator at one time (Rauen; Scherer et al.). It has also been discussed that students may experience anxiety, as well as, intimidation with the use of new technology (Scherer et al.). Faculty development must also occur (Good; Nehring et al.), as teaching with this method differs from traditional lecture (Good). Teaching with simulation can be considered a total paradigm shift (Rauen). Other faculty barriers include: (a) the steep learning curve that must take place with using this technology; and (b) lack of confidence/competence with the equipment (Nehring et al). Often, there are problems with input, calculations, and/or output with any simulation (Prensky, 2002). It has also not been proven that information learned within a simulated setting will be transferred to the real work setting (Fletcher). Lupien & George-Gay caution that simulations should not be overgeneralized to the real world. In addition, ". . . simulations are often accepted uncritically, with undue emphasis being placed on technological sophistication at the expense of theory-based design" (Kneebone, 2005, p. 549).

According to Issenberg, Gordon, Gordon, Safford, and Hart (2001), studies that are evidenced-based must be done to show that simulation technology is effective. Long

(2005) agreed that studies must be conducted to validate the cost/benefit ratio for using high-fidelity simulation in education. Additionally, Ravert (2002) discussed that much of the research on simulation has been done in medicine; however, there are still not many quantitative studies that have looked at how simulation affects both knowledge and performance of skills.

Although there are barriers, Cooper (2004) believes that teaching with simulation is ". . . the right thing to do" (p. 23). Simulation, as a tool, will be increasingly used to prepare health care professionals (Vandrey & Whitman, 2001). According to Larew et al. (2006), it is believed that "simulation will play an increasingly important role in clinical education and competency evaluation of nurses" (p. 21). Simulation, as a teaching strategy, may be used to improve clinical performance (Scherer et al., 2004). Additionally, simulation can help ". . . achieve the cognitive, affective, and psychomotor competencies necessary for the complexities of clinical practice" (Morton, 1997, p. 69).

Learning and Education

Learning Theories

Diamond (1998) summarized research findings related to learning and instructional methods. Most of the research suggests that lecture is the method most often used (approximately 80% of the time). Lectures many times, however, focus on learning of facts, often those associated with recall. Questions, if used during lecture, often do not result in participation from students (Diamond). Another problem associated with lecture is that it encourages students to either talk about or write about what is learned, instead of actually doing it (Cason, Cason, & Bartnik, 1977). Additionally, traditional methods encourage concrete or linear thinking (Rauen, 2001). Nursing has historically used lecture as a basis for instruction (Vandrey & Whitman, 2001).

Research has shown that active learning has been found to be more successful than learning passively (Diamond, 1998). Nursing educators often prefer the active approach to learning, because it allows students to link concepts (Vandrey & Whitman, 2001). Also, engaging the learner through multiple sensory channels has been shown to increase learning (Diamond). Diamond also discussed that reinforcement throughout the educational process helps students learn higher-order skills.

Knowles (1973) stated that ". . . the heart of education is learning, not teaching, and so our focus has started to shift from what the teacher does to what happens to the learners" (p. 41). His theory about adult learning is based on andragogy. The assumptions related to andragogy are that as a person matures: (a) his or her self-concept moves from a dependent state to one of self-directedness, (b) a person has increased experiences and builds a larger knowledge base, (c) readiness to learn is based on what is needed for a particular developmental phase, and (d) the orientation of learning is related to problems, i.e., lack of coping or inadequacy (Knowles, 1970; 1973). In turn, ". . . time perspective changes from one of postponed application of knowledge to immediacy of application . . ." (Knowles, 1970, p. 39).

There are several technological implications for teaching when applying Knowles' (1970) theory. With self-concept, the instructor should: (a) make the environment comfortable, (b) help the learner self-diagnosis his learning needs, (c) help the learner plan his learning, (d) help the learner take some responsibility in the learning process, and (e) have the learner evaluate his learning. For experience, exercises such as simulation are good for adult learners, because they help the adult learner apply previous experience. Practical application of learning, along with, transitions from preconceptions is also important. With readiness to learn, it is important for the instructor to time the learning process with a developmental task. Grouping learners according to the developmental task may also need to take place. With orientation to learning, instructions should help the learner to learn and orient teaching toward center problems, not certain subjects. Learning experiences should also start with the learner's particular problems or questions (Knowles, 1970).

There are several other important things to consider from Knowles (1970, 1973) theory including: (a) the goals of learning should be those of the learner; (b) the learner should play an active role during learning; and (c) the learner should progress toward the identified goals. Learning, therefore, should be student-centered, not teacher-centered (Knowles, 1970, 1973).

A study conducted by Jeffries, Rew, and Cramer (2002) evaluated two different methods for teaching skills to nursing students: one which was interactive and focused on the student and another which was traditional. With the interactive approach, sophomore nursing students ($n = 70$) were given responsibility for their learning through several self-paced modules supplied to them. The traditional approach was used for the junior nursing students ($n = 50$) and included both lecture and labs with demonstration. The study took place over a semester. Satisfaction, self-efficacy, and self-reliance were measured on 5-point Likert subscales with Cronbach alphas ranging from 0.30 to 0.88. Increases in knowledge were measured by a pre and post-test on one of the content areas. Student performance was measured through faculty observation. The student either passed or had to repeat the skills. There was a significant difference in satisfaction by group with greater satisfaction noted in the student-centered group ($p < .01$). Greater self-efficacy, although not significant, was noted in the student-centered group ($p = .06$). No significant difference was noted between the groups on attitude regarding self-reliance or knowledge. On the first attempt, both groups had a 100% pass rate on performance of surgical asepsis skills. The authors revealed in this study that a more interactive learning style increased student satisfaction and self-efficacy over traditional methods. One weakness of this study was the low reliabilities, as indicated by Cronbach's alphas, on two scales: self-efficacy and self-reliance (Jeffries et al., 2002).

The importance of reinforcement and learning through modeling has been discussed by Bandura (1977) in the Social Learning Theory. He stated ". . . most human behavior is learned observationally through modeling: from observing others one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action" (Bandura, 1977, p. 22). In observing others, a person can acquire knowledge, along with, new behavior (Bandura, 1986). Boyd, Graham, Gleit, and Whitman (1998) further describes the outcome of modeling as the observer then tries to match the observed behavior. In Bandura's theory, it is also thought that reinforcement for behavior increases learning. Additionally, when one observes another being reinforced, known as vicarious reinforcement, adoption of the behavior is greater than with modeling alone (Bandura, 1977).

According to Prichard (2005), there are several definitions of learning style, one of which is "a mode of learning – an individual's preferred or best manner (s) in which to think, process information and demonstrate learning" (p. 53). Types of learning styles include: (a) visual, (b) auditory, and (c) kinaesthetic. Those who are visual learn best by seeing. Examples of this include: (a) diagrams, (b) maps, and (c) posters. Those learners who are auditory prefer listening. Examples of this include: (a) lectures, (b) discussion, and (c) audio tapes. In contrast, kinesthetic learners prefer to do something. Examples of this include: (a) physical activity, (b) field trips, and (c) manipulation of objects.

A complementary and overlapping theory to learning styles is multiple intelligences (Prichard, 2005) by Gardner. Gardner (1983) defines intelligence as ". . . the ability to solve problems, or to create products, that are valued within one or more cultural settings-a definition that says nothing about either the sources of these abilities or the proper means of 'testing' them" (p. x). Gardner (1983, 1993, 2006) contends that there are multiple types of intelligence: (a) linguistic, which has to do with language (b) musical, which relates to musical skill (c) logical-mathematical, which has to do with problem-solving and is often called "scientific thinking" (d) spatial, which is spatial problem-solving (e) bodily-kinaesthetic, which has to do with bodily movement (f) interpersonal, which is noticing the distinction among others and (g) intrapersonal, which is having a effective model of oneself (Gardner, 1983, 1993, 2006). Different types of intelligences have preferred learning activities (Pritchard). Those with linguistic intelligence tend to like to read and write and learn best by talking aloud, hearing, or seeing words. Those with musical intelligence like to play instruments or sing and learn best by listening, particularly to music. Those with logical-mathematical intelligence like to work on things, explore, and ask questions, and learn best through categorizing and classifying. Those with spatial intelligence like to build and create objects and learn best by visualizing or working with objects such as pictures. Those with bodily- kinaesthetic intelligence like to move and perform and learn best through touching and moving. Those with interpersonal intelligence like to have friends and be in groups and learn best through sharing and talking. Those with intrapersonal intelligence like to work individually and learn best through individual projects (Prichard).

Prichard (2005) states: "when pupils are taught with approaches and resources that complement their particular learning styles, their achievement is significantly increased" (p. 69). Instructors can benefit by learning each student's preferred style of learning in order to plan appropriate activities to achieve the student's learning goals (Prichard).

Prensky (2001) defines today's learners as "Digital Natives," meaning "our students today are all 'native speakers' of the digital language of computers, video games and the Internet" (p. 1). Instructors, on the other hand, are often known as "Digital Immigrants," meaning that they may adapt to this new technology at a slower pace and/or may speak a different language entirely. Prensky (2001) discussed that this is a significant hindrance in education, and that teachers must learn ways to communicate with their students. Simulation is one teaching method discussed that "Digital Immigrants" can use to reach "Digital Native" students (Prensky, 2001).

Simulation experts have adapted the experiential learning theory by Kolb to simulation (Dunn, 2004a).According to Dunn (2004a), "experiential learning, accordingly, involves reflective thought and influences subsequent actions an personal development" (p. 18). In this adapted theory, which is circular, a concrete experience happens, which is a type of event. The participant reflects on what happened, known as reflective observation. Then, abstract conceptualization occurs which includes: (a) ethical/moral, and (b) technical. This is where the participant takes what was learned and then thinks about future implications. The next step is planning for implementation, and the participant thinks about what will be changed or done differently the next time. The final step is what has been changed, which is called active experimentation (Dunn, 2004a).

Learning in Context

According to Koens, Ten Cate, and Custers (2003), one of the topics discussed frequently in medical education is learning-in-context. In order to test this presumption, these authors designed a study to evaluate the hypothesis ". . . that students who recall words in the same environment as where they learned it, would show better recall than students who reproduce it in a different environment" (Koens et al., 2003, p. 157). Participants consisted of volunteer medical students who had just completed the first part of their internal medicine clerkship ($N = 63$). Students were put into groups of between 6 and 10 students. They were given a list of 20 randomly ordered words and also a patient scenario about gallstones. The test words were tape recorded and presented by a familiar clinical instructor. The words were given to the students two times, while the case was given only once. The students, however, knew the patient's diagnosis. Three phases were included in the study: learning, interim, and recall. Fifty percent of the participants heard the tape in a classroom setting, while the other half heard it while they were at the bedside during the learning portion of the study. In the interim phase, students were taken to another place in the ward which was considered "neutral." Then, students were either given the same or different environment (classroom versus bedside). They were then told to remember as much as they could about the words and also the case. "Thus, four conditions were included, which consisted of all four combinations of learning environment (classroom or bedside) and recall environment (classroom or bedside" (Koens et al., 2003, p. 158). Overall, the sessions were about one hour. The "analysis of variance with words as the dependent variable revealed no main effect of learning environment [$F(1,59) = 0.342, p = 0.561$], recall environment [$F(1,59) = 0.496, p = 0.484$] and no significant interaction [$F(1,59) = 0.315, p = 0.577$]" (Koens et al., 2003, p. 159). Overall, students who were tested within the same context remembered slightly more words, although not significantly more, than those who were tested in a different context (10.9 versus 10.4 words). "Analysis of variance with the patient case as the dependent variable revealed no main effect of learning environment [$F(1\ 59) = 2.591, p = 0.113$], recall environment [$F(1,59 = 0.021$, $\mathrm{p} = 0.885$] and no significant interaction [$F(1,59) = 0.013, p = 0.911$]" (Koens et al., 2003, p. 160). Again, those in the same context remembered slightly more propositions, although not significantly more, than those in the opposite context (52.0 versus 51.5 propositions). In this article, the authors revealed that students who learn in an environment similar to one in which the information needs to be recalled may have increased retrieval of the information, based on the observed difference. However, participants did not reveal a significant improvement in recall (Koens et al.).

Educational Strategy

Bearnson and Wiker (2005) stated that "simulation is an effective strategy for both teaching and evaluating" (p. 421). It also allows for experiential learning, while being able to mimic what is seen in clinical (Cioffi, 2001; Medley & Horne, 2005). Knowledge can be applied and integrated, while allowing students to use critical thinking (Rauen, 2001) and problem solving techniques (Morton, 1997). Additionally, simulation is interactive and often immersive (Maran & Glavin, 2003). However, simulation as a method in nursing education, particularly with that of undergraduate students, is often underappreciated and underused (Medley & Horne). One of the benefits of learning with high-fidelity simulators is that assessment findings can be changed (Medley & Horne), and it provides an innovative way to teach (Medley & Horne; Morton). Jeffries (2005b), stated "To keep up with our changing society and the technological advances in nursing practice, nurse educators will have to be creative in developing new, innovative models of teaching" (p. 3).

Teaching with simulation is starting to increase in nursing education, often to help students learn skills (Feingold et al., 2004) and to learn to think critically (Feingold et al.; Medley & Horne, 2005). One of the reasons for this increase is that students must be better prepared to work upon graduation due to increased patient acuities and technological advances (Feingold et al.). Additionally, the realism of patient simulators is also improving (Feingold et al; Vozenilek et al., 2004).

Faculty who educate advanced practice nurses (APNs), such as acute care nurse practitioners (ACNPs), often have a hard time deciding the best way to teach technical and cognitive skills so that students will be able to understand and apply the information learned within clinical practice (Hravnak et al., 2005). Most often, the skills-related lecture portion is done in the classroom setting, while the application is done in clinical. In the clinical setting, application of skills is not always observable by faculty (Hravnak et al.). Clinical experiences can also vary between students depending on the patients that are available (Larew et al., 2006). Thus, there is a gap between what is taught within the classroom setting and actual practice (Flanagan et al., 2004; Henneman & Cunningham, 2005; Morgan et al; 2006). This gap often leaves graduates, including both medicine and nursing, unprepared to deal with real-life, especially crises (Flanagan et al). Educating appropriately, therefore, is crucial to developing advanced practice nurses (Furlong & Smith, 2005).

Simulation is one method that can be used to ensure that faculty are able to oversee student application, while being able to control the learning environment (Fletcher, 1995; Henneman & Cunningham, 2005; Hravnak et al., 2005; Morton, 1997; Rauen, 2001). In addition, skills can be developed (Fletcher; Henneman & Cunningham; Hravnak et al; Morton). Simulation also provides an objective way to measure not only a student's knowledge, but also skills and critical thinking (Nehring et al., 2002).

