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Anxiety as a Mediating Variable to Learning Outcomes in a Human Patient Simulation
Experience: A Mixed Methods Study

A dissertation submitted to the
Graduate School
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In partial fulfillment of the requirements for the degree of
Doctor of Philosophy
of the College of Nursing
by
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Abstract

The primary purpose of this study was to test a hypothesized model describing the direct effects of learning variables on anxiety and cognitive learning outcomes and the mediating effects of anxiety on cognitive learning outcomes in a high-fidelity human patient simulation (HPS) experience. The secondary purpose of this study was to explain and explore student perceptions concerning the qualities and context of human patient simulation affecting anxiety and learning that may be amenable to intervention.

This study used a mixed methods QUAN dominant explanatory design with simultaneous qualitative data collection to examine variables affecting learning in undergraduate, beginning nursing students ($n=124$) enrolled in a fundamental nursing course. Data were collected using an investigator constructed Factors Affecting Learning Questionnaire, as well as, a Learner and Lifestyle Questionnaire, Elsevier Evolve custom parallel pre- and post-tests, the Building Excellence Survey, the State-Trait Anxiety Inventory, and a semi-structured group discussion.

A path analysis identified relationships between cognitive learning and anxiety, readiness to learn, preparation for simulation, and learning styles. Both readiness to learn ($\beta = -.31, p < .01$) and preparation for simulation directly affected anxiety ($\beta = .22, p < .01$). Anxiety and cognitive learning outcomes were directly affected by having a strong auditory-verbal learning style ($\beta = .21, p < .01$) and ($\beta = .27, p < .01$), respectively. A hands-on learning style mildly influenced cognitive learning outcomes ($-.17, p < .05$). The standardized indirect effect between anxiety and cognitive learning outcomes was .08; indicating anxiety did not mediate cognitive learning outcomes as theorized.

Dissonance was found between the quantitative and qualitative data. Students reported increased levels of anxiety, which negatively affected their learning.

A gap exists in the literature involving variables affecting learning outcomes in simulation experiences. Filling this gap in the literature is the strength of this study. This study advances nursing education science by providing evidence concerning variables affecting learning outcomes in high-fidelity HPS. Using a mixed methods design provided a complete representation of student perspectives concerning the qualities and context of human patient simulation affecting anxiety and learning.

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“I’ve heard it said
That people come into our lives for a reason
Bringing something we must learn ...
I know I’m who I am today
Because I knew you...”
~ Schwartz

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Dedications

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“Because I knew you...I have been changed ...*for good*.” ~Schwartz

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Chapter One: Introduction

Statement of the Problem

Nurse educators can no longer afford to teach the way they were taught (Diekelmann, 2002), since the healthcare system for which they were educated no longer exists (Porter-O'Grady, 2001). It is vitally important for faculty members to teach nursing students critical thinking skills for a rapidly changing, contemporary healthcare system (Ironsides, 2005).

The ever-rising patient acuity in hospitals has created major changes in acute care systems. Emergency department visits alone have climbed by 29% during the past 17 years (American Hospital Association, 2009). Patients require increasingly complex care, yet are being discharged more quickly. The average length of a hospital stay during the past 20 years has decreased by 24% (American Hospital Association, 2009), leading to a significant decrease in nursing student learning opportunities in the acute hospital environment. Difficulty in procuring clinical placements for nursing students parallels an increasing nursing student enrollment (Department of Health & Human Services, 2005).

Concurrent with the change in healthcare, students presently attending universities are not the same students the higher education system was designed to teach (Prensky, 2001a). Current students have been raised in a digital age, a culture all its own. These students are familiar and comfortable with both digital language and digital learning styles. Students also have become

accustomed to instantaneous information and education that is entertaining (Ridley, 2007). Tools and habits provided by one's culture influence thinking processes and behavior (Nesbitt & Norenzayan, 2002) and ultimately influence how one learns (Brislin, 1990; Tweed & Lehman, 2002). The digital age in which the current population of students has been raised most certainly affects how they think, process information, and learn (Nesbitt & Norenzayan, 2002; Prensky, 2001a; Prensky, 2001b).

As a result of the concurrent changes in the healthcare system and the evolution of the learner, healthcare educators are challenged to transform the higher education system. They are being asked to use more interactive teaching strategies based on student-centered learning and the constructivism model of education (Ridley, 2007). Implementing interactive teaching strategies requires teachers to: a) encourage students to take an active role in their own learning; b) create student-centered classrooms as opposed to teacher-dominant instruction; c) provide a supportive, risk free environment in which to learn; and d) construct creative activities to foster learner engagement (National Research Council, 2000; Ridley, 2007; Wolfe, 2001).

Nursing faculty members are incorporating the use of technology into the classroom to bridge the disconnect between the changing healthcare system and the contemporary learner. Miller, Kokot, et al. (2005) reported that students who used Personal Digital Assistants (PDAs)

in the clinical setting asked more questions concerning clinical situations and recognized the importance of using current resources in the clinical setting more than students without PDAs.

The use of hand-held tracking devices by community clinical students is another effective mode of interactive teaching. Webcasting and Web-based courses (Ndiwane, 2005; Jang, Hwang, Park, Kim, & Kim, 2005; Miller, Koyanagi, & Morgan, 2005; Ostrow & DiMaria-Ghalili, 2005), as well as, interactive, Web-based environments, such as The Neighborhood TM and Second Life TM are rapidly emerging, technology-enhanced teaching tools (Educause Learning Initiatives, June 2006; Giddens, 2007; Skiba, 2007).

Conducting simulation activities using a high-fidelity human patient simulator (HPS) is yet another increasing popular approach to using technology to bridge the gap between the needs of the learner and the changing healthcare environment. Schools of nursing are purchasing high-fidelity simulators despite having minimal data supporting that simulators are effective teaching tools. This type of high-fidelity technology comes with a steep cost during a time when receiving educational grant funding is very competitive. To purchase high-fidelity simulators schools spend between \$30,000 and \$300,000, depending on the simulator's fidelity or physiological complexity (M. Sizemore, T. LeMaster, personal correspondence, September, 2008, Bremner, Aduddell, Bennett, VanGeest, 2006). Associated costs include staffing to maintain the high-fidelity HPS and the situated learning environment for the simulator.

Purchases are made with the assumption that simulation activities will prepare students to think critically (e.g., see Rauen, 2004 and Jeffries, 2005 a). Many healthcare educators assert that the use of high-fidelity HPS prepares students to perform skills with competence and confidence (Alinier, Hunt, & Gordon, 2004; Ziv, Small, & Wolpe, 2000), while additionally meeting the learning needs of the digital age student (Jeffries, 2007) but little data has been reported to support these assertions.

Proponents of high-fidelity human patient simulators in healthcare education believe simulation experiences provide an interactive learning environment necessary for meaningful or deep learning (Bearnson & Wiker, 2005; Cioffi, 2001; Eaves & Flagg, 2001; Jeffries, Spunt, Childs, Robers, & Childress, 2006). Likewise, students value the use of a high-fidelity human patient simulator as an interactive learning tool (Henneman & Cunningham, 2005; Jeffries, 2007; Kuznar, 2007). Simulation experiences have increased confidence in nursing and medical students alike (Henneman & Cunningham, 2005). Yet, there are scant rigorous, quantitative research studies concerning the effectiveness of using a high-fidelity HPS as a teaching tool to improve cognitive outcomes. Many health education scholars are calling for research regarding the efficacy of using the high-fidelity HPS as a teaching tool (Halstead, 2006; Jeffries, 2007). However, before empirically determining the efficacy of simulation, it is important to explore variables with potential to affect the educational outcome of simulation experiences. The

literature suggests there are many variables that affect learning: a) environment, b) nutrition, c) emotions, d) gender, e) sleep, f) culture, g) learning styles, h) previous learning experiences (Jensen, 2000). There are no studies to date, however, examining variables affecting learning in a simulated environment.