Another benefit of high-fidelity simulation is that the faculty member can act as role model (Lupien & George-Gay, 2001). When learning new procedures, the instructor can model the behavior or procedure and then have the student, in turn, demonstrate (Lupien & George-Gay). Diamond (1998) discussed another benefit of simulation is that it can be used in projecting how a student may perform in the "real-world." Simulation also allows competencies to be assessed since cases, or simulated scenarios, can be repeated (Wang & Vozenilek, 2005) and reproduced (Larew et al., 2006). This repetition also allows the instructor to reinforce important points (Rauen, 2001) or the instructor can pause the simulator to teach (Fletcher, 1995). Students are also able to repeat the scenarios as often as necessary (Wang & Vozenilek). Additionally, another benefit of simulation is that it is predictable, unlike patients (Wang & Vozenilek). Therefore, the faculty member can control the learning experience.

Johnson et al. (1999) discussed that the use of simulation is one good example of using cognitive learning theory in practice. Students, during the simulation, must stay active (Cioffi, 2001; Fletcher, 1995; Hawke, 2002; Hravnak et al., 2005; Jeffries, 2005a; Johnson et al.; Lupien & George-Gay, 2001; Medley & Horne, 2005; Morton, 1997; Rauen, 2001). In addition, students must use knowledge and skills previously learned (Johnson et al.). According to Hravnak et al. (2005), simulation, thus, can be used ". . . as a bridge between theory and practice" (p. 98). Lupien and George-Gay (2001) agree as they stated that ". . . high-fidelity simulators can effectively bridge the gap between static classroom-based instruction and the dynamic, unpredictable clinical environment" (p. 147).

Bradley and Postlethwaite (2003) stated that areas simulation may "…impact include risk management, lifelong learning, education, training and continuing personal and professional development, staffing and staff management, continuous quality improvement and the management of poor performance" (p. 1). Simulation, therefore, can have a broad and long-term impact on all aspects of medical education.

Simulation can also affect the way pediatric content is learned. Fiedor (2004) discussed that simulation is valuable for learning about pediatric patients since life-threatening scenarios can be practiced, and students can perform technical skills. Thus, pediatric education is an important arena in which to use simulation.

Simulation Effects

Effectiveness of Medical Simulation

A systematic literature review was performed by Issenberg, McGaghie, Petrusa, Gordon, and Scalese (2005) from the years of 1969 to 2003 to assess what factors associated with high-fidelity medical simulation were effective for learning. Close to 110 studies were reviewed. Almost half of the studies reported that simulation allowed for feedback, and that this may be one of the most important features associated with it. Other highlighted features of simulation included: (a) that it allows for repetitive practice (39% of articles), (b) it can be integrated into the curriculum (25% of articles), (c) the range of difficulty levels for tasks are wide (14% of articles), (d) simulation adapts to multiple learning strategies (10% of articles), (e) simulators can mimic a variety of patient conditions (10% of articles), (f) the environment can be controlled (9% of articles), (g) learning can be individualized (9% of articles), (h) outcomes can be clearly defined for the learner (6% of articles), and (i) validity of the simulator is correlated with effective learning (3% of articles). Conclusions of the study were that "while research in this field needs improvement in terms of rigor and quality, high-fidelity medical simulations are educationally effective and simulation-based education complements medical education in patient care settings" (Issenberg et al., 2005, p. 10). Through this study, the authors revealed that simulation has been effective and complemented educational practices; however, more rigorous research needs to be done (Issenberg et al.).

Simulation and Knowledge

According to Fiedor (2004), one of the major benefits associated with medical simulation is that skills, including both technical and cognitive, can be integrated at the same time. Several studies have evaluated the change in knowledge of participants after a simulated experience. A study by Ravert (2002) reviewed quantitative research associated with computer-based simulation. The purpose was to evaluate what effect simulation had on both education and learning. After reviewing over 510 references, a total of 9 studies met the predetermined criteria. The majority of the studies were related to medical school education, while the remainder were nursing studies. The author indicated ". . . that 75% of the studies showed positive effects of simulation on skill and/or knowledge acquisition" (p. 203). Simulation, although computer-based, has proven to be effective in increasing skills and knowledge (Ravert).

Jeffries et al. (2003) studied the effectiveness of teaching two different methods of 12-lead ECG performance to baccalaureate nursing students randomized into one of two groups: traditional, which included a module for self-study, a small lecture with instructor demonstration, and practice on a static mannequin with a functioning 12-lead ECG machine; and a second method, which used a interactive CD-ROM with virtual reality, plus the self-study module. Before and one week after each instructional method, knowledge was tested by a 27-item multiple-choice test. Satisfaction with methodology was elicited at the one week follow-up with a 5-item Likert questionnaire ". . . ranging from strongly agree to strongly disagree" (Jeffries et al., 2003, p. 72). Scores on this could range between 5 and 25. Skill related self-efficacy was also measured at the one week follow-up with an 8-item subscale. Summed scores were from 8 to 40. Additionally, outcomes were measured on a competency checklist at the same one week follow-up by having a nurse evaluator observe the skill being performed on a standardized patient (actor). Scores on this tool ranged from 0 to 30. Results from the participants ($N = 77$) showed that with both groups, scores increased significantly between the pre and post-tests ($p < .0001$); however, there were no significant differences between the groups on either the pre-test, post-test, or improvement scores. No difference was noted between the groups on satisfaction. For both groups, satisfaction with the methodology was moderately high. No significant differences were noted between the groups on self-efficacy or competency related to performing a 12-lead ECG. This authors of this study revealed that other methods of teaching, which may be more cost-effective, can be as effective as traditional methods on student knowledge, acquisition of skills, satisfaction, and self-efficacy (Jeffries et al., 2003). Strengths of the study were the high power (0.80) and high Cronbach's alphas on the satisfaction scale (0.92) and self-efficacy test (0.84).

Knowledge has also been measured with the use of high-fidelity patient simulators. One aspect of knowledge is critical thinking. According to Weber and Kelley (2007), "critical thinking is the way in which the nurse processes information using knowledge, past experiences, intuition, and cognitive abilities to formulate conclusions or diagnoses" (p. 75). Schumacher (2004) conducted a study which compared three different types of teaching strategies: traditional lecture, including a PowerPoint presentation; high-fidelity patient simulation; and a combination of both lecture and high-fidelity patient simulation. The effects on critical thinking and learning outcomes were measured using a standardized examination known as the Health Education Systems Incorporated (HESI) exam. Participants were undergraduate nursing students ($N = 36$) in a pharmacology class. A customized pre-test consisting of 60 items (HESI exam) was given to all participants. Then, participants were randomized into groups based on the pretest (critical thinking score) using a technique known as block rank ordering. Each group participated in three different activities using one of the three instructional methods. All groups received each of the instructional strategies throughout the 6-week period through the three learning activity rotations. The content of the activities ". . . illustrated the nursing care of clients experiencing an emergent cardiovascular or respiratory event: myocardial infarction, deep vein thrombosis leading to pulmonary embolism, and shock (anaphylactic or hypovolemic)" (Schumacher, 2004, p. iii-iv). After each activity, another customized test (HESI exam), which consisted of 20 items and reflected the activity content, was given to measure both critical thinking and outcomes of learning. Each participant, therefore, took three post-tests. Students who had traditional classroom instruction had no statistically significant difference in either critical thinking ($p > .08$) or learning outcomes ($p > .12$). Statistically significant differences were noted on both critical thinking ($p \leq .002$) and learning outcomes ($p \leq .001$) when either simulation was used alone or in combination with lecture. Thus, critical thinking and learning outcomes were higher in students who were exposed to high-fidelity simulation either alone or paired with didactic content. Caution must be taken in generalizing this study, however, due to the small sample size (Schumacher).

A pilot study by Gordon, Brown, et al. (2006) explored whether a simulated experience using a high-fidelity simulator increased learning among medical students who had not yet attended clinical. A convenience sample of beginning medical students ($n = 37$) first talked about a case involving a myocardial infarction. Then, all were given a small test (6 items) related to cardiovascular physiology. Fifteen of the students were then put into a control group, while 22 of the students experienced a simulation, using a high fidelity simulator, based on the case. Immediately following the simulation, intervention participants filled out a post-test (same questions as the pre-test). One year later, all participants again filled out the post-test. Less than half of the control group participants filled out the one year post-test. The authors, therefore, identified another control group sample of medical students in their second year ($n = 48$). These students had previously discussed the same case. Results indicated that "performance among simulator-exposed students was significantly enhanced on immediate testing (mean score 4.0 [control], 4.7

[intervention], $P = .005$). Gains among the simulator cohort were maintained at 1 year (mean score 4.1 [control], 4.7 [intervention], $P = .045$)" (Gordon, Brown, et al., 2006, p. 13). At the one-year follow-up, those in the control group had scores that were essentially unchanged. Over time, the intervention was shown to be a significant component of performance ($p < .001$). In addition, 90% of the students reported that the exercise was positive (excellent or very good) (Gordon, Brown, et al.).

Gordon, Shaffer, et al. (2006) compared teaching with a high-fidelity simulator to the traditional teaching method on the following content systems: respiratory (reactive airway disease) and cardiac (myocardial infarction). The sample was medical students in their third and fourth years. Students were randomized into groups of three students. All groups completed a pre-test on both topics then a simulation lasting 90 minutes on one of the subject areas. After the simulation, they received a lecture for 90 minutes on the other subject area, followed by a post-test on both topics. Two versions of each test consisting of either 11 or 12 items, some with several parts to the answer, were written. Results from the participants ($N = 38$) indicated that the mean scores improved between the pre and post-tests for both methods "(overall change score [simulation] = 8.8 [95% CI = 2.3-15.3], pretest [62.7]; change score [lecture] = 11.3 [95% CI = 5.7-16.9], pretest [59.7])" (Gordon, Shaffer, et al., 2006, p. 33). There were no significant differences, however, between the simulator-based and traditional method in either of the content areas. After one session with medical students, cognitive differences between traditional lecture and simulation teaching were not detected (Gordon, Shaffer, et al., 2006). Limitations of the study included a small sample size, and Cronbach's alphas on the written tests were not reported.

Another study which evaluated whether there was an increase in knowledge in medical students with the use of high-fidelity simulation was done by Morgan et al. (2006). In this study, after obtaining demographic information, participants first took a short (10 questions) multiple-choice pre-test related to cardiac arrhythmia pharmacology management. Then, student teams consisting of between two and three students went through four different scenarios related to cardiac arrhythmias. Performance of each team was assessed by faculty with two different tools: checklists and a global rating scale. The first time through the scenarios, which were videotaped, the assessment tools were used as a pre-test. Then, feedback was given to the students by the faculty with use of the videotape. After, students were given guidelines from the American Heart Association about arrhythmias. After a 30 minute review of the material and a break, the student teams repeated the scenarios with a different student "team leader." The tools were again repeated as the post-test. After the scenarios, students completed the pharmacology post-test and also an evaluation of the experience. Results over a two year period ($N = 299$) showed that between the pre and post pharmacology test, there was a significant improvement in individual scores, $t = -7.650$ ($p < .0001$). A significant increase was also noted between the pre and post simulation scores for team performance, $F(1, 103) = 101.29, p < .0001$. Some of the scenarios were shown to be more difficult, which impacted learning, $F(3, 103) = 15.63$, $p < .0001$. Between the pre and post scenario performance, a significant improvement was also noted on the scores for the checklist and global rating. Scenarios 1 through 3 had checklist and global pre/post-test p values of $< .0001$. The fourth scenario had checklist pre/post-test p value of $= .011$ and a global pre/post-test value of $p = .008$. All but one of the four scenarios showed ". . . a good correlation between checklist and global rating scores" (Morgan et al., 2006, p. e10), with p values of .01 or .05. Participants also felt the experience was very positive. Overall, simulation increased both individual test scores, along with, improving team performance in this study. Students were also satisfied with the use of simulation (Morgan et al.). Strengths of this study included a large sample size and instruments with previous Cronbach's alphas between 0.6 and 0.9.

Bearnson and Wilker (2005) studied the positives and negatives of using a patient simulator with beginning nursing students as a substitute for one of their clinical days. Two groups of participants, along with their instructors, participated in three simulation scenarios for a total of 2 hours using a patient simulator. Students filled out a Likert questionnaire regarding the experience (4 = strongly agree, 1 = strongly disagree), and about half of them wrote a journal entry. Results did not indicate the number of participants but did show that the students self-reported an increase in knowledge about side effects of medications ($M = 3.13$) and understanding of different patient responses ($M = 3.31$). Students also felt the experience made them safer in administering medications ($M = 3.06$), and they were more confident about the skill of medication administration ($M = 3.00$). On open-ended questions, most felt more confident after the experience. Students liked being able to do an assessment, see and recognize abnormal findings, and be able to critically think. Most felt the experience was valuable. One of the main themes of the journal entries was the ability to work as a team (Bearnson & Wilker). In this study, students felt they had more knowledge and confidence after a simulated experience. Weaknesses of this study include no reported sample size, descriptive statistics only, and no reported Cronbach's alpha on the instrument created for the study. Additionally, no actual measures of knowledge were obtained.

In a pilot study by Kardong-Edgren, Anderson, Michael, Schrum, and Warren (2007), pre and post-test scores regarding knowledge about congestive heart failure (CHF) were compared between three groups of pre-nursing students conveniently sampled from a pre-nursing course at a nursing school ($N = 14$). The three groups consisted of: (a) those who received lecture on CHF only (control), (b) those who received the same lecture plus a simulated experience about CHF using a static mannequin, (c) and those who received the lecture plus a simulated experience using a high-fidelity simulator. All simulations were brief, lasting only fifteen minutes. The knowledge pre-test was given the same day as the lecture and simulation, while the post-test was given two weeks later. The pre and post-test consisted of the same 15 multiple choice questions. No significant differences between the scores of the pre and post-tests for the three groups were noted: "lecture only (control group) $t(3)=.522$, $p=.638$; lecture and static manikin $t(4)=1.118$, $p=.326$; lecture and SimMan® $t(4)= 1.206$, $p=.294$." (Kardong-Edgren et al., 2007, p. 4). Additionally, there were no statistical differences between the three groups either, $F(2,11) = 1.687$, $p > .05$. Limitations of this study included a small sample size (Kardong et al.) and lack of reported Cronbach's alpha on the knowledge test.

The National League for Nursing (NLN) and a simulator manufacturer, Laerdal, sponsored a national, multi-site, three-year study of simulation (Jeffries & Rizzolo, n.d.). In the spring of 2005, 357 students across six different sites participated during their first course on medical-surgical nursing. All students received a pre-recorded lecture about post-operative care, and also a simulation which demonstrated this care. Students were put into one of three groups randomly: (a) those who were given a paper/pencil scenario about a patient post-operatively and were allowed to work as a group to solve the problems (control), (b) those who participated in a simulated experience about a post-operative patient using a static mannequin, and (c) those who participated in a simulated experience about a post-operative patient using a high-fidelity patient simulator. After all received a debriefing session, data was collected. Results revealed that "there were no significant differences in knowledge gains among the three groups as measured by pre and post testing, using Kruskal-Wallis non-parametric tests (non parametric version of the ANOVA) between each pair of groups" (Jeffries & Rizzolo, n.d., p. 7). Among the groups, no significant differences were noted on self-perceived performance within the simulation. Students in the patient simulator group, however, felt there was more fidelity, or realism, than the other two groups. Those in the patient simulator group reported a significantly greater level of satisfaction ($p < .001$) in the teaching method. Both groups who used a mannequin reported more self-confidence ($p < .0004$) about caring for a patient post-operatively than the paper/pencil scenario group. Through this study, use of high-fidelity patient simulation was shown to increase student satisfaction and self-confidence (Jeffries & Rizzolo, n.d.)

Simulation and Confidence/Self-Efficacy

Vandrey and Whitman (2001) described self-efficacy as being confident in one's abilities to execute tasks appropriately. In the Social Learning Theory, Bandura (1977) defined "an efficacy expectation is the conviction that one can successfully execute the behavior required to produce the outcomes" (p. 79). The greater the efficacy, the more effort a person will make, especially during trials and tribulations (Bandura, 1977). Boyd et al. (1998) stated: "the more capable and confident the individual feels about performing health-related activity, the more likely the individual will procedd with behavior change" (p. 90). According to Bandura (1977), efficacy expectations come from several different sources: performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal. Performance accomplishments have to do with one's own experience. A successful experience increases expectations, while continued failures decrease them. Vicarious experience is "seeing others perform threatening activities without adverse consequences . . . " (Bandura, 1977, p. 81). If others do not have negative consequences with the behavior, the observers believe they too can succeed. Verbal persuasion also influences efficacy. If a lot of persuasion is required to produce the behavior, the efficacy often does not last. The fourth influence is emotional arousal. Anxiety and stress can have adverse effects on efficacy expectations (Bandura, 1977).

Such as with the 12-lead ECG study (Jeffries et al., 2003) and the NLN/Laerdal studies mentioned above (Jeffries & Rizzolo, n.d.), the use of simulation in health care training has been shown to increase both confidence and self-efficacy of participants. A pilot study by Cioffi, Purcal, and Arundell (2005) looked at how simulation affects clinical decision-making for midwifery students. A convenience sample of 35 graduate diploma students were assigned randomly to either a control group, which received only the standard two didactic lectures, or an experimental group, which received two different simulations. One simulation was related to normal labor, which was done during the second semester, while the other was about jaundice, which was given in the third semester. The simulations, which included some role play, thinking aloud, and inferences, were done in place of the scheduled lectures on the appropriate content. Both groups, in the last week of the third semester, completed a post-test, which were the previous simulations on labor and jaundice. Audiotapes of the simulations were transcribed to get the data. After transcription, "... two independent raters analyzed the resulting verbal protocols into segments... " (Cioffi et al., 2005, p. 133). Students who played the role of decision-maker also completed a confidence scale after both simulations. Results showed that those in the simulation group were able to make decisions more quickly for the normal labor material, although not significantly. The number of segments needed to collect data for the verbal protocol was: experimental, (*M* = 52, *SD* = 19); control, (*M* = 59, *SD* = 14). For the jaundice content, the experimental group needed more segments (*M* = 43, SD = 14) compared to the control group (*M* = 39, *SD* = 18). The effect sizes were 0.4 (normal labor) and 0.3 (jaundice). Those in the experimental group collected more data than the control group in both content areas, although not significantly. For the labor, the number of segments for data collection was: experimental, (*M* = 63, *SD* = 13); control, (*M* = 56, *SD* = 18). For jaundice, the data collection segments were: experimental, (*M* = 69, *SD* = 9); control, (*M* = 62, *SD* = 14).

The effect sizes were 0.5 (normal labor) and 0.6 (jaundice). Those who participated in the simulation did not revisit the clinical data as many times as the control group The number of segments for data review in the labor material was: experimental, ($M = 16$, $SD = 9$); control, ($M = 20$, $SD = 9$). For jaundice, the mean segments were: experimental, ($M = 12$, $SD = 9$); control, ($M = 14$, $SD = 8$). The effect sizes were 0.4 for the normal labor, and 0.3 for the jaundice. During decision-making, those in the simulation group also made fewer inferences. For normal labor inference segments, the means were: experimental, ($M = 20$, $SD = 16$); control ($M = 22$, $SD = 10$). For jaundice, the means were: experimental, ($M = 17$, $SD = 8$); control, ($M = 19$, $SD = 11$). Effect sizes for both content areas were 0.2. Median confidence levels were higher among those in the experimental group, although not stated significantly (labor, 70% in experimental group versus 60% in control group; jaundice, 80% in experimental group versus 50% in control group). The effect size for the labor content was 0.1 and 0.5 for the jaundice material, respectively. Overall, students who participated in the simulation group were able to make decisions faster and collect more needed clinical data. They were also less likely to review the data and make inferences. Additionally, they had higher confidence levels while making decisions (Cioffi et al.). Weaknesses of this study were the low to moderate effect sizes (between 0.1 - 0.6) and small sample.

Goldenberg, Andrusyszyn, and Iwasiw (2005) studied what effect in-class simulation with baccalaureate nursing students had on self-efficacy with health teaching. The simulation was group role play using several different cases. A total of 22 participants filled out the questionnaires related to self-efficacy feelings pre and post-simulation. The self-efficacy tool was on a 4-point Likert scale "ranging from 'completely lacking in confidence' to 'very confident'" (Goldenberg et al., 2005, p. 312). Both the pre and post questionnaires were filled out two weeks following the course. Results indicated that students had significantly greater self-efficacy scores overall after the simulation ($p = .001$), which meant more confidence with health teaching after the simulation ($M = 2.96$ pre-workshop vs. $M = 3.55$ post-workshop). In addition, there were significant differences ($p < .001$) before and after the simulation related to the different phases of health teaching, including assessment, implementation, and evaluation. The planning phase of health teaching scores, however, did not change. One weakness was the small sample size (Goldenberg et al.).

Another study by Meier, Henry, Marine, and Murray (2005) evaluated the feasibility of a web and simulation based surgical curriculum for beginning surgical residents. Residents were given an introduction and content on six different topics via a website. After, they were emailed a Likert scale about how confident they felt about postoperative emergencies and different tasks for surgery. Two months later, residents went through simulation sessions on a high-fidelity patient simulator. Prior to the simulations, the residents filled out a questionnaire related to simulator assessment. Following the simulations, the participants filled out a Likert scale questionnaire regarding the benefit of the simulations. Finally, another confidence questionnaire was sent to them on their first week on medical service. Results revealed ($N = 17$) that 94% of the participants viewed the web-based curriculum. All of them (100%) went through the simulations. Only 11 or 65% of the participants completed both of the questionnaires.

Overall, the confidence score increased from 5.4 to 6.7 ($p < .0001$). On the simulation assessment questionnaire, over 60% of the participants had been through simulation prior to the training. Over 70% felt simulation was an important component in surgical education. The post-simulation feedback was positive, with 100% rating the simulation experience highly. Participants especially enjoyed how realistic and non-threatening the scenarios were. In this study, confidence again increased after simulation (Meier et al.). A weakness was the small sample size.

Docherty, Hoy, Topp, and Trinder (2005) evaluated self-efficacy in nursing students after clinical simulation using eLearning techniques.. In this study, one group (n = 160), who received the course in the traditional format, was compared with another group, who received eLearning (n = 143). The traditional group had lecture each week plus three hours of problem-based learning tutorials. The tutorials were geared towards practicing the skills discussed in lecture. The eLearning group attended a "technology-facilitated clinical simulation, where the students were much more in control of their learning" with use of web pages during one of the tutorial hours (Docherty et al., 2005, p. 529). This group also had on-line discussions and email available. Self-efficacy on 25 different nursing activities was measured using a Likert scale both before and after the experience. Satisfaction was elicited with use of a Likert questionnaire which contained 26-items. Knowledge was also tested with a multiple-choice/short answer exam. No reliability or validity data were given on the tools, nor was it discussed when they were given. Interviews were also conducted with several of the lecturers, students, and mentors within the eLearning group. Results showed that for the eLearning group, self-efficacy scores on each of the skills increased significantly. Values ranged from $p = .0047$ to $p = .0001$. Significant differences were noted between the two groups on satisfaction, with the eLearning cohort reporting higher satisfaction ($p < .001$). No significant differences were noted between the groups on the short answer knowledge items. Significant differences occurred between the groups on the multiple-choice items, with the eLearning group having higher scores ($p = .0003$). Interviews were conducted with two of the lecturers and less than 10 students at the start, in the middle, and at the end of the eLearning module. An unknown number of mentors were also interviewed. Identified themes were: (a) understanding, related to increased student growth and application of knowledge, (b) learning relationships, essential to increasing understanding, and (c) reflection, or being able to reflect on the simulated experience through use of video (Docherty et al., 2005).

Other studies have shown increased self-efficacy with high-fidelity simulation. A study by Treloar, Hawayek, Montgomery, and Russell (2001) looked at how feasible and efficacious it was to use a high-fidelity patient simulator in training emergency naval personnel, consisting of physicians, emergency medical technicians, and corpsmen. All groups, consisting of between 2 and 4 participants, were trained using a high-fidelity simulator. Some of the groups had an instructor on-site, meaning that the instructor was present in the room during the training, while some groups had an instructor off-site, meaning that the instructor was not physically on-site but was present through videoconferencing. A pre and post-test with a Likert scale was used to look at both preparedness and self-efficacy related to caring for patients. Questions on the scale were

". . . from 1 to 10, with 10 being the highest" (Treloar et al., 2001, p. 1004). The time frame between pre-test, simulation, and post-test was not stated. Another 5-point Likert survey from 1 (strongly disagree) to 5 (strongly agree) was used to look at the participants perceptions of using the simulator. Significance was set at $p < .05$. Results of the convenience sample ($N = 18$) indicated that both preparedness and self-efficacy increased significantly (*p* value not reported). Significant improvement also occurred in each of the 5 individual scenarios (*p* value not reported). Other results showed that participants felt training was better using interactive mannequins ($Mdn = 4.88$, $SD = 0.34$). Those who had off-site instruction felt that this method would be helpful for skill maintenance during times of extended deployment ($Mdn = 4.44$, $SD = 0.88$). However, participants only moderately agreed that the off-site training was just as effective as the one on-site ($Mdn = 3.44$, $SD = 1.33$). A weakness of this study was the small sample size and non-reported levels of significance. The importance of this study was that high-fidelity simulation increased both self-efficacy and preparedness, and participants perceived that using the simulator was both helpful and better than using a static mannequin (Treloar et al.).

High-fidelity simulation use with nursing students has also increased self-efficacy. In an unpublished doctoral dissertation by Michael (2005) which is related to this study, perceived self-efficacy scores related to performing cardiovascular assessment in undergraduate nursing students ($N = 89$) were evaluated and compared for students who attended traditional lab and simulation lab experiences, with use of a patient simulator. Results showed that perceived self-efficacy increased after both the traditional assessment lab and simulation lab experiences; however, there was a significantly greater increase in those that attended the simulation lab, $t(88) = -7.14, p < .001$. In the study, the pre-tests were given prior to lecture. Three days following the lecture, students attended the traditional lab where the first post-test was given following the lab. One week following the traditional lab, students attended the simulation lab. Following the simulation lab on the same day, students completed the second post-test. In this study, traditional methods used for assessment did not increase self-efficacy as much as the high-fidelity simulation method (Michael).

In a recent manuscript submitted for publication (Leflore, Anderson, Michael, & Anderson, 2007), the authors compared similar attributes to this study: knowledge, self-efficacy, and skill acquisition between three different groups of NP students who used high-fidelity simulation. The participants ($N = 16$) consisted of NP students conveniently sampled from a pediatric management course at a nursing school located in the South. After receiving lecture regarding management of pediatric respiratory emergencies for the outpatient, students were assigned to a group. The groups consisted of a control group, self-directed team (student team collaborating during the simulated scenario), and instructor-modeled team (team who was modeled appropriate behaviors by an instructor team). Knowledge was assessed using a Knowledge Assessment Test at three different times: prior to lecture, right after the lecture, and after a simulated experience with a high-fidelity simulator. Self-efficacy was assessed at the same three times as knowledge using a Self-Efficacy Tool adapted from Michael (2005). Performance was evaluated using a Technical Evaluation Tool which mimicked SOAP format. Finally, behavior management in a crisis was assessed using a Behavioral Assessment Tool. Results showed that there were no differences in knowledge regarding management of an infant in acute respiratory distress among the three groups (test 1: $p = .58$, test 2: $p = .44$, test 3: $p = .51$). Significant differences were noted between the three groups on self-efficacy at three time periods, with the control group having the lowest self-efficacy scores (time 1: $p = .006$, time 2: $p = .008$, time 3: $p = .012$) among the groups. Statistically significant differences were found between groups on starting treatment, i.e., Albuterol ($p = .025$). Significant differences were also noted between the three groups on the Behavioral Assessment Tool. "A strong correlation was observed between the overall score of the Behavioral Assessment Tool and the Self-Efficacy Score (time 1: $p = .002$, $R^2 = .7$; time 2: $p = .005$, $R^2 = .66$; time 3: $p = .02$, $R^2 = .6$) indicating that 60-70% of the variance in team behaviors may be explained by the confidence of the team members" (Leflore et al., 2007). The lecture regarding management of a newborn in acute respiratory distress was given approximately one week prior to the simulation day (J. Leflore, personal communication, October 27, 2006). The knowledge and self-efficacy pre-tests were given before the lecture and the first post-tests were given right after the lecture. The second post-tests were given right after the simulation evaluation. A weakness of this study was the small sample size (Leflore et al).

Simulation and Satisfaction

Use of simulation, in general, has been shown to be very satisfying for participants, as mentioned in several studies previously discussed. One simulation center reported that simulation training almost always receives high satisfaction scores from resident participants (Wang & Vozenilek, 2005). Several other studies have looked at satisfaction following simulation.

A study by Johnson et al. (1999) focused on simulation using a telephone for teaching nursing students how to triage patients. In this study, both videotaped simulation and simulation using a telephone were used for all students ($N = 51$). On a Likert scale with 1 being the least positive to 6 being the most positive, results indicated that students felt the experience was very positive (mean of all ratings > 5.39). Other results showed that: students felt that the simulation allowed them to think quickly ($M = 5.53$, $SD = 0.91$); utilize critical thinking ($M = 5.47$, $SD = 0.94$); communicate in a focused manner ($M = 5.39$, $SD = 0.96$); identify appropriate ways to intervene ($M = 5.47$, $SD = 0.94$); and reinforce what was previously learned ($M = 5.39$, $SD = 0.94$). Ratings were slightly greater, though not stated significantly, for those who received the telephone simulations ($M = 5.50$, $SD = 0.93$ vs. $M = 5.39$, $SD = 1.02$). Of the students, over 85% reported that the learning experience was positive (Johnson et al.). One weakness of this study was that all of the tools were self-report.