Purpose of the Study

The purpose of this mixed methods study was twofold. The primary purpose was to test a hypothesized model describing the direct effects of learning variables on anxiety and cognitive learning outcomes, as well as, the mediating effects of anxiety on cognitive learning outcomes in a high-fidelity human patient simulation experience. The learning variables hypothesized to affect anxiety and cognitive learning outcomes included age, anticipated course grade, gender, learning style, nutrition, sleep, preparation, work, and prior simulation experiences. The purpose of this study was also to explain and explore the qualities and context of high-fidelity human patient simulation that affect anxiety and learning.

Stage One: Quantitative Research Aims

The population studied was beginning baccalaureate, nursing students enrolled in 29-NURS 202, a fundamental nursing course, at a Midwestern Bachelor of Science in nursing program. The research aims in this population included:

1. To determine if the hypothesized model fit the observed data.

2. To determine whether individual and/or lifestyle characteristics (age, anticipated course grade, gender, learning style, nutrition, sleep, preparation, work, and prior simulation experience) directly affected anxiety and cognitive learning outcomes.
3. To determine if anxiety mediates cognitive learning outcomes.

Stage Two: Qualitative Research Aim

The qualitative research aim was to explain the quantitative results and explore student perceptions concerning the qualities and context of high-fidelity human patient simulation affecting anxiety and cognitive learning outcomes that may be amenable to intervention.

Theoretical Model

The theoretical model was based on literature, theory, and personal experience. Primarily, it was hypothesized that anxiety would mediate cognitive learning outcomes in beginning nursing students in a human patient simulation experience. It was also hypothesized that lifestyle characteristics: nutrition, sleep, and direct patient care work experience, as well as, learner characteristics: age, gender, anticipated course grade, preparation, learning style, and prior simulation experiences would directly affect anxiety and cognitive learning outcomes.

Figure 1.1 Theoretical Model

Conceptual Definitions of Terms

It is important to explain the concepts and terms used in this study before continuing further discussion. In this study a *high-fidelity human patient simulator* is a full-bodied mannequin that is operator-controlled via computer to imitate a patient's physiological responses to applied interventions. This mannequin represents the clinical patient who a student may encounter during a clinical rotation. The student is expected to intervene appropriately to address medical problems presented by the simulator, brand named SimMan®.

The *simulation experience* in this study is an unfolding case study of a post-operative patient being bathed by the beginning nursing student. The "patient's" vital signs deteriorate requiring the students to intervene. A typical simulation at the University of Cincinnati College

of Nursing consists of the following: two weeks prior to the simulation experience the student is given the scenario, the objectives of the simulation, and an explanation of the roles in the simulation scenario. The day of the experience the student arrives at the simulation laboratory and is given a “patient report”, similar to a report that is given to a registered nurse on a clinical unit. The student is then asked to “administer care” to the high-fidelity simulator as one would administer care to a patient in the hospital. The simulated scenario ends at either a pre-designated time or with the “patient’s” demise. The faculty member then conducts a debriefing and the simulation experience is completed. Please see Appendix A for entire simulation scenario.

State Anxiety is a brief, limited experience of apprehension and increased autonomic nervous system activity due to stressful or threatening stimuli (Spielberger, 1983). In a testing situation, the anxiety response is a function of perceived threat influenced by the nature of the test, test preparedness, the student’s aptitude and ability, as well as, personality traits (Spielberger, 1983).

Worry “refers to the cognitive elements of the anxiety experience, such as negative expectations and cognitive concerns about oneself, the situation at hand, and potential consequences” (Liebert & Morris, 1969, pg. 240).

Whereas, *emotionality* “refers to one's perception of the physiological-affective elements of the anxiety experience, that is, indications of autonomic arousal and unpleasant feeling states, such as nervousness and tension" (Liebert & Morris, 1969, pg. 240).

Learning is the complex process of knowledge construction through concrete experience, reflection of the experience, transformation of abstractions, and application of the knowledge gained to new situations (Jeffries, 2005b). Further, *deep learning* involves the process of integrating new information with stored information. Deep learning implies long-term retention. Learning how to learn is a significant component of deep learning (Marton, Hounsell, Entwistle, 1984; Houghton, 2004)

Cognitive learning outcomes are the result of conscious intellectual activity in the acquisition of knowledge (Merriam-Webster, 2007-2008). The acquisition of knowledge is manifested as the difference in pre-test and post-test scores in this current study.

A debriefing period involves a reflective-thinking discussion led by a faculty member. The debriefing occurs directly following the simulation to best capture the immediate emotions and perceptions of the learner. This is accomplished using standardized critique questions. These questions are used to guide the learner in reflection about the experience. In response, the faculty member refines students' perceptions about safe delivery of nursing care, hence moving them toward critical reasoning. Debriefing facilitates the link between theory and practice and

provides review of relevant teaching points (Jeffries, 2005a). The laboratory director at the University of Cincinnati College of Nursing, Valorie Grant MSN, MEd, RN, created the standardized debriefing tool used in this study. Please see Appendix B for the debriefing tool.

A beginning, undergraduate, nursing student differs among nursing programs. For this study, a beginning, undergraduate, nursing student is a Bachelor of Science in Nursing student enrolled in NURS 202 at the University of Cincinnati College of Nursing.

Lifestyle Characteristics are measurements of nutrition and sleep prior to a simulation experience using a high-fidelity human patient simulator. Whereas, *Learner Characteristics* are the participants' ethnicity, race, gender, age, study habits for simulation experience, prior simulation experience, work experience, self-reported grade in course, and learning style.

Participant roles are the roles to which each student was assigned when participating in the simulation experience. Typically, participant roles vary among simulations and are determined by the simulation scenario objectives. For the purposes of this study, the roles consisted of: a) Student Nurse 1 assigned to patient, b) Student Nurse 2 assigned to help Student Nurse 1, c) one or two Family Members, d) and one or two Observers. Participants in this study assigned to the Student Nurse 1 and Student Nurse 2 roles, are more actively involved and are directly responsible for the outcomes of the simulation experience compared to the Family Member and Observer roles.

Significance of the Problem

Safety

Patients are not safe in America's healthcare system. The statistics are staggering, as reported in the Institute of Medicine's safety report, *To Err is Human* (Kohn, Corrigan, & Donaldson, 2000). Adverse events-injury caused by medical errors- reportedly occur in between 2.9 to 3.7 % of all hospitalizations each year. This computes to approximately one million injuries a year. One half of these adverse events can be directly related to preventable medical errors. Further, between 6.6 and 13.6 % of adverse events end in a patient's death each year (Kohn et al., 2000). When the numbers are extrapolated to total hospital admissions in the United States, we find an astounding 44,000 - 98,000 deaths resulting from medical errors (Kohn et al., 2000).

Preventable adverse medication events cost the nation \$2 billion a year in increased hospital costs (Kohn et al., 2000). To this end, quality improvement with an emphasis on patient safety has become a strong initiative in healthcare. Nurses are on the forefront of promoting a culture of patient safety and need to be educated to do so (Stanton, Chambers, & Piggott, 2001).

The Joint Commission (TJC) and the Institute of Medicine of the National Academies (IOM) have recognized the need for more reliable and safety-focused teaching strategies that educate students to become competently safe practitioners (The Joint Commission, 2008; Kohn

et al., 2000). Both agencies call for greater use of human patient simulation to improve patient outcomes (The Joint Commission, 2007; Kohn et al., 2000). Many faculty members also indicate that using a human patient simulator as a teaching tool will aid in accomplishing this safety initiative (Devitt et al., 1998; Eaves & Flagg, 2001; Gaba, 2004; McCausland, Curran, & Cataldi, 2004; McGaghie, Issenberg, & Petrusa, 2003; Wrobel, 2005; Ziv et al., 2000).

Evidenced Based Teaching

Nurse educators are charged with using evidence-based teaching and evaluation strategies; however, the evidence of using human patient simulation to improve cognitive learning outcomes is not conclusive (National League for Nursing, 2005). The National League of Nursing (NLN) conducted a national multi-site, multi-method study over a three-year period, the largest of its kind. This NLN study consisted of eight different sites across the nation with a sample size of 403 nursing students. The study found no cognitive differences between students in a simulated learning environment and those participating in a traditional case study using paper and pencil (Jeffries, 2007). It is probable there were mediating variables affecting both the simulation and control groups, but none were examined. Failing to examine mediating variables weakened the study's conclusion. There is a compelling need to evaluate possible mediators of learning in simulation. This current study will advance nursing education science and inform teaching practices by examining the variable, anxiety, and determining its affect on learning

outcomes. In the event anxiety mitigates learning, future work will be directed toward interventions to decrease anxiety during simulations.

Anxiety and Simulation

Descriptive, exploratory studies have reported that faculty members believe student anxiety is a stress response to participating in a simulation learning experience (Beischel, 2007; Rauen, 2001); therefore, anxiety is an important variable to examine. There are numerous reasons this experience may provoke anxiety. First, a simulation activity using a high-fidelity human patient simulator is a novel learning experience for many students. One would expect a novel experience, during which one is expected to perform and then be evaluated, would evoke a fear of the unknown. This fear of the unknown may result in anxiety, similar to test anxiety. Secondly, simulation exposes students to situations that demand complex decisions in a volatile environment with potentially unpredictable outcomes. Volatile environments mimic the reality of many medical emergencies and/or crises (Small et al., 1999). Anecdotally, graduate and undergraduate students report the “perceived reality” of being required to make good decisions during medical emergencies with potential unpredictable outcomes leads to student anxiety in simulation (A. Frezco, A. Schroeder, C. Morrison, R. Evans, personal communication, April, 2007). Thirdly, students in simulation experiences seek to “impress the instructor or not let her

down, which provokes many feelings of anxiety” (Morrison, personal communication, May 19, 2007).

The standards for academic nurse educators, as well as, the hallmarks of excellence in nursing education clearly stipulate that teaching strategies should be grounded in educational theory and evidence (National League for Nursing, 2005). The effect anxiety has on learning is described in the extensive literature reported over the past fifty years. Nurse educators must consider the evidence of how anxiety affects learning when creating new teaching strategies that may evoke anxiety in their students.

Anxiety and Testing

Anxiety, test anxiety in particular, is likely to influence cognitive learning outcomes (Papanastasiou, 2006; Sarason, 1973). Similarly, literature indicates an individual’s performance is negatively affected when that performance is tested or critiqued (Meyers & Martin, 1974). Nurse educators cannot ignore the abundant literature concerning the anxiety induced by situations in which students are tested nor anxiety’s negative impact on learning.

The high-fidelity simulation experience is similar to a testing situation for numerous reasons. The student’s performance is inevitably critiqued independent of whether a grade is attached to the performance. When a student is asked to act in front of others, erroneous answers and faulty execution of nursing interventions are apparent to all. This is particularly true when

video playback is a component of the debriefing period (Elfrink, Nininger, Rohig, & Lee, 2009).

The student is also aware of the expectation that the information presented in a simulated experience will be tested at a later date. Similar to test anxiety, it is anticipated that heightened anxiety negatively affects learning outcomes when a student participates in a high-fidelity human patient simulation learning experience.

Improving the quality of student learning outcomes is the purpose of seeking innovative teaching tools, such as the high-fidelity HPS. If elevated anxiety does indeed exist in a simulation experience and learning is thereby challenged, interventions must be developed to decrease debilitating anxiety. Yet, there are no reported quantitative studies examining whether anxiety has a mediating effect on the learning outcomes in a simulation experience.

This study will add to nursing education science by first examining whether anxiety mediates cognitive outcomes in a high-fidelity HPS experience. The study will identify learning variables directly affecting anxiety and cognitive learning outcomes and qualities of the simulation experience increasing anxiety that may be amenable to interventions.

Summary

While HPS is a teaching tool, it is nonetheless a situation where students are asked to perform in the presence of peers, are critiqued on their performance, and subsequently expected to retain the knowledge for testing purposes. A simulation experience is thought to be a safe

environment for learning, yet students claim anxious feelings when faced with a simulation experience. The literature indicates anxiety increases drive in some and has debilitating effects on others. It is important to study the effect anxiety, as a mediating variable, has on learning outcomes in a high-fidelity human patient simulation experience.

This chapter presented the problem statement, as well as, the purpose and significance of studying the relationship between anxiety and learning in a human patient simulation experience. Finally, key conceptual terms pertaining to this study were defined and research aims and hypotheses were provided.

Chapter Two: Literature Review

Background

Learning is influenced by many factors. It is important to examine the effect these influencing factors have on learning outcomes in simulation experiences before the effectiveness of simulation can be established. This literature review includes the following sections: a) simulation literature including, the history, rationale, applications, and research, b) variables as they apply to learning including, sleep, learning style, age, gender, participant roles, and nutrition, and c) test anxiety as the theoretical framework.

Simulation Defined

Simulation has been used in numerous fields such as the car industry, nuclear power planning, economics, education, aviation, medicine, and in the military (Bradley, 2006; McCausland, 2004). The term “simulation” has a multitude of meanings in healthcare education and a variety of simulators are being used. The National Council for the Boards of Schools of Nursing (NCSBN, 2005) has defined simulation as a means to mimic the reality of clinical situations, thereby allowing learners opportunities to demonstrate procedures, and to practice decision-making and clinical reasoning. Simulation in healthcare includes activities, such as, role-play, standardized patients, interactive videos, and mannequins. Table 2.1 summarizes a variety of simulators being used (Decker, Sportsman, Puetz, & Billings, 2008).

*Table 2.1**Summary of Simulation Typology*

Simulators	Definition	Uses
Partial task trainers	Models or mannequins used to learn, practice, and gain competency in simple techniques, and procedures	To learn,/evaluate competency in specific skill (eg. Venipuncture); patient scenarios can be integrated into learning experience to promote learners' development of critical thinking.
Peer-to-peer learning	Peer collaboration used to develop and master specific skills	To learn, develop, and evaluate competency in basic health and physical assessment.
Screen-based computer simulations	Computer programs used to (1) acquire knowledge, (2) assess competency of knowledge attainment, and (3) provide feedback related to clinical knowledge and critical-thinking skills	To learn, develop, and evaluate competency in a specific skill and integrate this knowledge and skill into patient care scenarios that require critical thinking.
Virtual reality	Combines a computer generated environment with tactile, auditory, and visual sensory stimuli provided through sophisticated partial trainers to promote increased authenticity.	To learn, develop, and evaluate competency in a specific skill (e.g., intravenous catheter insertion)
Haptic systems	A simulator that combines real-world and virtual reality exercises into the environments	To develop and evaluate competency in a specific skill with real time tracking of the practitioner's performance.
Standardized patients	Individuals, volunteers, or paid actor taught to portray patients in a realistic and consistent manner using case studies and role playing in the simulated learning environment	To develop and validate competency related to communication skills, while completing an interview, performing a physical assessment, and devising a plan for a patient.
Human patient simulators	Simulation incorporating a computerized full-body mannequin programmed to provide realistic physiologic responses to a practitioner's actions: requiring a realistic environment and the use of actual medical equipment and supplies.	Integrate and evaluate competencies, and clinical reasoning related to the synthesis of knowledge, technical and communication skills, and interdisciplinary team in the management of patients with complex problems.