Another study of participant satisfaction related to simulation was conducted by Bond, Kostenbader and McCarthy (2001). In this study, satisfaction was evaluated after a group of health care providers, including nurses, physicians, paramedics, emergency medical technicians, and various students, used a high-fidelity patient simulator. A total of 78 individuals participated. Two of the five Likert scale questions related to overall satisfaction and included scores from 1, "disagree" to 5, "agree completely." The last three questions related to usefulness of the training and scores were from 1, "not helpful" to 5, "extremely helpful." Overall scores on the 5 questions were positive: simulator realism compared to other types of mannequins or training, $M = 4.73$, $CI \pm 0.126$ ($n = 77$) ; recommendation of training to others, $M = 4.77$, $CI \pm 0.126$ ($n = 78$) ; helpfulness of assessment on the simulator (such as auscultating breath sounds), $M = 4.\ 53$, $CI \pm 0.153$ ($n = 78$); helpfulness of treatment options, $M = 4.55$, $CI \pm 0.182$ ($n = 47$); and helpfulness of simulator responses to treatment interventions, $M = 4.70$, $CI \pm 0.125$ ($n = 63$).Written comments were also optimistic, with almost 50 positive comments and less than 10 negative ones. Most of the negative comments were related to simulator lab logistics, while realism of the simulator was the most common positive comment. The importance of this study was that a variety of health care professionals found training with high-fidelity simulation satisfying (Bond et al.). A weakness was that Cronbach's alpha was not reported on the tool.

Tsai, Harasym, Nijssen-Jordan, Jennett, and Powell (2003) developed an examination for pediatric residents using a high-fidelity child mannequin in order to test their competence. Development of a valid and reliable instrument was the main purpose of the study; however, responses of the participants were also collected on the realism and effectiveness of the simulation. During the simulation, resident pairs worked together. After being briefed about the scenarios on respiratory distress and shock, the pairs were allowed to spend some time with the mannequin and equipment. Prior to the simulation, they were pre-tested on the mannequin. Based on how they performed, they were then given a training session for one hour, and then they were post-tested. Pre and post-tests consisted of two different cases for 30 minutes each. Pre and post-test cases were not the same. Within the pairs, the residents alternated what roles they played: either physician or assistant. Following the simulation days, all participants filled out a questionnaire, which included demographic information and evaluation of the scenarios for realism, quality, and whether the scenarios would be valuable in the future. They also self-rated their performance. Results related to satisfaction, which included both attending physicians ($n = 4$) and residents ($n = 18$), showed that greater than 90% enjoyed the simulation and 90% felt they were given a proper briefing prior to the scenario. Seventy-five percent of the participants thought that both the mannequin and the environment were realistic and 95% felt the scenarios mimicked patient situations. The time allotted was also found to be adequate (85%). All participants were willing to have time to practice, even though unpaid. Ninety-five percent supported purchasing a mannequin for training and assessing competence of health care providers. Over half felt they knew enough to manage the scenarios. Ninety five percent felt the mannequin was reliable. Use of high-fidelity simulation was again found in this study to be satisfying (Tsai et al.). A weakness of this study was that only descriptive statistics were used to assess satisfaction.

A study by Feingold et al. (2004) evaluated satisfaction after high-fidelity simulation using SimMan®, by Laerdal. Students in a critical care nursing course in a baccalaureate program were given two high-fidelity simulations within the semester, which were used to assess students on clinical decision-making and also critical behaviors. Students filled out survey items at the end of the semester related to satisfaction on a 4-point Likert scale with 4 being "Strongly Agree" and 1 being

"Strongly Disagree." Subscales of the tools were: realism, related to the simulated experience; transfer, whether skills learned were transferable to the clinical setting; and value, whether the students thought the experience was valuable. Students from two semesters of the course used the tool. Faculty also filled out a tool using the same type of Likert scale. Questions were related to support and training needed to use the simulator. Results from the students combined ($N = 65$) indicated that the students felt it was a valuable experience (Value subscale $M = 3.04$). The lowest mean (2.52) was on the Transferability subscale. Greater than 85% reported that the experience was realistic, and the simulator was like a real patient (64.1%). Students also found that the setting, along with how the scenario flowed was like real-life (73.0%). On both testing of skills and decision-making, students reported that the experience was adequate (greater than 80%). Almost 70% felt the experience was valuable, while greater than 76% thought it improved learning. Greater than 95% felt that they received appropriate feedback about how they performed in the simulation. Greater than 46% said the experience increased self-confidence or improved their competence in the clinical setting. Almost 55% said the experience prepared them for how to function in the actual clinical setting. Additionally, all faculty ($N = 4$) felt the experience prepared the students for real-life. All faculty also agreed that the scenario was realistic, and that the simulator was an effective tool for teaching. Use of high-fidelity simulation for both students and faculty was a valuable learning experience in this study, however, students did not necessarily feel that the skills learned in a simulator were transferred to the clinical setting (Feingold et al.). A weakness in this study is that no Cronbach's alphas were reported for either student or faculty tool.

As part of the National League of Nursing study mentioned above, a study was conducted at one particular site to assess the reliability and validity of the tools used in the larger national study. One of the tools, The Educational Practice Scale for Simulation (EPSS), was used to measure if there were four different educational practices, derived from Chickering and Gamson (1987), within the simulation. These practices include: "active learning, collaboration, diverse ways of learning, and high expectations" and how important each of these was (Childs & Sepples, 2006, p. 156). This tool was on a 5-point Likert scale. The second tool, The Simulation Design Scale (SD), was used to ask ". . . students to evaluate five design features of the simulations: objectives/information, support, problem solving, feedback, and fidelity" (Childs & Sepples, 2006, p. 156). In the study, student participants were in their senior capstone course. After attending lecture related to the topic, groups of between four and five went though four different scenarios using a high-fidelity simulator. Results ($N = 55$) showed that the tools evaluated were reliable and valid (statistics not published). The two best features of the simulation were found to be feedback and objectives/information. Complexity and fidelity followed. Feedback was found to be the educational practice rated the highest. Students overall found the experience to be very positive, and they enjoyed the scenarios (Childs & Sepples). A major weakness of this article was that the statistics were not published.

Simulation and Health Education

Although no specific literature was found using high-fidelity simulation in health education beyond nursing and medicine, other types of simulation, such as computer-based and case studies, within this field have been utilized for both clients and students of health education. A study by Thomas, Cahill, and Santilli (1997) tested and evaluated a computer program called "Life Challenge," which was ". . . developed by the New York State Department of Health as a tool for enhancing adolescents' sense of self-efficacy in HIV/AIDS prevention programs" (Thomas et al., 1997, p. 71). This program was a game where participants could choose their partner and negotiate tasks. Examples of negotiated tasks included: saying "no" to sex and negotiation of condom use. A playback mechanism allowed the user to talk with the simulated partner. Audio recordings of these were analyzed. Pre and post knowledge and self-efficacy were also assessed. The self-efficacy scale included items on a 4-point Likert scale from "*strongly agree* to *strongly disagree*" (Thomas et al., 1997, p. 76), which participants answered how they would respond in a given situation related to sexual activity. Additionally, a seven item knowledge test was given. Participants were taken from residential facilities, group homes, Job Corp sites, rehabilitation facilities for substance abuse, and non-profit organizations. In the analysis of audio responses ($n = 211$) in one of the scenes, greater than 80% included a response coded as saying "no" to sex. In another scene, over 90% asked their partner to either use a condom or dental dam. Greater than 75% had content negotiation related to safer sex. In all of the recorded scenes, two-thirds of the participants negotiated in the appropriate direction. Demographics revealed that greater than 85% of the sample (ages 12 to 22) was sexually active, with 5% stating they had used IV drugs and slightly less than 5% were HIV positive. On the knowledge test, four out of the 7 items had significantly increased at the post-test (3 items at $p < .001$; 1 item at $p < .05$). Additionally, "the mean change in self-efficacy (posttest score-baseline score) was +0.47; a paired t test indicated that this gain in self-efficacy was statistically significant ($t = 2.18, p = 0.03$)" (Thomas et al., 1997, p. 82). Those with the lowest self-efficacy scores at the baseline had higher levels of change. Most of the participants took the negotiating tasks seriously during the game in this study. Some knowledge was improved with the simulation, along with increased self-efficacy. This study is one example of how simulation, via the computer, can be used within health education for clients to be able to practice skills (Thomas et al.).

Korn, Murray, Morrison, Reynolds, and Skinner (2006) discussed how an interactive website was developed by a group of youth in Canada to prevent gambling in this population (ages 10 to 19). Using strategies from public health, the website, YouthBet.net, was designed to include games and resources, along with information on prevention of harm related to gambling. Almost 35 participants were recruited in three different phases over three years to evaluate the site. Video capture was used, along with recording of participant voices, during navigation of the site. Additionally, each participant was interviewed for approximately 15-20 minutes about their thoughts. Demographics and a basic survey about their usage of the Internet were also collected. Results showed that the participants liked the site because of the realistic games and quizzes included. Participants felt that the site was easy to navigate and content was easily found. All of the youth stated they would recommend the site to a friend with a gambling problem and would return to the site themselves (Korn et al.)

Simulation can also be used for students of health education. According to Rowitz (2004), instructors of public health need to look beyond traditional lecture and reading assignments as teaching strategies. Some suggestions include: use of case studies, stories, and games (Rowitz). Bareford (2001) discussed an interactive computer simulation, SimCity©, and how it could be used in educating health education professionals. The example of nursing students was given. Students were able to complete simulated scenarios where communities have different types of environmental problems, such as traffic, crime, or disasters (earthquakes, floods). The scenarios allowed for problem-solving, such as identifying critical environmental factors in the community that impact health, creating changes in order to solve the problem, and evaluation of the participants' interventions. This author of this article suggested that use of SimCity© needs to be researched to determine if improvements in participant critical thinking occur (Bareford).

The use of simulation could be used in this population of students to teach certain skills such as communication. Arnold and Koczwara (2006) discussed that one application of simulation is practicing communication skills. One example used is breaking bad news to patients. According to the authors, "practicing communication skills in a structured setting allows for feedback from the object of communication that cannot be achieved through a didactic session" (Arnold & Koczwara, 2006, p. 5099).

Broder and Janal (2006) evaluated the use of simulation, via patient instructors (PI's) or "standardized patients," on both interpersonal communication and cultural sensitivity skills for dental students in their third and fourth years. A total of 143 students participated. All students participated in two different training sessions, one of which was in the fall, and the other was the following summer. The scenarios in the fall dealt with patient situations in dentistry, while the summer scenarios were related to cultural sensitivity. Each of the two sessions had four different scenarios with the patient instructors, along with didactic sessions. During each of the sessions, a group of four students went through the four scenarios or "rounds." Each student did one of the four interviews, which included asking about the patient's chief complaint and history. The Arizona Clinical Interviewing Rating Scale (ACIR) was completed after each encounter by a PI to look at the participant's interpersonal skills. The 13 items on the scale were on a 5-point Likert scale from 1 = poor to 5 = excellent. The PI then provided feedback to the student. After the interviews, participants attended a seminar by the instructor in which teaching points were reinforced. The participants then completed a course evaluation of 5 questions to look at the value of the training. The authors indicated that time of training related to student performance was statistically significant, F (3. 405) = 211.8, $p < .001$. Interpersonal communication skills were significantly increased within each training session ($p < .05$). However, improvement over the four rounds was less in the second session as compared to the first, F (3, 405) = 7.82, $p < .001$. Additionally, the means of the five questions on the evaluations were all 4.4 or higher, meaning the participants felt the sessions were useful. Interpersonal skills increased with use of simulation in this particular population of dentistry students in this study (Broder & Jamal).

Summary

In summary, the literature has shown that the use of simulation, particularly that of high-fidelity simulation, within health care education is applicable and continues to grow. However, limitations with the use of this technology do exist, especially the cost. One of the major benefits of simulation is that it promotes active learning. Research has shown that the use of simulation increases participants' knowledge, self-efficacy, and satisfaction. No research, however, was found integrating the use of high-fidelity simulation within the lecture content. Additionally, no literature was identified concerning use of high-fidelity simulation for health education.

CHAPTER III

METHODOLOGY

This chapter will discuss the methods used in this quasi-experimental non equivalent control-group research design study. The following topics will be covered: population and sample; protection of human participants; data collection procedures, including theory for data collection and instrumentation; data analysis; and summary.

Population and Sample

This study was conducted at UTASON. The School of Nursing is considered one of the largest in the nation. Annually, greater than 1,000 students are taught within the school's programs: traditional BSN, RN to BSN, MSN, post-MSN, and PhD. The school uses a variety of advanced teaching methods/technology including patient simulators and web-enhancement (The University of Texas at Arlington School of Nursing, 1995-2007).

The School of Nursing offers nurse practitioner degrees at the Master's level in eight different focal areas including: adult, pediatrics, geriatrics, family, psychiatric, emergency and acute care (pediatrics and adult) (The University of Texas at Arlington School of Nursing, 1995-2007). All NP students are required to take a course in Advanced Health Assessment, which is taught in both the fall and spring. In this course, students learn health assessment as applied to the lifespan (Taylor, 2007).

For this study, all NP students (convenience sample) enrolled in the Advanced Health Assessment course during fall 2006 and spring 2007 at the School of Nursing were asked to participate by an instructor within the classroom setting. The course consisted of the following types of students: Pediatric NP (PNP), Acute Care Pediatric NP (ACPNP), Family NP (FNP), Adult NP (ANP), Geriatric NP (GNP), Psychiatric Mental Health NP (PMHNP), Emergency NP (ENP) (A. Schram, personal communication, September 18, 2006), and Acute Care (Adult) NP (ACNP). A priori power analysis was performed to determine sample size. Results showed a total of 50 participants, with a minimum of 20 in each group, were needed for this study. Power was set at 0.8.

Protection of Human Participants

Institutional Review Board (IRB) approval was obtained for the study from the University of Texas at Arlington (UTA) and Texas Woman's University (TWU). Informed consent was obtained from all participants (Appendix A). All collection materials were coded with an identification number; therefore, no materials were able to be linked to specific individuals. All data collection records will be stored in a locked cabinet within the principal investigator's office for at least three years following the study.

Data Collection Procedures

The students enrolled in the course during the fall of 2006 served as the control group, Group I. Students enrolled in the course during the spring of 2007 served as the experimental group, Group II. Students in Group I received traditional didactic lecture on newborn assessment content. Students in Group II received lecture integrated with high-fidelity simulation through use of a high-fidelity patient simulator, SimBaby™ manufactured by Laerdal (Laerdal Medical Corporation, 2001-2006).