History of High-Fidelity Human Patient Simulation

Nursing has been using simulation since the early 1900's. Simulation using mannequins began in 1911 with Mrs. Chase, a human like doll created to enhance teaching and repetitive practice of psychomotor skills (Herrmann, 1981). In the 1960's, the medical education community was introduced to 'Harvey', a mannequin equipped with heart and lung sounds. (Issenberg, McGaghie, Hart, et al. 1999) Soon after, Asmund Laerdal developed the well-known "Resusci-Anne", to facilitate resuscitation education. The fidelity, or realness, of simulators has continued to escalate in complexity to the current state.

The stimulus for high-fidelity human patient simulation seen in healthcare institutions and education facilities originated with the aviation industry. Simulation in the aviation industry began with Ed Link's creation of a simulated instrument panel in the 1930's. Aviation simulation progressed to the development of the crew resource management (CRM) model, created by Robert Helmreich. The CRM model was based on human factors research. This model focused on team improvement after studies demonstrated that more than 70 percent of airline accidents were due to human error stemming from poor communication, teamwork and decision-making. The overwhelming success of CRM training has recently compelled the healthcare industry to respond to safety initiatives by embracing high-fidelity human patient simulation experiences (Barach, Satish, & Streufert, 2001).

High-fidelity Human Patient Simulation

High-fidelity human patient simulation is a dramatic new teaching method in healthcare education. The high-fidelity HPS, a full-body mannequin with physiological responses programmed to respond to applied interventions, takes clinical simulation a step further. The mannequin breathes, blinks, seizes, and talks. In addition, the mannequin has palpable pulses and a heart rhythm that can be monitored, as well as, a heartbeat and respirations that can be auscultated.

Chickering's and Gamson's (1987) seven principles of good practice based on extensive higher education teaching and learning research form the foundation for using HPS as a teaching tool. The principles of good practice in undergraduate education include: a) "encourages contact between students and faculty", b) "develops reciprocity and cooperation among students" c) "uses active learning techniques", d) "gives prompt feedback:", e) "emphasizes time on task", f) "communicates high expectations", and g) "respects diverse talents and ways of learning" (Chickering & Gamson, 1987, pg. 2). Utilizing high-fidelity human patient simulation experiences in nursing education provides faculty members a venue to practice these principles.

Rationale for Human Patient Simulation

The high-fidelity human patient simulator is a teaching tool that allows the instructor to teach interactively. Students comment that simulation is most effective when the scenario and

environment are authentic to clinical situations (Childs & Sepples, 2006; McCausland et al., 2004). Participants in simulation experiences state this type of learning laboratory affords them an assurance of patient safety while they learn critical elements of patient care (Jeffries et al., 2006; McCausland et al., 2004; Nehring, Ellis, & Lashley, 2001). Simulation experiences also expose gaps in knowledge that otherwise may go unnoticed (Ackerman, Kenny, & Walker, 2007; Lasater, 2007). Simulation provides students the opportunity to make mistakes without an adverse effect on patients. Students appreciate this, reporting that simulation experiences are effective because they are able to learn from their mistakes without harming a patient (Ackerman, 2007; Lasater, 2007).

Faculty members in healthcare education report human patient simulators are useful teaching tools to facilitate critical thinking skills, to bridge the gap between theory and practice, and to provide a safe environment in which to practice psychomotor skills prior to clinical experience (Feingold, Calaluce, & Kallen, 2004; Nehring & Lashley, 2004; Rhodes & Curran, 2005). Simulation experiences also offer students opportunities to work on team building, communication skills, and leadership (Elder-Van Hook, 2004). Using a high-fidelity HPS enables instructors to create clinical situations in which students can experience infrequent but high stake medical events. This is often cited as one of the most important reasons for using the HPS (Issenberg, McGaghie, Petrusa, Gordon, & Scalese, 2005; Ziv et al., 2000).

Applications for Using Human Patient Simulation

The first nursing students to use high-fidelity human patient simulators were advanced practice nurses, specifically, nurse anesthesia students. Students studying to be nurse anesthetists used simulation experiences to become skilled at both, intubating patients and caring for them while under anesthesia. Using high-fidelity human patient simulators to train residents to be surgeons was another early application of simulation. High-fidelity simulation quickly advanced to training entire operating room teams the necessity of teamwork using CRM.

There are currently many applications for high-fidelity human patient simulators in undergraduate nursing education. In an international survey of thirty-four schools of nursing, Nehring and Lashley (2004) found applications for use include the evaluation of a student's: a) competency in synthesizing knowledge, b) technical and communication skills, c) ability to manage airways, d) use of the nursing process, and d) the management of critical events and complex clients.

Another use for high-fidelity simulation includes remediation. When students have difficulty transitioning between classroom and clinical arenas they require remediation. To this end, schools of nursing report using the HPS as a tool to provide individualized attention for students who experience these transition difficulties. Faculty members have reported anecdotal

success with using the HPS for this reason (Beischel, 2007; Haskvitz & Koop, 2004; M.

Sizemore, personal communication, September 2008).

Further use includes using the HPS as a tool for teaching pediatric and adult advanced cardiac life support skills. Additionally, Nehring, Lashley and Ellis (2001) report numerous scenarios in which students learn critical incident nursing management through the use of a high-fidelity human patient simulator. Some use this tool for clinical exams while others use it strictly to increase clinical exposure.

In 2004, Nehring and Lashley found that very few universities and community colleges were conducting research related to the use of simulation. In addition, they found community college programs used HPS more often than university programs and HPS were used with undergraduate nursing students more than graduate students. These findings were consistent with what Beischel (2007) found in southwest Ohio and northern Kentucky. While some faculty members, engaged in this type of active learning initiative, are excited about the prospects of what high-fidelity simulation brings to clinical education, others report skepticism. Voiced concerns include extensive faculty time for training and use, cost, fear of technology (Beischel, 2007; Nehring & Lashley, 2004), and lack of faculty knowledge about using HPS (Beischel, 2007).

Simulation Research: Descriptive or Qualitative

There are countless descriptive, qualitative studies in the simulation literature. Much of this literature reports the effect of high-fidelity human patient simulation experiences on the students' level of confidence. Some students report more confidence in nursing skills after participating in a simulation experience, as well as, a decreased level of stress when performing in the clinical setting (Alinier, Hunt, Gordon, & Harwood, 2006; Bremner, Aduddell, & Amason, 2008; Eaves & Flagg, 2001). Some students report they believe they will commit fewer clinical errors after participating in a simulation experience (McCausland et al., 2004), while others feel just as confident when practicing case studies (Jeffries, 2007). Developing self-confidence is an important element affecting a nurse's ability to make appropriate clinical decisions (White, 2003). But, determining whether cognitive learning outcomes and clinical performance improve with the use of this expensive teaching tool is likewise important.

Simulation Research: Quantitative

Students report an improvement in clinical performances after a human patient simulation experience (Alinier et al., 2006; M. N. Bremner et al., 2008; Eaves & Flagg, 2001) but this has not been well substantiated with large randomized, controlled trials. Leigh (2007), in her review of the simulation literature concerning self-efficacy, reports, "Studies validate learning is enhanced and knowledge is retained after participating in simulation exercises" (Section,

Effectiveness of HPS, par.5). However, the studies validating learning as cited in Leigh's literature review are descriptive, focus on the participants' satisfaction or confidence levels (Hamilton, 2005), claim quantitative evidence where none exists (Long, 2005), or are inaccurate citations in literature reviews (Feingold et al., 2004; Hamilton, 2005; Nehring et al., 2001).