In order to protect confidentiality of participants, all students present for lecture in both semesters were handed a packet of questionnaires. Those who chose not to participate were able to return the packet with the questionnaires unanswered. Students in Group I and II who chose to participate took the Newborn Assessment Knowledge Tool regarding newborn assessment (Appendix B), at three time points: before lecture, after lecture, and then four weeks later. Their score on the Newborn Assessment Knowledge Tool did not count toward their course grade. They also filled out a Perceived Self-Efficacy Tool for Newborn Assessment (Appendix C), regarding how confident they felt about performing a newborn assessment at the same three time points as the Newborn Assessment Knowledge Tool. Post lecture only, participants filled out the Educational Session Satisfaction Tool, which included a few demographic questions (Appendix D). Demographic information was filled out again at the four week follow-up. The same instructor was used to give the lecture content for both groups.

The control group received traditional didactic lecture on November 6, 2006. All pre-tests (Newborn Assessment Knowledge Tool and Perceived Self-Efficacy Tool for Newborn Assessment) and the first post-tests (Newborn Assessment Knowledge Tool and Perceived Self-Efficacy Tool for Newborn Assessment), along with the Educational Session Satisfaction Tool, were filled out on this date. The second post-tests (Newborn Assessment Knowledge Tool and Perceived Self-Efficacy Tool for Newborn

Assessment), as well as, the second demographic sheet were filled out four weeks later on December 4, 2006.

The experimental group received lecture integrated with high-fidelity simulation on January 20, 2007. During the two hour lecture, the instructor demonstrated assessment techniques on the simulated patient (mannequin). For example, when discussing assessment of the anterior fontanel, the instructor demonstrated how to sit the infant up to palpate the fontanel. One of the features of the mannequin is that the fontanel can swell (Laerdal Medical Corporation, 2006) to simulate increased intracranial pressure, therefore, when discussing signs and symptoms of meningitis, the instructor demonstrated this. Some of the other techniques the instructor demonstrated on the mannequin included: auscultation of breath and heart sounds; palpation of hips for dislocation, and signs of a fractured clavicle. The cumulative of time spent on the simulator was approximately 20 minutes. All pre-tests (Newborn Assessment Knowledge Tool and Perceived Self-Efficacy Tool for Newborn Assessment) and the first post-tests (Newborn Assessment Knowledge Tool and Perceived Self-Efficacy Tool for Newborn Assessment), along with the Educational Session Satisfaction Tool, were filled out on this date. The second post-tests (Newborn Assessment Knowledge Tool and Perceived Self-Efficacy Tool for Newborn Assessment), as well as, the second demographic sheet were filled out four weeks later on February 17, 2007.

Theory for Data Collection

The data collection procedures were based on the Post-Positivist theory (Trochim, 2006). In this theory, epistemology has to do with "the *philosophy* on how we come to know the world," while methodology is the *practice* of knowing. A key component in this theory is that measurement is considered fallible; therefore, things must be observed and measured multiple times. Additionally, constructivists believe that our perceptions help us construct how we see the world (Trochim). Based on this theory, several of the data collection instruments in this study were collected multiple times.

Instrumentation

Three instruments were used in the study:

1. *Newborn Assessment Knowledge Tool.* This multiple-choice test consisted of a series of 10 application-type questions related to newborn assessment content, which was approximately twice the number of questions that students received on the didactic examination related to newborn assessment (A. Schram, personal communication, January 5, 2007). Questions were validated through face and content validity with the use of three experts through written feedback on test items. Scores on this instrument could range from 0 to 100%, with 100% being the highest score. To determine reliability, KR-20 was done using the control group pre-test in fall 2006.
2. *Perceived Self-Efficacy Tool for Newborn Assessment.* The tool was modified from one used by Michael (2005), "Report of Perceived Self-Efficacy of Nursing Students towards Health Assessment Skills for the Cardiovascular system" (p. 5). The tool developed by Michael was revised from a tool formulated by Schwarzer and Jerusalem (1995) in 1979. It had been further adapted in 1992. Cronbach's alphas from the 1992 version reported "internal

consistency across samples from 23 nations and languages ranged from .76 to .90 with the majority in the high .80s" (Michael, 2005, p. 23).

The adapted tool by Michael (2005) was used to assess perceived self-efficacy in undergraduate nursing students related to cardiovascular assessment for two types of lab experiences: traditional and simulation. The tool consisted of 19 items on a Likert scale (pre-experience) and 20 items on a Likert scale (post-experience). It also included one open-ended question on the post-experience tool. Reported Cronbach's alpha for the tool in this study was 0.927 (Michael).

The tool was again modified to assess perceived self-efficacy in NP students related to managing asthma in an outpatient setting. The management occurred on an infant patient simulator. This tool, which consisted of 15 items, had a Cronbach's alpha of 0.96 (Leflore et al., 2007).

Permission to use and modify the instrument for this study was obtained from the author (J. Michael, personal communication, September 29, 2006). Questions were validated through face and content validity with the use of three experts through written feedback on items. Additionally, reliability was obtained using the alpha coefficient with the data collected from the control group in the fall.

The adapted self-efficacy tool for newborn assessment in this study consisted of 15 questions, with one of the items having four embedded questions. The 4-point Likert scale consisted of: 1, "Not at all True;" 2, Hardly true;" 3, "Moderately true;" and 4, "Exactly true." Summed scores could range from to 18 to 72. The higher the score, the more confidence or self-efficacy the student had related to the item.

3. *Educational Session Satisfaction Survey.* This tool was adapted from the post-simulation evaluation survey used at the School of Nursing. Questions were validated through face and content validity with the use of three experts through written feedback on items. Reliability was obtained using the alpha coefficient with the data collected from the control group in the fall.

   The Likert scale for this tool was a 5-point scale from 5 "Strongly Agree" to 1 "Strongly Disagree." Summed scores could range from 9 to 45. Participants were also able to answer three open ended questions including: "What did you like about this education session?;" "How could this education session be improved for the future?;" and "Other Comments."

Data Analysis

Chi square was used to analyze the nominal demographic information between the groups, while an independent t-test for unequal groups was used to analyze the interval data (years of experience as a nurse and number of years of newborn assessment) between the groups (Leedy & Ormrod, 2005). A correlation was first run to assess the association between the Newborn Assessment Knowledge Tool and the Perceived Self-Efficacy Tool for Newborn Assessment, and to determine if multivariate analysis of covariance (MANCOVA) was useful. MANCOVA with between groups design was utilized to assess the main effects and interaction effects between the groups on the

Newborn Assessment Knowledge Tool and Perceived Self-Efficacy Tool for Newborn Assessment, to control for the prior tests and confounding demographic variables. Repeated measures were used to analyze and compare the slopes of the lines between the Newborn Assessment Knowledge Tool and the Perceived Self-Efficacy Tool for Newborn Assessment. An independent t-test for unequal groups was also used to compare the difference in Educational Session Satisfaction Survey between the groups, as the scores from this tool were summed. Adjustment was made for unequal sample sizes in Statistical Package for Social Sciences (SPSS) version 11.5 (2002). Coefficient alpha was set at .05. Bonferroni correction for multiple comparisons was also used.

Summary

The population and sample; protection of human participants; data collection procedures, including theory for data collection and instrumentation; and data analysis methods were chosen to answer the purposes of the study. The first purpose to compare knowledge, perceived self-efficacy, and satisfaction between nurse practitioner (NP) students enrolled in N5418 Advanced Health Assessment in Nursing Practice at the University of Texas at Arlington School of Nursing (UTASON) who received traditional didactic lecture compared with those NP students who received lecture integrated with a high-fidelity simulator for the newborn assessment content. A secondary purpose was to apply the principles regarding knowledge, self-efficacy, and satisfaction, and relate them to the present body of knowledge in the field of health studies in order to improve health education outcomes.

CHAPTER IV

RESULTS

The goals of this study were twofold: compare knowledge, perceived self-efficacy, and satisfaction between nurse practitioner (NP) students enrolled in N5418 Advanced Health Assessment in Nursing Practice at the University of Texas at Arlington School of Nursing (UTASON) who received traditional didactic lecture compared with those NP students who received lecture integrated with a high-fidelity simulator for the newborn assessment content, and apply the principles regarding knowledge, self-efficacy, and satisfaction, and relate them to the present body of knowledge in the field of health education in order to improve health education outcomes. This chapter will cover the results of this study. Topics presented include: participants, demographics, knowledge/ perceived self-efficacy, and satisfaction. A summary concludes the chapter.

Participants

In the fall of 2006, there were 25 students enrolled in the course. From those enrolled, a total of 23 (92%) (control group) completed the Newborn Assessment Knowledge Tool pre-test. A total of 22 (88%) filled out the Perceived Self-Efficacy Tool for Newborn Assessment pre-test. Twenty-three students from the course (92%) completed the Educational Session Satisfaction Survey. At the four week follow-up, a total of 23 (92%) filled out the demographic sheet, the Newborn Assessment Knowledge Tool post-test 2, and the Perceived Self-Efficacy Tool for Newborn Assessment post-test

2. Therefore, a total of 23 students made up the control group; however, all data were reported, regardless of missing information.

In the spring of 2007, 51 students were enrolled in the course. From those enrolled, a total of 48 (94.12%) (experimental group) completed the Newborn Assessment Knowledge Tool pre-test. A total of 49 (96.08%) completed the Perceived Self-Efficacy Tool for Newborn Assessment pre-test. Forty-six students from the course (90.2%) completed the Educational Session Satisfaction Survey. Two students were absent at the four week follow-up. Forty-seven students (92.16%) filled out the demographic sheet, 46 students (90.2%) completed the Newborn Assessment Knowledge Tool post-test 2, and 46 students (90.2%) filled out the Perceived Self-Efficacy Tool for Newborn Assessment Tool post-test 2. Therefore, a total of 49 students made up the experimental group; however, all data were reported, regardless of missing information.

Demographics

Data collected from the participants in the control and experimental groups included: gender, NP major, age, years of experience as a nurse, previous experience with a high-fidelity simulator, pediatric experience beyond basic registered nurse (RN) preparation, years of pediatric experience beyond basic RN preparation, previous experience with newborn assessment beyond basic RN preparation, and years of experience with newborn assessment beyond basic RN preparation. There were no statistically significant differences between the groups on eight of the nine variables. However, there was a statistically significant difference ($p = .01$) on years of RN experience. See Tables 1 and 2.

Table 1

Chi-square Comparisons between Groups Reported in Frequencies, Percentages, and Probabilities

	Control Frequency (%) $n = 23$	Experimental Frequency (%) $n = 47$	*P*
Gender			
Male	3 (13)	4 (8.5)	.68
Female	20 (87)	43 (91.5)	
Major			
PNP	1 (4.3)	11 (23.4)	
ACPNP	1 (4.3)	4 (8.5)	
ANP	3 (13.0)	2 (4.3)	
FNP	6 (26.1)	13 (27.7)	
GNP	0 (0)	0 (0)	.31
PMHNP	1 (4.3)	4 (8.5)	
ENP	2 (8.7)	4 (8.5)	
ACNP	4 (17.4)	5 (10.6)	
Dual pediatrics (PNP & ACPNP)	4 (17.4)	4 (8.5)	
Dual adult (ANP & GNP)	1 (4.3)	0 (0)	
Age			
20-30	7 (30.4)	24 (51.1)	
31-40	5 (21.7)	13 (27.7)	
41-50	10 (43.5)	8 (17.0)	.12
51-60	1 (4.3)	2 (4.3)	
Over Age 60	0 (0)	0 (0)	

Previous experience with a high-fidelity simulator			
Yes	2 (8.7)	4 (8.9)	1.000
No	21 (91.3)	41 (91.1)	
Pediatric experience beyond basic RN preparation			
Yes	12 (52.2)	25 (55.6)	.80
No	11 (47.8)	20 (44.4)	
Previous experience with newborn assessment beyond basic RN preparation			
Yes	6 (26.1)	18 (40)	.30
No	17 (73.9)	27 (60)	

Table 2

Means, Standard Deviations, T-values, and Probabilities between Groups on Demographics

	Control $n = 23$ $M±SD$	Experimental $n = 47$ $M±SD$	t	p
Years of experience as a nurse	11±7	7±6	2.65	.01
Years of pediatric experience beyond basic RN preparation (If yes to pediatric experience beyond basic RN preparation)	7±6	5±5	1.01	.32
Years of newborn assessment beyond basic RN preparation (If yes to experience with newborn assessment beyond basic RN preparation)	7±6	4±5	1.20	.24

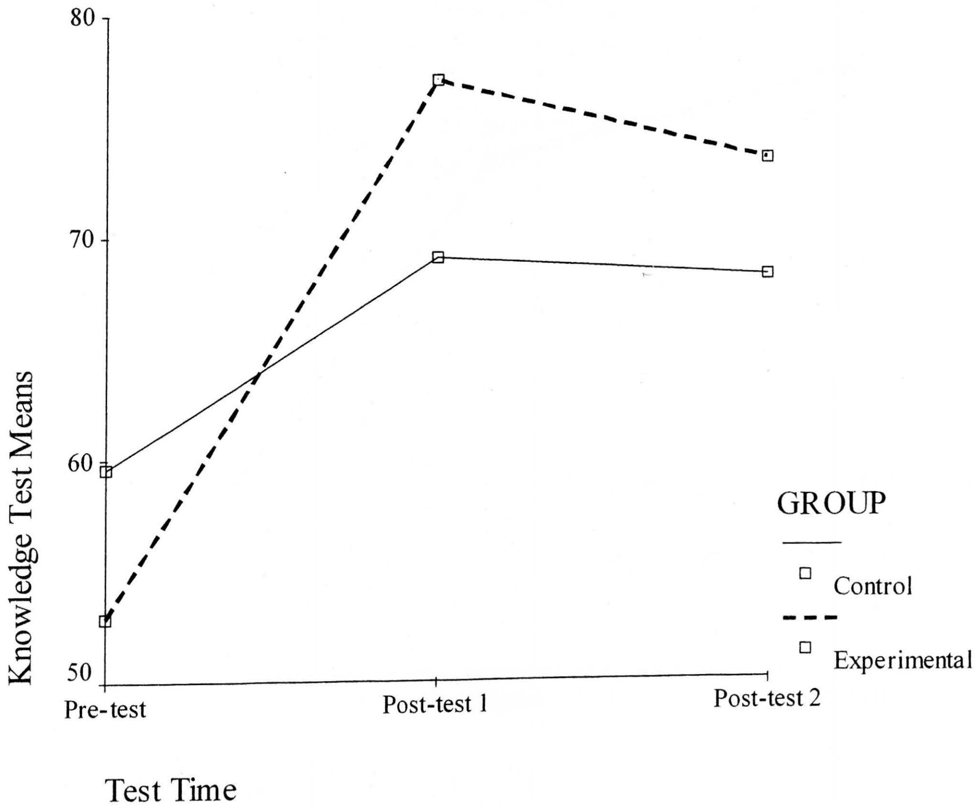
Although there was not a statistically significant difference in area of NP major, there was a clinically significant difference in the number of PNP students in the experimental group compared to the control group ($n = 11$ versus $n = 1$, respectively).