In 2005, the Best Evidence in Medical Education Collaboration (BEME), an organization of individuals and institutions committed to promoting best evidence medical education, conducted an analysis of 171 studies in an attempt to determine which features and uses of high-fidelity simulations led to effective learning. This effective learning was measured by the level of participation in simulation, as well as, improved knowledge, skills and attitudes (Issenberg et al., 2005). Issenberg et al. noted the simulation studies used dissimilar tools to measure effectiveness, limiting the comparability of research methods. Likewise, the committee concluded the overall quality of the research was poor, resulting in an inability to provide a true synthesis of the literature. The BEME report disclosed that only 20% of the reviewed research publications reported outcomes that are "clear and probably true" (Issenberg et al., 2005, pg.24). From these findings, Issenberg et al. (2005) established guidelines concerning methods, tools and designs for future simulation researchers in an attempt to yield better research and scholarship in the simulation arena.

Since 2005, mixed results have been reported concerning the effectiveness of HPS. In a quasi-experimental study, Scherer, Bruce and Runkawatt (2007) found an increase in knowledge with no significant difference between the experimental (simulation) and control (case study) groups of nurse practitioner students. Likewise, there was no difference between groups when the students rated the experiences. The control group did experience a significant increase in all confidence scores when compared with the experimental group. Members of the case study group were permitted to elicit input concerning the diagnosis and management of the patient from the whole group, whereas the simulation group members were required to problem solve without the aid of others. Further, the simulation group was required to demonstrate hands-on skills while the control group was not. The differences between the experiences elicited different levels of confidence. Determining which variable mediated the difference is an important question to answer. As demonstrated in the literature, the difference could be performance anxiety.

Other studies have demonstrated the effectiveness of using HPS when teaching nursing students. Howard (2007) compared the effectiveness of using interactive case studies to human patient simulation for the acquisition of cognitive learning and critical thinking skills. Although the sample was small (n=50), Howard found a significant difference in cognitive learning outcomes and critical thinking skills in the HPS group as compared to the group using the

traditional interactive case study method of teaching. An Elsevier Evolve custom exam was used as the cognitive learning measurement tool in this study.

Ackerman (2007) conducted a quasi-experimental study of 64 nursing students to determine the effectiveness of acquiring cardiopulmonary resuscitation (CPR) knowledge and skills when using a high-fidelity HPS scenario in addition to the traditional review using half-mannequins. Ackerman's results, similar to Howard's (2007), found HPS significantly more effective in acquiring CPR knowledge and skills. When retention of knowledge and skills were tested, both groups (n=49) had lower scores than the original post-test scores, yet the HPS group experienced significantly higher scores than the control group.

Theoretical Perspectives Guiding Simulation Research

The use of learning theory as a guide for simulation activities is nearly nonexistent. Following their systematic review of the use of learning theory in nursing simulation literature, Kaakinen and Arwood (2009) concluded faculty are more likely to approach simulation using a teaching paradigm rather than learning paradigm. They examined 120 articles to determine if learning theories were used to design and assess learning in simulation experiences. From these articles, only 16 referenced any use of developmental or learning theory as the foundation for designing or conducting the simulation experience. Only two of the 16 studies referenced referred to learning as a cognitive task.

HPS Summary

The rationale for the use of high-fidelity HPS makes sense and the applications for use abound. Yet, there is little evidence supporting that students using HPS have better cognitive learning outcomes, improved psychomotor and communication skills, and/or increased ability to think critically. Much of the simulation literature are reports of student confidence after experiencing a simulation experience rather than the cognitive learning outcomes of such experiences. The majority of simulation research concerning learning outcomes that does exist used small sample sizes and noncomparable methods of instruction, lacked learning theoretical frameworks, and failed to examine known variables affecting learning outcomes.

Learning Variables

Some educators argue that increased fidelity of simulation experiences is responsible for enhancing learning and fueling knowledge transfer from clinical laboratories to practice. However, others contend learning is not a direct result of high-fidelity simulation, but rather the educational principles applied during the simulation experience (Scerbo & Dawson, 2007). Educational principles take into account the many variables affecting learning. These variables must be accounted for when teaching methods are employed and when research is conducted to determine the effectiveness of those teaching methods. This section provides an overview of the variables to be measured in this study.

Sleep

Seventy five years ago, in their pioneering report, Jenkins and Dallenbach (1924) indicated information recall in humans was affected by sleep. Since then in independent reviews, Samkoff and Jacques (1991) and Wolfson and Carskadon (2003) reported learning abilities and consequential academic performance are also dependent on sleep. Impairment of neurocognitive functioning from sleep deprivation affects adolescents and college age students alike and as a result, learning from lectures or practica is significantly reduced (Curcio, Ferrara, & Gennaro, 2006; Samkoff & Jacques, 1991; Wolfson & Carskadon, 2003).

Evidence shows both rapid eye movement (REM) and nonrapid eye movement (NREM) sleep are essential in the consolidation of knowledge and skills required for learning and memory (Ficca & Salzarulo, 2004; Rauchs, Descranches, Foret, & Eustache, 2005; Smith, 2001). Acute sleep loss impairs attention, language, decision-making skills, and memory while increasing response inhibition and divergent thinking (Curcio et al., 2006). These findings were confirmed via neuroimaging (Drummond, S. P. A. et al., 2000). Sleep deprivation, even for one night, can lead to poor decision-making, lack of flexible and innovative thought, an inability to focus attention on essential information, and helplessness to change strategies when the unexpected occurs (Harrison & Horne, 2000). Finally, research indicates the learning of procedural matter is

reduced in adults who are not sleeping soundly, as well as, in adults who experience frequent onset of sleep changes (Smith, 2001).

Learning Styles

Learning style is the approach with which each individual begins to concentrate on, process, internalize, and retain new and difficult information (Dunn, Dunn, & Perrin, 1994). The five common learning styles included in this study are: auditory, visual, kinesthetic, tactual, and auditory-verbal. A debate exists pertaining to whether an increase in academic achievement exists when the teaching modality is matched with the student's learning style (Willingham, 2005; Moreno, 2006; Stahl, 1999; Dunn, 1990). In a meta-analysis Kavale, Hirshoren and Forness (1987) concluded that using teaching modalities to match student learning styles yields no benefits in terms of student learning. Dunn (1990) refuted these findings, consequently conducting another meta-analysis. Findings of Dunn's meta-analysis demonstrated that students experienced achievement gains when taught using their preferred learning style(s) (Dunn, Griggs, Olson, Beasley, & Gorman, 1995). The Dunn et al. (1995) meta-analysis of 36 studies examined the effect sizes for students' achievement and attitudes. They found that students whose learning styles were accommodated had higher academic achievement than those whose learning style were not accommodated. The effect sizes were considered medium to large. Again Kavale, Hirshoren, and Forness (1998) contested the results. Only one research study in Dunn's

meta-analysis appeared in a peer-reviewed journal. All of the other studies used in the meta-analysis were unpublished doctoral dissertations. Further, 21 of the 35 were conducted at St. John's University where Dunn was a professor. However, Lovelace (2005), in a second meta-analysis of 76 studies, also found improvement in academic achievement and student attitudes toward learning when teaching modalities matched student learning style preferences.

These mixed reports have led cognitive scientists to examine the debate concerning matching teaching modalities to learning styles. Willingham (2005) maintains people differ in their ability to learn when taught using diverse teaching modalities but matching learning styles to the teaching modality does not affect academic achievement. Rather, Willingham reports (2005) that people learn best when the content to be learned is the driver of the appropriate modality with which to teach. For example, if a person was an “auditory” learner, it would still be most appropriate to teach this learner how to throw a baseball using a tactile modality rather than giving verbal directions alone. Likewise, a teacher would not withhold a picture of the Mayan ruins from a student who is a verbal learner. The debate continues. Some say the debate will continue as it is difficult to prove a negative and many educators are vested in the belief that teaching to learning styles affects academic achievement (Kavale & Forness, 1987; Stahl, 1999; Moreno, 2006).

Age and Gender

Age and gender are also important variables to consider. There are inconsistent findings concerning gender differences in their approach to learning (Duff, 2002). Some believe males approach learning with a deep approach (Sadler-Smith, 1996) and females a surface approach (Duff, 2002; Sadler-Smith, 1996); others report the opposite (Gledhill & van Der Merwe, 1986) while, still, some report no gender differences (Duff, 2002; Zeegers, 2001). In a longitudinal study, Zeegers (2001) found no gender differences in approaches to learning but he did find age correlations to both a deep approach to learning and increased GPA.

Perhaps it is not a student's approach to learning, but instead, his/her learning style that is important. Dunn et al. (1995) discovered differences in learning styles between traditional and non-traditional students. Traditional beginning students, 18 to 25 years old, have different environmental, perceptual, and chronobiological traits than non-traditional students. To this end, late afternoon and evening classes are most preferred by traditional students rather than the early classes to which they are scheduled. On the other hand, non-traditional students, greater than 25 years old, prefer early morning classes in which various instructional methods include incorporating small-group discussions and peer interactions. Males tend to prefer evenings, cool temperatures, and the opportunity to be mobile while learning whereas females prefer warmer

temperatures, visual text and auditory learning, diversity in teaching strategies and well-lit rooms.

Nutrition

Nutrition affects cognition, memory, and mood (Benton, Slater, & Donohoe, 2001; Smith, Clark, & Gallagher, 1999), all of which are important factors in any learning experience. Smith et al. (1999) found breakfast has a positive effect on spatial memory and mood, whereas caffeine had a positive effect on time needed to encode new information and increased alertness. In addition, breakfast has a calming effect on mood as participants report less anxiety (Smith et al., 1999).

Participant Roles

The national, multi-site simulation study conducted by the National League for Nursing found no differences in cognitive learning outcomes between those students who had active roles within the simulation experience such as primary nurse and those who had observation roles (Jeffries, 2006). It is likely the benefit of being actively involved in the scenario parallels the benefit of being able to examine the whole picture without performance anxiety. This is the only study to date in which participant roles were specifically examined in relation to learning outcomes.

Elfrink et al. (2009) discovered that nursing students in a simulation experience felt highly anxious when they were the primary nurse. Students reported the perceived anxiety stemmed from the primary nurse being “on the spot” during a simulation while the observers were given a “free pass” (pg 85).

Summary

The psychology and education literature abound with studies examining the effect diverse variables have on learning. Yet, no studies to date have examined these variables when measuring cognitive learning outcomes resulting from high-fidelity human patient simulation.

Theoretical Framework

The theory of test anxiety (TA) (Spielberger, 1983) provides the theoretical framework for this study.

Stress versus Anxiety

It is important to understand the difference between stress and anxiety. Stress is a call to action due to a threat in the environment, resulting in a task oriented thought process (Sarason, 1972a; Sarason, 1980; Zeidner, 2007). The call for action is determined by the situation and personal dispositions or past experiences. In contrast, anxiety is an emotional reaction to stress resulting in self-preoccupying thoughts that interfere with task-oriented thought processing

(Sarason, 1980; Sarason, 1984; Tobias, 1979; Zeidner, 2007). A person experiencing anxiety is unable to respond to the stress induced call. (Sarason, 1980)

Historical Development of Test Anxiety

Fear has been studied for more than one hundred years. Darwin described fear as the inherited response to real dangers needed for survival (Darwin, 1899). The response humans experience when confronted with fear is an activation of the autonomic nervous system.

According to Freud (1936), the response to fear is not solely biologically based but has an additional psychological response. Freud claimed anxiety was the emotional reaction to fear and he differentiated anxiety into objective and neurotic states. Objective fear and the anxiety experienced as a result is rational and in accord with the type of stressor one faces. For instance, if a person faces a hungry lion and experiences fear of being eaten he is experiencing objective fear for he may indeed be eaten. On the other hand, neurotic fear and the anxiety accompanied by the fear are not proportional to the imminent danger of the situation. Neurotic fear is exaggerated and invents potential dangers where none exist (Rutledge, 2005).

Effects of Stress on Learning

The Yerkes-Dodson Law is the result of the pioneering, experimental study of the relationship between the strength of a stimulus, such as fear, and learning (Yerkes & Dodson, 1908). Yerkes and Dodson concluded that the relationship between fear, often termed drive, and

learning is curvilinear or forms an inverted U when plotted on a graph (Yerkes & Dodson, 1908).

Low-level drive impedes motivation to learn whereas high-level drive interferes with the ability to learn. A middle drive level is the optimal level for learning (Levitt, 1967; Yerkes & Dodson, 1908). This theory evolved into the principle that anxiety is the stimulus, or drive, which either induces or inhibits learning.

In 1914 researchers began studying test anxiety (TA) and its effect on learning. Over the next 20 years, studies examined individual differences in student responses to test situations. One difference was the response TA evoked in psychologically unstable students, as these students were unable to manage the stress of a testing situation. It became apparent that TA had detrimental consequences for some after two university students' suicides were attributed to extreme anxiety about impending examinations (Bond & Spillane, 2002; Zeidner, 1998). The movement toward examining individual differences continued into the 1940's as the first psychometric scale was developed to empirically identify high-risk test-anxious students (Zeidner, 1998).

In the early 1950's, George Mandler, Seymour Sarason and a team of psychologists from Yale University began investigating TA and are hailed as the pioneers of the development and validation of the TA construct (Zeidner, 1998). Mandler and Sarason advanced the idea that

anxiety is situationally specific and affects learning outcomes (Sarason, Davidson, Lighthall, Waite, & Ruebush, 1960).

Situational Specific Anxiety

The situational specific anxiety theory was first called the Yale Theory. This deductive theory had four propositions. First, anxiety is a learned drive and is situation specific. Given the same situation people will react with differing responses; the same situation may evoke anxiety in one person and not in another. Secondly, life experiences affect individuals' characteristic responses to anxiety. Responses to anxiety can be task-irrelevant, which disrupts performance, or task-relevant, which facilitates performance. Thirdly, some reactions disrupt performance or cause cognitive interference, whereas others increase the ability to focus and facilitate performance. Lastly, the attitude of the teacher or experimenter and the meaning of the task to the individual both affect the anxiety level more significantly than the level of difficulty of the task (Sarason et al., 1960).

Evaluative instructions and failure feedback influence the performance of both low-anxious and high-anxious students (Mandler & Sarason, 1960). When the evaluation instructions emphasize the importance of the examination or the evaluative feedback is negative the highly anxious student performs poorly. In contrast, when the evaluation stress is minimized, the student with little anxiety performs more poorly than the highly anxious student.

Researchers also investigated approaches to reduce the negative impact of TA on performance. For instance, allowing students to express themselves in narrative form on multiple-choice questions alleviated some of the tension created by the test. Any further reduction of the negative impact of TA on academic performance proved to be a difficult task, as no clear definitions of TA existed up to this time (McKeachie, 1951).

The lack of clarity concerning test anxiety has and continues to cause a mire of confusion for scholars studying this phenomenon. For example, the term anxiety is used to describe a transitory response, an emotional reaction, and/or a personality trait. Further, researchers have used the TA construct in a myriad of ways and continue to do so. The literature equates TA to constructs such as stressful evaluative stimuli, individual differences toward evaluative situations, and anxiety experienced in specific situations (Zeidner, 2007).