Knowledge/Perceived Self-Efficacy

Comparison within the Groups

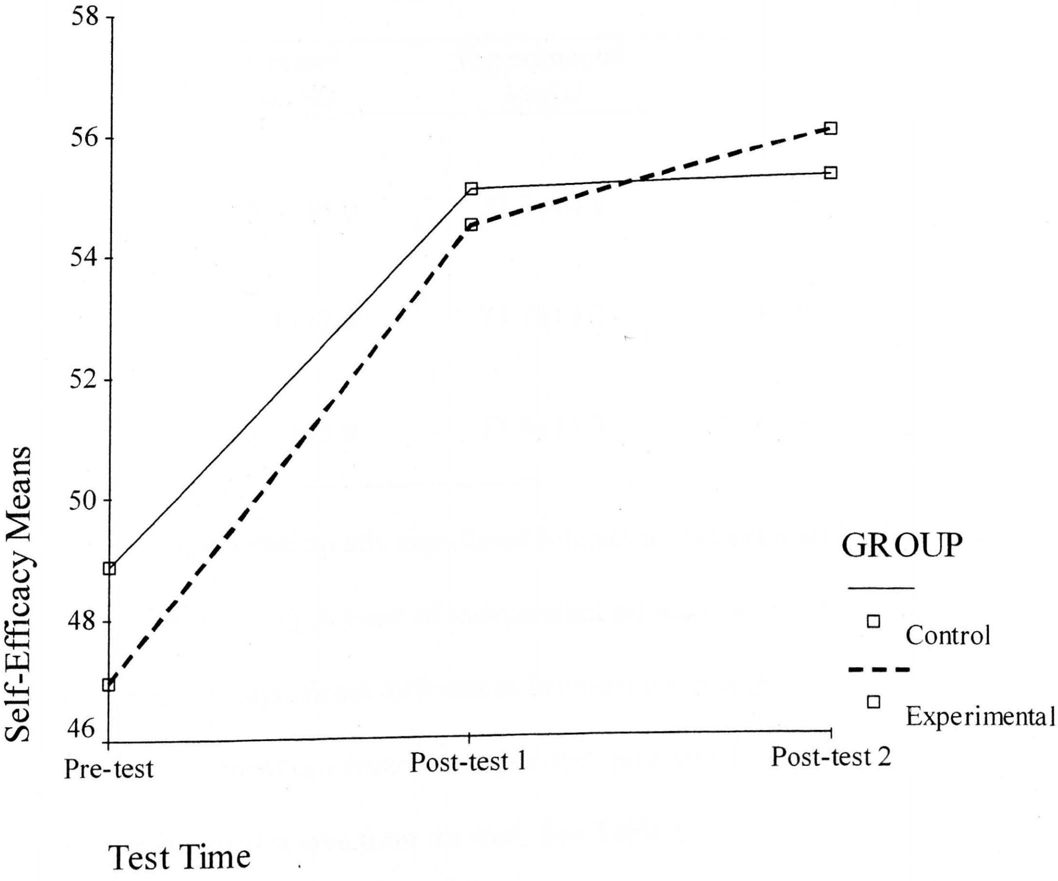
Statistically significant differences were observed between the Newborn Assessment Knowledge Tool pre-test and Newborn Assessment Knowledge Tool post-test 1 ($p < .001$) and between the Newborn Assessment Knowledge Tool pre-test and Newborn Assessment Knowledge Tool post-test 2 ($p < .001$), but not between Newborn Assessment Knowledge Tool post-test 1 and Newborn Assessment Knowledge Tool post-test 2 ($p = .59$). See Figure 1.

Figure 1. *Changes in Knowledge Test Means within each Group over Time*



There were statistically significant differences within each group between the Perceived Self-Efficacy Tool for Newborn Assessment pre-test and Perceived Self-Efficacy Tool for Newborn Assessment post-test 1 ($p < .001$) and between the Perceived Self-Efficacy Tool for Newborn Assessment pre-test and Perceived Self-Efficacy Tool for Newborn Assessment post-test 2 ($p < .001$), but not between Perceived Self-Efficacy Tool for Newborn Assessment post-test 1 and Perceived Self-Efficacy Tool for Newborn Assessment post-test 2 ($p = .9$). See Figure 2.

Figure 2. *Changes in Self-Efficacy Test Means within each Group over Time*



Comparison between the Groups

There was a statistically significant interaction between knowledge and group membership ($p < .001$). A t-test of independent samples between unequal groups showed no statistically significant differences between the groups based on the percentage of correct answers on the Newborn Assessment Knowledge Tool pre-test or post-test 2. There was a statistically significant difference on the Newborn Assessment Knowledge Tool post-test 1 ($p = .05$). See Table 3.

Table 3

Means, Standard Deviations, T-values, and Probabilities between Groups on Knowledge

	Control *M*±*SD*	Experimental *M*±*SD*	*t*	*p*
Knowledge Pre-test	59.6±14.0	52.5±14.9	1.90	.06
Knowledge Post-test 1	69.1±12.8	75.7±13.2	-1.99	.05
Knowledge Post-test 2	68.3±15.0	73.0±13.3	-1.35	.18

There was not a statistically significant interaction between self-efficacy and group membership ($p = .53$). A t-test of independent samples between unequal groups showed no statistically significant differences between the groups on the Perceived Self-Efficacy Tool for the Newborn Assessment pre-test, post-test 1, or post-test 2. The means are based on the summed scores from the tool. See Table 4.

Table 4

Means, Standard Deviations, T-values, and Probabilities between Groups on Self-Efficacy

	Control *M*±*SD*	Experimental *M*±*SD*	*t*	*P*
Self-Efficacy Pre-test	48.9±11.0	46.7±11.3	.77	.45
Self-Efficacy Post-test 1	55.0±9.3	54.3±8.6	.30	.77
Self-Efficacy Post-test 2	55.2±7.5	56.1±7.6	-.44	.66

There were statistically significant correlations between the Newborn Assessment Knowledge Tool pre-test and the Newborn Assessment Knowledge Tool post-test 1 ($p < .001$), the Newborn Assessment Knowledge Tool pre-test and the Newborn Assessment Knowledge Tool post-test 2 ($p < .001$), and between the Newborn Assessment Knowledge Tool post-test 1 and the Newborn Assessment Knowledge Tool post-test 2 ($p < .001$) (Table 5). Therefore, the comparisons were repeated using MANCOVA to control for the prior tests and the significant demographic variable of years of RN experience (Table 6).

There were statistically significant correlations between the Perceived Self-Efficacy Tool for Newborn Assessment pre-test and the Perceived Self-Efficacy Tool for Newborn Assessment post-test 1 ($p < .001$), the Perceived Self-Efficacy Tool for Newborn Assessment pre-test and the Perceived Self-Efficacy Tool for Newborn

Assessment post-test 2 ($p < .001$), and between the Perceived Self-Efficacy Tool for Newborn Assessment post-test 1 and the Perceived Self-Efficacy Tool for Newborn Assessment post-test 2 ($p < .001$) (Table 5). Therefore, the comparisons were repeated using MANCOVA to control for prior tests and the significant demographic variable of years of RN experience (Table 6).

Table 5

Correlations between Measurement Instruments

	Knowledge Pre-test *r* (*p* value)	Knowledge Post-test 1 *r* (*p* value)	Self-Efficacy Pre-test *r* (*p* value)	Self-Efficacy Post-test 1 *r* (*p* value)
Knowledge Post-test 1	.41 ($p < .001$)			
Knowledge Post-test 2	.41 ($p < .001$)	54 ($p < .001$)		
Self-Efficacy Post-test 1			.81 ($p < .001$)	
Self-Efficacy Post-test 2			.60 ($p < .001$)	.69 ($p < .001$)

Table 6

Comparison between Groups Controlling for Previous Testing and Years of RN Experience

	Control *M*	Experimental *M*	*F*	Observed Power	*p*
Knowledge Pre-test◊	61.1	52.6	4.3	.53	.04
Knowledge Post-test 1 ◊●	66.5	78.8	15.7	.97	<.001
Knowledge Post-test 2 ◊●□	70.0	73.5	1.0	.17	.31
Self-Efficacy Pre-test◊	50.4	46.5	1.7	.25	.2
Self-Efficacy Post-test 1 ◊▲	54.8	55.0	.02	.05	.9
Self-Efficacy Post-test 2 ◊▲▶	54.0	56.8	2.5	.34	.12

◊Years of RN Experience
●Knowledge Pre-test
□Knowledge Post-test 1
▲Self-Efficacy Pre-test
▶ Self-Efficacy Post-test 1

KR- 20 on the Newborn Assessment Knowledge Tool pre-test from the control group ($n = 23$) in the fall was a negative value, thus was unable to be interpreted. Cronbach's alpha on the Perceived Self-Efficacy Tool for Newborn Assessment pre-test for the control group ($n = 22$) in the fall for was 0.95.

Satisfaction

A t-test of independent samples between unequal groups showed no statistically significant difference between the groups on satisfaction scores ($p = .27$). See Table 7. Cronbach's alpha on the Educational Session Satisfaction Survey from the control group ($n = 23$) was 0.94.

Table 7

Means, Standard Deviations, T-values, and Probabilities between Groups on Satisfaction

	Control $M \pm SD$ $n = 23$	Experimental $M \pm SD$ n = 46	t	p
Satisfaction	34.5±6.9	33.1±3.6	1.12	.27

Two open-ended questions regarding what students' liked and what needed improvement were included on the survey tool. Please see compilation of student comments in Table 8.

Table 8

Open-Ended Comments from Students on Satisfaction Survey

	Control	Experimental
What did you like about this education session?	"Educator enjoys the topic" "Very informative." "Pictures and knowledge of the instructor" "The topic is very much my interest"	"Pictures" "photos with descriptions help to identify" "very informative, great speaker" "having the infant model to watch" "The pictures & simulation baby" "slides, examples" "Very interesting content-great refresher." "Good info" "informative, good teacher" "speaker was very informative" "I love the info." "Knowledge of instructor." "Instructor" "very important to current practice"

How could this education session be improved for the future?	"Please heat this room!" "Little more time allotted." More focus on how to complete physical assessment & break in middle. Wish it wasn't so rushed" "The handout in outline form instead of slides"	"*allow more time!!*" "more time or fit to time available" "more time to practice, slow down" "more time, audible sounds of assessment on speakers, able to assess simbaby" "Allocate more time for hands on experience & breaks" "more time" "Longer class time" "not enough time for all of the info; too fast paced." "more time for this lecture, it's good information, should NOT be so rushed" "more time for use of Sim baby" "too short too much info in space of time we had" "more time to work the model" "needed more time, would like to have more assessment [with] sim baby" "Not enough time, could not use simulator. I was rushed" "Shortened slides"

	"Shortened slides" "A lot more time" "need more time to cover lecture" "Allow more time to use simulator or allow sounds to be heard audibly in the entire class for practice"
Additional Comments	"Question 7 on self-efficacy confusing- are we suppose to answer 7 x ea A-D or only A-D"

Summary

Within the groups, there were significant differences between the Newborn Assessment Knowledge Tool pre-test and Newborn Assessment Knowledge Tool post-test 1 and between the Newborn Assessment Knowledge Tool pre-test and Newborn Assessment Knowledge Tool post-test 2, but not between Newborn Assessment Knowledge Tool post-test 1 and Newborn Assessment Knowledge Tool post-test 2. Between the groups, there was a statistically significant difference in knowledge scores concerning newborn assessment on post-test 1 only between the groups. When controlling for confounding variables, there were statistically significant differences in knowledge scores on both the Newborn Assessment Knowledge Tool pre-test and post-test 1 between the groups. There were statistically significant differences within each group between the Perceived Self-Efficacy Tool for Newborn Assessment pre-test and

Perceived Self-Efficacy Tool for Newborn Assessment post-test 1 and between the Perceived Self-Efficacy Tool for Newborn Assessment pre-test and Perceived Self-Efficacy Tool for Newborn Assessment post-test 2, but not between Perceived Self-Efficacy Tool for Newborn Assessment post-test 1 and Perceived Self-Efficacy Tool for Newborn Assessment post-test 2. Between the groups, there were no significant differences in perceived self-efficacy scores, as measured by the Perceived Self-Efficacy Tool for Newborn Assessment, before lecture (pre-test), after lecture (post-test #1), and at the four week follow-up (post-test #2) between the groups. There was also no statistically significant difference in satisfaction scores, as measured by the Educational Session Satisfaction Survey, between the two groups.

CHAPTER V

DISCUSSION

This chapter will summarize the research study. The following topics will be covered: summary, conclusion, discussion and implications, and recommendations.

Summary

The purpose of this quasi-experimental non equivalent control-group research study was to compare knowledge, perceived self-efficacy, and satisfaction between nurse practitioner (NP) students enrolled in N5418 Advanced Health Assessment in Nursing Practice at UTASON who received traditional didactic lecture compared with those NP students who received lecture integrated with a high-fidelity simulator for the newborn assessment content. A secondary purpose was to apply the principles regarding knowledge, self-efficacy, and satisfaction, and relate them to the present body of knowledge in the field of health education in order to improve health outcomes.

The convenience sample included NP students enrolled in N5418 Advanced Health Assessment in Nursing Practice at UTASON during fall, 2006, and spring, 2007. The following NP majors were represented in the sample: PNP, ACPNP, ANP, FNP, PMHNP, ENP, ACNP, dual pediatrics (PNP and ACPNP), and dual adult (ANP and GNP). The control group from fall, 2006, who received traditional didactic lecture for the newborn assessment content, consisted of 23 participants. The experimental group from spring, 2007, who received lecture integrated with a high-fidelity simulator for the newborn assessment content, consisted of 49 participants.

Students in both the control and experimental groups who chose to participate took the Newborn Assessment Knowledge Tool regarding newborn assessment, at three time points: before lecture, after lecture, and then four weeks later. They also filled out a Perceived Self-Efficacy Tool for Newborn Assessment, regarding how confident they felt about performing a newborn assessment at the same three time points as the Newborn Assessment Knowledge Tool. Post lecture only, participants filled out the Educational Session Satisfaction Tool, which included a few demographic questions. Demographic information was filled out again at the four week follow-up.