The confusion led Spielberger (1966) to differentiate anxiety as two separate entities: state anxiety and trait anxiety. He defines state anxiety (A-State) as an emotional reaction consisting of feelings of tension, apprehension and nervousness. This is a direct effect of the activation of the autonomic nervous system. In contrast, trait anxiety (A-Trait) is defined as a personality trait or an individual's proneness to anxiety. The threatening situation that evokes state anxiety is more likely to be an instance in which a person's adequacy is being evaluated, where failure is a possibility and threats to self-esteem are at stake (Spielberger, 1966).

Spielberger found persons who were test anxious approached tests with elevated A-State scores thus leading to the theoretical formation that TA is a situation-specific anxiety trait (Spielberger, 1966).

Anxiety's Affect on the Cognitive Process

Given the complex nature of anxiety, researchers differentiated between cognitive and affective facets of anxiety. Liebert and Morris (1967) suggested the cognitive facet encompasses the worry and irrelevant thinking seen in the anxious person, whereas, the affective component concerns the bodily reaction to the worry, termed emotionality. Persons who experience TA are prone to self-centered worry and self-deprecation when challenged with cues suggesting their behaviors will be evaluated (Sarason, 1972a; Sarason, 1975). This self-deprecation then constricts the person's ability to focus on the task at hand (Sarason, 1972a).

Sarason (1972a) noted high-test anxious students to be more self-critical and the worry that accompanied testing situations interfered with these students' performances. On the other hand, Sarason also found that a low test-anxious person eagerly performs a task in which the outcome is evaluated, whereas the highly test-anxious person responds in an opposite manner. Focusing on self doubt and worry limits the highly anxious student from attending to task cues, whereas, the low anxious student attends to the task at hand (Wine, 1971).

Tobias (1977), in his seminal work, suggests anxiety is an affective state negatively influencing cognitive processes, which in turn mediates learning at various stages. His conceptual model describes the instructional process and concurrent information-processing components. The three components influenced by anxiety include: input, processing, and post-processing.

The input component is the presentation of the instructional information to the student. The processing component describes the period in which students attempt to store, retrieve, and transform learning into long-term memory. Output corresponds to performance on evaluation of student learning after instruction (Tobias (1977)).

Anxiety in the preprocessing and processing stages may interfere with the student's ability to process and register or internalize the instructional input (Tobias, 1977). The student's attention is diverted away from the task at hand and instead focuses on either negative self talk or avoidance of impending pain. The post-processing component comes directly after processing or the point of instruction and the evaluative measurement. Anxiety caused by the mere threat of evaluation interferes with the student's ability to retrieve what was learned.

Spielberger and Vagg (1995) refer to the phenomenon of self-preoccupation as task-irrelevant thoughts, which is merely thinking about things with no relevance to the task at hand. There are many reasons one may experience task irrelevant thoughts, such as negative self

appraisals related to fear of failure and comparison to others (Sarason, 1972b; Sarason & Stoops, 1978; Sarason, 1984). It is also a consequence of pervasive thoughts of probable negative outcomes (Sarason, 1973). Task irrelevant thoughts and behaviors can occur when anticipating a stressful event, perceiving adversity to the event or perceiving a lack of coping strategies and skills (Bond & Spillane, 2002). The inability to recall information previously learned is referred to as interference (Tobias, 1980). Whether stress produces anxiety that results in task irrelevant thoughts or interferes with cognition has much to do with self-perceptions, which arise from life experiences (Eysenck, 1992; Sarason, 1984). Perceptions about a future professional life also interfere with cognition. For instance, Papanastasiou (2006) found that students who experienced high levels of anxiety in their research course were students who considered research to be integral to their professions.

Test anxiety's interference with cognition that results in poor performance is one school of thought, skills deficit is another (Tobias, 1977). The skills deficit theory presupposes anxiety arises from insufficient preparation or poor test taking skills. Anxiety from insufficient *study* skills is induced by a student's awareness of being poorly prepared for the task. On the other hand, the student with deficient *test* taking skills experiences elevated anxiety as the student begins to perform poorly on the test (Tobias, 1977).

Kirkland and Hollandsworth (1979) found, other than scholastic ability, study habits and achievement anxiety were the major predictors of grade-point average. High-test anxious students have reported deficient study skills and are more likely to procrastinate on academic tasks than their low-anxious counterparts (Culler & Holahan, 1980; Wittmaier, 1972). In a recent study of college age students, Bond and Spillane (2002) also found study habits, test-taking skills, worry, emotionality, and the subsequent ability to process and retrieve information correlated to test anxiety.

Nursing Student Anxiety

Nursing students are no different in their experience of anxiety that interferes with learning and performance (Gohrke-Blainey, 1980; Kleehammer, Hart, & Keck, 1990; Meisenhelder, 1987). Blainey (1980) reported her own perceptions concerning sources of anxiety experienced by nursing students in clinical situations. She believed these sources included: procedures, nursing care plans, patient conditions, and interpersonal relationships with faculty and physicians. Kleehammer et al.(1990) found student anxiety resulted from talking with the patient and the patient's family, performing procedures, manipulating hospital equipment, and fear of making mistakes. Thirteen years later, White (2003) found similar results in her qualitative study of fourth-year nursing students. Nursing students experienced anxiety when they were unsure of: nursing skills, interpersonal relationships with staff, and patient conditions

(White, 2003). The participants believed these uncertainties negatively affected their clinical decision-making ability.

Interactive teaching strategies can also provoke fear in students (Stiles, Johnson, Trigg, & Fowler, 2004). Students cite the preparatory requirements and the interactive nature of the strategy as being responsible for this fear (Stiles et al., 2004). Human patient simulation is an interactive teaching method and thus could provoke anxiety. As Papanastasiou (2006) found in research students, nursing students may consider any tactile experience in which they are learning to give competent nursing care as important to their future profession. In turn, this may provoke anxiety.

Summary

Anxiety has a curvilinear effect on learning. Testing produces situation specific anxiety in some individuals. Testing is similar to performance in that one is evaluated on knowledge or skill performance. A student in a high-fidelity human patient simulation experience is performing and being evaluated on that performance. Nursing students experience anxiety in clinical situations much like simulation scenarios in which they are expected to perform well. It is reasonable to conclude that a simulation experience would evoke anxiety in nursing students. If the anxiety is at a debilitating level, learning will be compromised.

Conclusion

High-fidelity human patient simulation is a teaching strategy with little evidence to guide its implementation in nursing education. It is well-documented that learning is affected by many variables, yet little is known about the effect of these variables on learning outcomes in simulation experiences.

The literature supports that test anxiety has a powerful affect on learning outcomes. While existing empirical studies have examined student anxiety in clinical following simulation experiences (Bremner et al., 2008; Hogan, 2004), there are only anecdotal accounts of anxiety in a human patient simulation experience (Beischel, 2007). There have been no studies to date examining anxiety as a mediating variable to learning outcomes in a high-fidelity human patient simulation. This study will examine whether anxiety is indeed a mediating variable to learning outcomes as hypothesized.

Chapter Three: Method

Study Design

This study used a QUAN + qual explanatory mixed methods with simultaneous qualitative data collection design (Creswell, 2007; Morse & Niehaus, 2009). The core component in this study was quantitative. The independent variables in this study included the students' learner and lifestyle characteristics, the dependent variables included the cognitive learning outcomes, as well as, the mediating variable, anxiety. The data obtained from the pre-test/post-test scores and learner and lifestyle characteristics facilitated a general understanding of conceptual relationships. The data obtained from the anxiety scale quantified the mediating effect of anxiety. Because using a quantitative approach would not have described the context in which anxiety existed, I used a supplementary component with a qualitative approach (Morse & Niehaus, 2009). The supplementary component was used to explain student perceptions concerning their anxiety and the resultant impact on learning in a simulation experience (Creswell, 2007; Creswell & Plano Clark, 2007; Morse & Niehaus, 2009). Structural equation modeling (Kline, 2005) was used to explain the direct and indirect effects of the explored variables on learning outcomes. The structural equation model in this dissertation study only includes observed variables, and such modeling is also called path analysis. Therefore, path analysis will be used hereafter. Figure 3.1 provides a model of the study design.