Conclusion

Knowledge

Within the groups, there were statistically significant differences in knowledge, as measured by the Newborn Assessment Knowledge Tool, between the pre-test and post-test 1 and between the pre-test and post-test 2, but not between post-test 1 and post-test 2. Between the groups, there was a statistically significant interaction between knowledge and group membership. Additionally, there was a statistically significant difference in knowledge, as measured by the Newborn Assessment Knowledge Tool, before lecture (pre-test) and after lecture (post-test #1) between the two groups. At the four week follow-up (post-test #2), there was not a statistically significant difference in knowledge between the groups. See Table 9.

Self-Efficacy

Within the groups, there were statistically significant differences in self-efficacy, as measured by the Perceived Self-Efficacy Tool for Newborn Assessment, between the pre-test and post-test 1 and between the pre-test and post-test 2, but not between post-test 1 and post-test 2. Between the groups, there was not a significant interaction between self-efficacy and group membership. Additionally, there was not a statistically significant difference in perceived self-efficacy scores, before lecture (pre-test), after lecture (post-test #1), and at the four week follow-up (post-test #2) between the groups. See Table 9.

Satisfaction

No statistically significant difference was revealed between the groups on satisfaction, as measured by the Educational Session Satisfaction Survey. See Table 9.

Table 9

Summary Null Hypotheses: Rejected or Not Rejected

Null Hypothesis	Null Hypothesis Rejected or Not Rejected
1. There will be no statistically significant difference in knowledge scores concerning newborn assessment, as measured by the Newborn Assessment Knowledge Tool, before lecture (pre-test), after lecture (post-test #1), and at the four week follow-up (post-test #2) within and between NP students who received traditional didactic lecture and NP students who received lecture integrated with a high-fidelity simulator.	Within Pre-test and Post-test 1= Rejected Pre-test and Post-test 2= Rejected Post-test 1 and Post-test 2= Not Rejected Between Before Lecture (pre-test)= Rejected After Lecture (post-test 1)= Rejected Four Week Follow-up (post-test 2)= Not Rejected

2. There will be no statistically significant difference in perceived self-efficacy scores, as measured by the Perceived Self-Efficacy Tool for Newborn Assessment, before lecture (pre-test), after lecture (post-test #1), and at the four week follow-up (post-test #2) within and between NP students who received traditional didactic lecture and NP students who received lecture integrated with a high-fidelity simulator.	Within Pre-test and Post-test 1= Rejected Pre-test and Post-test 2= Rejected Post-test 1 and Post-test 2= Not Rejected Between Before Lecture (pre-test)= Not Rejected After Lecture (post-test 1)= Not Rejected Four Week Follow-up (post-test 2)= Not Rejected
3. There will be no statistically significant difference in satisfaction scores, as measured by the Educational Session Satisfaction Survey, between NP students who received traditional didactic lecture and NP students who received lecture integrated with a high-fidelity simulator.	Not Rejected

Limitations

Several limitations were noted in this study. These included: (a) a small sample size, (b) unequal groups, (c) self-report questionnaires (Perceived Self-Efficacy Tool for Newborn Assessment and the Educational Session Satisfaction Survey), and (d) a negative KR- 20 on the Newborn Assessment Knowledge Tool. Additionally for the experimental group, limitations included: (a) a brief episode with the simulator since it was utilized for only one content area, newborn assessment (b) limited simulator time since only approximately 20 minutes of the lecture time was spent demonstrating on the mannequin, (c) use of the simulator increased lecture time, therefore, the instructor was unable to finish the lecture content, (d) lack of structured time with the simulator, and (e) since the group and room size were large, along with limitations with the mannequin, not all students may have been able to hear abnormal sounds or see the demonstration clearly.

Discussion and Implications

Knowledge

Prior to lecture when controlling for years of RN experience, there was a significant difference in knowledge between the groups, with the control group having a higher mean. Other than having more years of RN experience in the control group, this could be explained by the fact that the control group had a higher mean on both years of pediatric experience beyond basic RN preparation and years of newborn assessment beyond basic RN preparation, although not significantly. On post-test 1 following lecture, there was again a significant difference in knowledge between the groups, with the experimental group having a higher mean. On post-test 1 when controlling for years of RN experience, the experimental group mean increased approximately 26% from the pre-test, compared to the control group, which only improved approximately 5%. Since one group did much better than the other, the lines crossed and there was an interaction effect. Additionally, when looking at the test means, based on the percentage of correct answers, on post-test 1 and assigning them a course grade, the experimental group mean would have been a "C," compared to an "F" in the control group (Taylor, 2007). Therefore, the difference was not only statistically significant; it was academically significant as well.

At the four week follow-up, there was not a significant difference between the groups on knowledge scores. However, the experimental group mean remained higher than the control group. When controlling for years of RN experience and prior tests, the experimental group mean dropped approximately 5% from post-test 1 to post-test 2, whereas, the control group mean increased approximately 4% from post-test 1 to post-test 2. Therefore, the control group knowledge means increased steadily from pre-test to post-test 1 and then continued to increase from post-test 1 to post-test 2. In the experimental group, the mean scores increased from pre-test to post-test 1, but dropped from post-test 1 to post-test 2. This may imply that the experimental group was unable to retain the knowledge learned as well as the control group four weeks following lecture. When controlling for years of RN experience, the knowledge mean increased approximately 9% for the control group between the pre-test and post-test 2, and approximately 21% for the experimental group between the pre-test and post-test 2. Overall, the experimental group had greater improvement on the knowledge tool, despite having a lower mean at the onset. Additionally, this group did not hear the entire lecture, as the instructor ran out of time. They did, however, receive the same notes as the control group. This higher mean could be explained by the intervention of lecture integrated with high-fidelity simulation.

Within the groups, there were statistically significant differences in knowledge between the pre-test and post-test 1 and between the pre-test and post-test 2, but not between post-test 1 and post-test 2. It appears that neither group was able to retain the knowledge as easily four weeks following the lecture, however as discussed, the mean for the control group increased between post-test 1 and post-test 2. As expected with lecture, knowledge did improve from the pre-test to post-test 1 and from the pre-test to post-test 2. It is interesting to note that for both groups, a major examination was given the day of post-test 2. The post-tests were given for both groups prior to the examination. It is possible that students were more focused on the upcoming examination than taking the second post-test.

The negative KR- 20 on the Newborn Assessment Knowledge Tool from the control group in the fall was a limitation in this study. However, one would expect that the KR-20 would be low due to the fact that the group had not yet received lecture. The knowledge tool test items may have been more advanced than students were used to since the items were based on application of knowledge learned, not on basic recall of knowledge. This course was one of the first courses for these students in the program; therefore, students may have been unsure how to take a graduate test. Additionally, since the students were all beginning their coursework and were probably similar in their abilities, this may have accounted for the lack in variability of scoring on the test items. According to Frank-Stromborg (1988), coefficient alpha, which encompasses KR-20, is not appropriate for instruments which are criterion-referenced or for instruments that have a small number of items. Many of the studies previously discussed did not report a KR-20 or Cronbach's alpha for knowledge tests (Gordon, Brown, et al. 2006; Gordon, Shaffer, et al., 2006; Jeffries et al., 2003; Kardong-Edgren et al., 2007; Morgan et al., 2006).

The results regarding knowledge on this study are in contrast to results found in several high-fidelity simulation research studies. As discussed in Chapter 2, results from the study by Gordon, Shaffer, et al. (2006), showed no significant differences between the simulator-based and traditional method in either of the content areas. After one session with medical students, cognitive differences between traditional lecture and simulation teaching were not detected (Gordon, Shaffer, et al). In another high-fidelity research study by Kardong-Edgren et al. (2007), there were no significant differences between the scores of the pre and post knowledge tests for three groups: one that received lecture only, one group who received lecture plus demonstration on a static mannequin, and one group who received lecture and demonstration on a high-fidelity simulator, Sim-Man®. A third study by Jeffries & Rizzolo (n.d.) also showed no difference in knowledge gain between three groups: (1) control, who were given a paper/pencil scenario about a patient post-operatively and were allowed to work as a group to solve the problems, (2) those who participated in a simulated experience about a post-operative patient using a static mannequin, and (3) those who participated in a simulated experience about a post-operative patient using a high-fidelity patient simulator.

The findings related to knowledge may support the fact that lecture many times focuses on learning of facts, often those associated with recall (Diamond, 1998). Therefore, application of the knowledge in a test is not evaluated, or if it is, students may not perform satisfactorily. This was demonstrated in this study by the fact that students had a hard time with an application test and that the highest mean, which was after lecture content, would still have only been a "C" in the course. Engaging the learner through multiple sensory channels, such as auditory and visual, with the simulator may have increased learning (Diamond) in this study. It is possible that the experimental group had a higher number of participants with auditory and visual preferred learning styles and greater linguistic and spatial intelligence (Prichard, 2005). Demonstration with the simulator may have also helped the adult learner apply previous experience (Knowles, 1970). In this study, learning in an environment similar to one in which the information needs to be recalled may have increased retrieval of the information, based on the observed difference between the groups (Koens et. al, 2003). Those students who had to recall information about newborn assessment who had demonstration within the classroom setting had increased knowledge compared to those that had lecture alone. Additionally, by observing others, a person may acquire knowledge (Bandura, 1986).

Self-Efficacy

Within the groups, there were statistically significant differences in self-efficacy, between the pre-test and post-test 1 and between the pre-test and post-test 2, but not between post-test 1 and post-test 2. As one would expect, self-efficacy or confidence about performing newborn assessment, increased after lecture (between the pre-test and post-test 1). Additionally, there was increased self-efficacy from before the lecture (pre-test) to after lecture four weeks later (post-test 2). However, between the first post-test and the second post-test four weeks later, there was not a statistically significant increase in self-efficacy. Students may not have felt they retained the knowledge about performing newborn assessment for four weeks, and that they may not have had any experience in assessing newborns within that time period. One would hypothesize that knowledge alone is not sufficient enough to retain or further increase self-efficacy and that performance or practice may play a role in this process. This is supported by Knowles (1970, 1973) who says that the learner should play an active role during learning. Research has shown that active learning has been found to be more successful than learning passively (Diamond, 1998). Even though demonstration was present in lecture with the simulator group, it did not require much active learning from the participants. Originally, the goal was to have all participants in the experimental group have some time with the simulator during the lecture time, but due to the lack of time, this was not possible.

Between the groups, there was not a statistically significant difference in perceived self-efficacy scores before lecture (pre-test), after lecture (post-test #1), and at the four week follow-up (post-test #2) between the groups. It is interesting to note, however, that when controlling for years of RN experience and prior tests, self-efficacy scores increased steadily for the experimental group from pre-test to post-test 1 and from post-test 1 to post-test 2. The control group had increased self-efficacy scores from pre-test to post-test 1, but then scores decreased slightly from post-test 1 to post-test 2. Overall, self-efficacy was higher in the control group at the pre-test, possibly due to the fact that the control group had a higher mean on both years of pediatric experience beyond basic RN preparation and years of newborn assessment beyond basic RN preparation, although not significantly. The highest self-efficacy scores, however, were in the experimental group on post-test 2. As discussed above, knowledge may not be sufficient enough to retain or further increase confidence. Demonstration, as with the experimental group, may not have any added benefits for increasing self-efficacy. Additionally, exposure time to simulation may not have been sufficient in dose to see a change in self-efficacy.

Self-efficacy in this study was increased, although not significantly between the groups. Several other research studies discussed previously have demonstrated an increase in perceived self-efficacy with the use of high-fidelity simulation (Jeffries & Rizzolo, n.d.; Leflore et al., 2007; Michael, 2005).

Satisfaction

No statistically significant differences were noted between the groups on satisfaction; however, scores were slightly higher in the control group. When looking at the student comments on what they liked, several in the experimental group commented that they liked the mannequin. Both groups commented that the instructor was good, along with liking the Powerpoint pictures. Additionally, several liked the topic, in general. For improvement suggestions, a theme that emerged from both groups was that more time was needed for the lecture. However, more comments were made in the experimental group regarding the lack of time. Since demonstrating on the mannequin took extra time, the instructor did not have time to finish the lecture in the experimental group. This may be one reason that this group was not more satisfied than those in the control group. Additionally, due to the large room size and numbers of students enrolled in the course, along with limitations with the mannequin, not all students may have been able to hear abnormal sounds or see the demonstration clearly. There was also no structured time for students to have hands-on time with the mannequin, as several other topics were scheduled in the same day, and as discussed, the instructor ran out of time.

Results of this study were in contrast to many of those found in the literature. Most studies have found that participants who use high-fidelity simulators are satisfied (Bond, Kostenbader and McCarthy, 2001; Childs & Sepples, 2006; Feingold et al., 2004; Gordon, Brown, et al., 2006; Jeffries & Rizzolo, n.d.; Morgan et al., 2006; Tsai et al., 2003). Again, this lack of satisfaction may be due to lack of hands-on time with the simulator, along with decreased lecture time. From previous experience, students are often dissatisfied if not all lecture material is covered.

Recommendations

This section includes recommendations for further research based on the results of this study:

1) Repetition of the study is suggested due to the small number of participants and unequal groups. Since the intervention was conducted in a brief episode, it would be interesting to repeat the study using simulation integrated into lecture for several of the content areas.
2) Due to the lack of "hands-on" time with the simulator, student comments, and lack of increased self-efficacy between the groups, it is suggested to repeat this study, however, allowing those in the experimental group structured time with the simulator where all participants would be allowed time to practice newborn assessment. This would also maximize the use of the simulator, in which the instructor could model the behavior or procedure and then have the student, in turn; demonstrate (Lupien & George-Gay, 2001). This instructional strategy may increase knowledge, as it would further mimic the environment in which the information needs to be recalled (Koens et al., 2003). It would also provide the participants experience which may increase self-efficacy through several different means. The participants would be able to have a successful experience, i.e. performance accomplishment (Bandura, 1977). Vicarious reinforcement might

occur by having participants observe another get reinforced, which has been shown to increase adoption of the behavior more than with modeling alone. In a supportive educational practice environment where anxiety would be at a minimum, emotional arousal might also occur (Bandura, 1977). Practice would further give participants a concrete experience (event), in which to reflect (reflective observation), take what was learned (abstract conceptualization) and plan what would be changed the next time (planning for implementation) and then change it for the next time (active experimentation) (Dunn, 2004a).. Additionally, this type of learning might benefit kinaesthetic learners, along with those with bodily-kinaesthetic intelligence, since they learn best by doing (Prichard, 2005).

3) It would be interesting in a repeated study to assess primary learning style of the participants in order to assess whether kinaesthetic learners have increased satisfaction and knowledge with high-fidelity simulation over auditory and visual learners. Additionally, a tool could be found or developed to evaluate type of intelligence. Type of intelligence could then be related to learning with high-fidelity simulation.
4) This study demonstrated Miller's (1990) bottom layer of medical competence, knowledge. It possibly also demonstrated the second layer, competence, which is applying that knowledge, although application in this study was demonstrated through an objective paper-pencil test. To test the next level, performance, it is suggested that a research study be conducted where performance (assessment of the newborn) is evaluated between two groups: those that receive didactic lecture

and those that receive lecture integrated with simulation. The high-fidelity simulator could also be used for demonstration of performance. By evaluating performance, it might further demonstrate that by observing others, a person can acquire not only knowledge, but new behavior (Bandura, 1986).

5) A secondary purpose of this study was to apply the principles regarding knowledge, self-efficacy, and satisfaction, and relate them to the present body of knowledge in the field of health education in order to improve health outcomes. In this study, integration of simulation into lecture increased knowledge over lecture alone; self-efficacy increased, although not statistically significant between the lecture group and the group that had lecture integrated with simulation; and satisfaction was not statistically significant between the groups. Additionally, the review of literature demonstrated a lack of high-fidelity simulation usage in health education, beyond nursing and medicine. Although other types of simulation, such as computer-based and case studies, within this field have been utilized for both clients and students of health education, not many research studies were found in this area. It is suggested that a variety of simulation methods be explored for both clients and students of health education, and that research be conducted to evaluate the instructional methodology.

It is hypothesized that the results of this study differ from those in the literature for several reasons. The first is that, in this study, the high-fidelity simulator (mannequin) was integrated into lecture content and was not used as an "event" post-lecture. Knowledge was assessed not only following the lecture, but also four weeks later.

Additionally, statistics were run controlling for the confounding variable of years of RN experience.

High-fidelity simulation integrated within lecture content, as demonstrated in this study, may be used ". . . as a bridge between theory and practice" (Hravnak et al., 2005, p. 98). However, demonstration alone with a high-fidelity simulator may not be enough. Additionally, integrating high-fidelity simulation into lecture increases lecture time. Further research into this method of instruction, which utilizes constructs from health education theory, such as modeling (Bandura, 1977. 1986), and active learning (Knowles, 1970, 1973, 1978, 1984), needs to be explored for those in health education professions.

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APPENDIX A

Informed Consent

INFORMED CONSENT

PRINCIPAL INVESTIGATOR: Mindi Anderson, MSN, RN, CPNP

TITLE OF PROJECT: Effect of Integrated High-Fidelity Simulation in Knowledge, Perceived Self-Efficacy and Satisfaction of Nurse Practitioner Students in Newborn Assessment?

This Informed Consent will explain about being a research subject in an experiment. It is important that you read this material carefully and then decide if you wish to be a volunteer.

PURPOSE:
The purpose(s) of this research study is/are as follows:
To compare knowledge, perceived self-efficacy, and satisfaction between nurse practitioner students enrolled in N5418 Advanced Health Assessment in Nursing Practice at the University of Texas at Arlington School of Nursing (UTASON) who receive traditional didactic lecture compared with those nurse practitioner students who receive lecture augmented with a high-fidelity simulator for the newborn assessment content. Additionally, the purpose will be to apply the principles regarding knowledge, self-efficacy, and satisfaction and relate them to the present body of knowledge in the field of health studies in order to improve health education outcomes.

DURATION:
In addition to lecture, the duration of this study is approximately 1 ½ hours total (approximately 30 minutes each time) to fill out the three questionnaires.

PROCEDURES:
After IRB approval is obtained from the University of Texas at Arlington and Texas Woman's University, all nurse practitioner students enrolled in N5418 Advanced Health Assessment in Nursing Practice at UTASON, which consists of Pediatric Nurse Practitioner students, Acute Care Pediatric Nurse Practitioner students, Family Nurse Practitioner students, Adult Nurse Practitioner students, Geriatric Nurse Practitioner students, Psychiatric Mental Health Nurse Practitioner students, and Emergency Nurse Practitioner students, will be asked to participate by an instructor within the classroom setting. Informed consent will be obtained from all participants.

The students enrolled in the course during the fall of 2006 will serve as the control group, Group I. Students enrolled in the course during the spring of 2007 will serve as the experimental group, Group II. Students in Groups I will receive traditional didactic lecture on newborn assessment content. Students in Group II will receive lecture augmented with high-fidelity simulation through use of a high-fidelity patient simulator, SimBaby® manufactured by Laerdal (Laerdal Medical, 2001-2006).

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All students present for lecture will be handed a packet of questionnaires. Those who chose not to participate may return the packet with the questionnaires unanswered. For those students in Group I & II that chose to participate, before and after lecture, they will take the Newborn Assessment Knowledge Tool regarding newborn assessment, which will not count toward the course grade. They will also fill out a Perceived Self-Efficacy Tool for Newborn Assessment, regarding how confident they feel about performing a newborn assessment. Post lecture, participants will fill out the Educational Session Satisfaction Tool. The satisfaction survey will include a few demographic questions. Four weeks following the lecture, students will again fill out the Newborn Assessment Knowledge Tool and the Perceived Self-Efficacy Tool for Newborn Assessment.

POSSIBLE RISKS/DISCOMFORTS:
The possible risks and/or discomforts of your involvement include:
In any study, there is a chance of breach of confidentiality, however, no identifiable information will be collected or stored. There is also a risk of coercion. In order to reduce this risk, no added benefits will be given to those who participate and no penalties will be given to those who choose not to participate. Another possible risk is emotional discomfort or anxiety regarding performance on the study questionnaires; however, the answers on three questionnaires will not influence your course grade in any way.

POSSIBLE BENEFITS:
The possible benefits of your participation are: helping the graduate faculty and the principal investigator evaluate the effectiveness of simulation in nurse practitioner education. In addition, you will be able to practice taking test questions related to the content. Participation is voluntary and participants may withdraw at any time without penalty. Refusal to participate will involve no penalty or loss of benefits to which the subject is otherwise entitled.

ALTERNATIVE PROCEDURES / TREATMENTS:
The alternative procedures / treatments available to you if you elect not to participate in this study are:
There are no alternatives to the way the lecture format is given as this is part of the course; however, participation in completing the questionnaires is completely voluntary.

CONFIDENTIALITY:
Every attempt will be made to see that your study results are kept confidential. A copy of the records from this study will be stored in a locked cabinet in Room 637 in Pickard Hall and available only to the principle investigator and designated staff/faculty within the School of Nursing for at least three for at least three (3) years after the end of this research. The results of this study may be published and/or presented at meetings without

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naming you as a subject. Although your rights and privacy will be maintained, the Secretary of the Department of Health and Human Services, the UTA IRB, and the personnel particular to this research (Mindi Anderson or Judy Leflore, School of Nursing) have access to the study records. Your information will be kept completely confidential according to current legal requirements. They will not be revealed unless required by law, or as noted above.

FINANCIAL COSTS:
The possible financial costs to you as a participant in this research study are: none.

CONTACT FOR QUESTIONS:
If you have any questions, problems or research-related medical problems at any time, you may call Mindi Anderson at (817) 272-2776 or Judy Leflore at (817) 272-2776. You may call the Chairman of the Institutional Review Board at 817/272-1235 for any questions you may have about your rights as a research subject.

VOLUNTARY PARTICIPATION:
Participation in this research experiment is voluntary. You may refuse to participate or quit at any time. If you quit or refuse to participate, the benefits (or treatment) to which you are otherwise entitled will not be affected. You may quit by calling Mindi Anderson, whose phone number is (817) 272-2776. You will be told immediately if any of the results of the study should reasonably be expected to make you change your mind about staying in the study. While completing the questionnaires, you may quit at any time by not completing the questionnaire/s or you may chose not to answer certain questions.

By signing below, you confirm that you have read or had this document read to you. You will be given a signed copy of this informed consent document. You have been and will continue to be given the chance to ask questions and to discuss our participation with the investigator.

You freely and voluntarily choose to be in this research project.

PRINCIPAL INVESTIGATOR: ______________________________

DATE

____

SIGNATURE OF VOLUNTEER DATE

APPENDIX B

Newborn Assessment Knowledge Tool

1. A new mother has a history of Type I diabetes. By history, she tells you that her blood sugar remained in control throughout her pregnancy. She just delivered her infant by Caesarian section. What assessment finding might you expect to find upon examination of the infant immediately after birth?

   A. Hydrocephaly
   B. Cephalohematoma
   C. **Macrosomia**
   D. Acanthosis nigricans

2. What is the best position to accurately assess an infant's anterior fontanel?

   A. Sitting up
   B. Prone
   C. Side lying
   D. Supine

3. During a newborn examination in the nursery, you note the infant is lying with one arm extended at his side while his other arm and legs are flexed. What do you suspect?

   A. Nothing, this is a normal finding
   B. Fractured clavicle
   C. Dislocated hip
   D. Erb's palsy

4. A newborn following a Caesarian section birth is breathing 70 times a minute, has a vigorous cry, and acryocyanosis. On physical examination, you note rales in the bases. The most likely etiology is

   A. respiratory distress.
   B. pneumonia.
   C. congestive heart failure.
   D. **transient tachypnea of the newborn.**

5. During the discharge examination of a newborn at 48 hours of life, you note a 2/6 systolic ejection murmur. Pulses are equal in the infant's upper and lower extremities, and you palpate the liver 2 cm below the right costal margin. The infant has been feeding well. Your next course of action is to

   A. Order an echocardiogram and chest X-ray.
   B. Call the physician immediately.
   C. Educate the parents about the murmur and signs of heart failure.
   D. Document the finding in the chart.

6. A mother calls you when her baby is 10 days old with the complaint that the baby is "not eating well." While breastfeeding, the baby latches on but then pulls away. She also notes some sweating during feeds and occasional "fast breathing." The mother states the baby is pink and still having wet diapers. What is your next course of action?

   A. Send her to the emergency room now.
   B. Schedule an appointment to see you today.
   C. Schedule the baby to see you first thing in the morning.
   D. Tell the mother to call 911.

7. You see an infant for a two week well visit. The physical exam reveals a 3/6 holosystolic ejection murmur. Pulses are equal in all extremities, and the baby is pink. You note the infant's liver is down 3-4 cm and exam of the respiratory system reveals a respiratory rate of 76 with mild to moderate intercostal and subcostal retractions and bilateral rales in both bases. The most likely etiology for these symptoms

   A. heart failure.
   B. pneumonia.
   C. normal newborn.
   D. reactive airway disease.

8. You are assessing a 10-day-old infant who is febrile, not eating well, and has a high-pitched cry. History reveals that the mother was colonized with Group B strep, and that the infant was not treated postnatally You decide that this baby has meningitis based upon the history and physical finding of

   A. macular papular erythematous rash on trunk and head.
   B. liver 2 cm below the right costal margin.
   C. full fontanel.
   D. blue macular patch on buttocks.

9. Which of the following physical findings would you expect to see in a newborn in the second stage (30 minutes-2 hours) of intrauterine to extrauterine life?

   A. Some twitching but quickly returns to rest.
   B. Heart rate of 80 beats per minute.
   C. Respiratory rate of 40 breaths per minute
   D. Generalized cyanosis.

10. Which of the following physical assessment findings would suggest a dislocated hip?

   A. No click noted with Ortolani's test.
   B. Unequal thigh folds.
   C. Negative Barlow's test.
   D. Flexed legs.

APPENDIX C

Perceived Self-Efficacy Tool for Newborn Assessment

Directions: This is a questionnaire designed to determine how confident/sure students are that they can do each of the following statements. Read each statement and then mark the number to the right of the statement to indicate how you generally feel. There is no right or wrong answers. Do not spend too much time on any one statement, but give the answer which seems to describe how you generally feel.

Statements 1 to 20 refer to conducting health assessment of the newborn

Not at all true 1	**Hardly true** 2	**Moderately true** 3	**Exactly true** 4

	1	2	3	4
1. I can always manage to obtain a valid peripartum history using appropriate interview techniques.				
2. I can recognize significant peripartum history findings related to risk factors for the newborn.				
3. I can document significant components of the peripartum history.				
4. I know which aspects of data collection are significant in assessment of the newborn.				
5. I can focus on the patient and obtain vital signs.				
6. I can focus on the patient and conduct a general survey.				
7. I can focus on the patient and conduct a complete newborn assessment which includes:				
a. Determining gestational age				
b. Inspection (skin; head, including hair; face, including mouth, eyes, and ears; neck; chest, including precordium; abdomen, including umbilical cord; anus; genitalia; extremities; posture)				
c. Palpation (fontanel; chest; pulses; abdomen; anal reflex; genitalia; hips for dislocation; newborn reflexes)				
d. Auscultation (lung, heart and bowel sounds; apical pulse)				
8. I can recognize assessment findings that may be a variation of normal and deal effectively with them.				
9. I can recognize and deal effectively with unexpected findings related to assessment of the newborn.				

10. I understand the significance of abnormal assessment data related to assessment of the newborn.				
11. I can remain calm when facing difficulties while conducting a newborn assessment because I can rely on my coping abilities.				
12. If I am having trouble conducting the newborn assessment, I can solve the problem.				
13. I can focus on the patient and document appropriate findings of a complete newborn assessment.				
14. I can usually handle whatever happens when I am conducting a newborn assessment.				
15. I am confident that I could deal efficiently with unexpected events while completing a newborn assessment.				

APPENDIX D

Educational Session Satisfaction Tool

University of Texas at Arlington
School of Nursing
Educational Session Satisfaction Tool

Instructions: Please evaluate the education session you participated in by checking one of the blocks to the right of the statement. Strongly Agree, indicates the statement was thoroughly and completely met, Strongly Disagree, indicates that the statement was not met at all.

Date of session: ________________

	Strongly Agree **5**	**Agree** **4**	**Neutral** **3**	**Disagree** **2**	**Strongly Disagree** **1**
1. The length of time allotted for this education session was sufficient.					
2. This education session helped me meet my learning objectives.					
3. I learned a lot from this education session.					
4. This education session was better than what I thought it would be.					
5. The environment for this education session was conducive to my learning.					
6. I believe the information learned in this education session will enhance my practice.					
7. I think the education session gave me an opportunity to demonstrate my critical thinking skills.					
8. I believe I will be able to appropriately apply the information learned in this education session to my practice.					

9. I believe that I will adequately be able to make decisions about physical findings associated with newborn assessment.					
Mark the correct response:					
10. I am: MALE FEMALE					
11. I am a/an _____ student : PNP ACPNP ANP FNP GNP PMHNP ENP					
12. Age 20-30 31-40 41-50 51-60 Over age 60					
13. Years of experience as a nurse _______________					
14. Do you have previous experience with a high-fidelity simulator? YES NO					
15. Do you have any pediatric experience beyond your basic RN preparation? YES NO					
16. If you do have pediatric experience beyond your basic RN preparation, how many years? _______________					

17. Do you have any experience with newborn assessment beyond your basic RN preparation? YES NO					
18. If you do have experience with newborn assessment beyond your basic RN preparation, how many years? ________________					

Comments:

What did you like about this education session?

How could this education session be improved for the future?

Other Comments:

Thanks For Your Input!

* Adapted with permission from Prairie View A & M University College of Nursing