Figure 3.1: QUAN + qual explanatory mixed methods design with simultaneous data collection

Sample and Setting

Participants for this study were beginning nursing students in their second quarter of nursing courses. They were recruited from 29-NURS 202, Foundations of Nursing Practice I, at the University of Cincinnati College of Nursing (UC CON).

Path analysis requires five to ten participants per parameter to be studied (Kline, 2005; Meyers, Gamst, & Guarino, 2006). There are 14 parameters in this study's initial model, resulting in a projected sample size of between 70 and 140 participants. Furthermore, the minimum sample for the maximum likelihood estimation should be 100 participants (Kline, 2005). Given the need for a large sample size, convenience sampling was used for this study as the UC CON is the only school of nursing in southwest Ohio or northern Kentucky with the

acceptable number of students enrolled in any one nursing course using high fidelity human patient simulation as a teaching intervention.

This study was nested within an already existing pre-post test evaluation and simulation experience for the 130 beginning nursing students enrolled in 29-NURS 202 course resulting in no undue burden of time placed on students who chose to participate. There were five students who did not consent to the study and one was absent. Thus, the final sample size was $n = 124$. Each participant received a \$10 gift card following the post-test.

As stated above, all beginning nursing students were invited to be included in this study. Any student inherently unable to participate in this study because of cognitive impairment would not have been admitted to the nursing program due to rigorous admission criteria at UC CON. The GPA required to be admitted as beginning nursing students at UC CON was 3.41, demonstrating the average student's cognitive and decision-making ability, as well as, the ability to read, write, and speak English.

The UC CON afforded the opportunity to access a sufficiently large number of research participants. An MSN/MEd prepared nurse with extensive knowledge in simulation education is the director of the simulation laboratory. She created and directed the simulation scenario used in this study. The director and course coordinator used the same simulation scenario with beginning nursing students the previous year. The course coordinator of 29-NURS 202 granted access to

the students to conduct this research. Please see Appendix C for course coordinator letter of assent.

This study presented no undue burden on faculty or administration in the CON. As previously stated, this study was completed in conjunction with an existing simulation incorporated into the course. Completion of computerized pre- and post-tests and a learning style survey were used as a portion of the students' course requirements whether they chose to participate in the study or not.

Procedures

Recruitment and Informed Consent Procedure.

Approval was granted from the Institutional Review Board of the University of Cincinnati and the University of Cincinnati College of Nursing's Associate Dean of Research prior to data collection. The beginning nursing students enrolled in the 29-NURS 202 were recruited for this study. Each of these students had completed the Building Excellence survey, a learning style survey, in the first week of the academic term as a class assignment.

All beginning nursing students in 29-NURS 202 participate in pre- and post-tests of learning module laboratory experiences to evaluate cognitive learning outcomes. One learning module, at the conclusion of the academic term, uses a high-fidelity human patient simulation experience. Students are expected to apply knowledge gained throughout the term to a simulated

patient care experience. The scenario requires students to respond appropriately to a patient who experiences a drop in blood pressure, heart rate and respiration rate.

I explained the organizational details of the study during the didactic class the week prior to the scheduled simulation experience. I provided the students with the following information: that the purpose of the study was to explore how elements of the simulation experience affect learning and that there were no obligations to participate in the study portion of the simulation experience; however, refusal to participate would not exempt students from the simulation experience or from the pre- and post-tests. I also assured the potential participants of their ability to withdraw from the study at any time without penalty to their grade in the course. Procedures to protect confidentiality were built into the design of this study and are explained in the human subjects section. The potential participants were informed of these procedures prior to signing the informed consent. Please see Appendix D for the script to consent.

After explanations were given and questions addressed, students were asked to participate in the study on a voluntary basis. All students received an informed consent form. Each student agreeing to participate signed the informed consent form and all students returned the signed and unsigned informed consent forms to me. The informed consent was written on a 9th grade reading level and consisted of the following elements: a statement of the purpose for the study, procedures involved in the study, potential risks and discomforts, benefits, alternatives to

participation, confidentiality, request for more information, information regarding refusal or withdrawal, an injury statement, and a consent statement. Please see Appendix E for informed consent.

The consenting process took approximately 30 minutes. To protect student confidentiality, there were no faculty members present during this process of consenting participants and the names of those consenting were not shared with the course faculty.

Stage One: Quantitative

The population studied was beginning baccalaureate-nursing students enrolled in 29-NURS 202, a fundamental nursing course, at a Midwestern Bachelor of Science in nursing program. The research aims in this population included:

1. To determine if the hypothesized model fits the observed data.
2. To determine whether individual and/or lifestyle characteristics (age, anticipated course grade, gender, learning style, nutrition, sleep, preparation, work, and prior simulation experience) directly affect anxiety and cognitive learning outcomes.
3. To determine if anxiety mediates cognitive learning outcomes.

Instruments and Measurements

Data were collected using four instruments. Each quantitative instrument and the corresponding variables it measured are reported in the following section.

Process Measures

Learner and lifestyle characteristics include variables hypothesized to affect learning.

These characteristics were measured using an investigator-constructed descriptive demographic questionnaire named “Learner and Lifestyle Characteristics”. The students’ demographic characteristics were obtained using 5 items: age (item 4), gender (item 5), ethnicity (item 8), race (item 9), and anticipated grade in the course (item 15). The three items on the questionnaire concerning the learners’ characteristics and lifestyle characteristics included: preparation for simulation (items 10 and 11), food and drink ingested (item 14), and hours slept prior to simulation experience (items 13). The clinically related items included work experience (item 7) and prior high-fidelity HPS experience (item 6). Please see Appendix F for Learner and Lifestyle Questionnaire.

In this study an additional learning characteristic is the student’s learning style. *Learning Style* is the manner in which individuals receive, process and retain new and difficult academic information (Rundle & Dunn, 2008).

As Byrne (2001) emphasizes, it is of critical importance to select a psychometrically sound measurement tool when measuring variables of path analysis. Many of the tools used to measure learning style either lacked psychometric dependability or failed to fit the needs of this study. After much deliberation, the Building Excellence (BE) Survey was chosen to measure learning

styles. Similar to many other tools, this tool measures whether the student is a visual, kinesthetic, or auditory learner.

The instrument measures six subscales categorized as environmental, perceptual, psychological, sociological, physiological, and emotional elements. These subscales measure patterns through which learning occurs. While theoretically, all six subscales could affect anxiety and learning in a human patient simulation experience, the purpose of this study was to determine if the perceptual subscale affected anxiety and learning outcomes. Testing all the subscales was beyond this study's scope. Thus, perceptual subscale which includes auditory, visual, tactile, kinesthetic, and auditory-verbal learning styles was utilized. Further, including the other five subscales would have increased the number of variables in this study, causing parameter and significant test instability (Meyers, Gamst, Guarino, 2006).

The BE survey consisted of statements using a five-point response scale to which the participants' answered 1 as *strongly agreed* with the statement to 5 as *strongly disagreed* with the statement. It took approximately 20-25 minutes to complete the survey. Individual and aggregate summaries were reported following the completion of the survey. In addition, each student received a Learning and Productivity Style (LPS) report, 18-20 pages in length that includes narrative descriptions of all preferences, and recommended strategies from which to choose (Rundle & Dunn, 2008).

To verify construct validity of the BE survey, Dunn and Dunn used principle component factor analysis with Kaiser normalization and varimax rotation, as well as, reliability analysis. The BE survey has been used in more than 850 studies by 135 universities worldwide to determine the reliability and validity for various populations. A random sample of $n = 1195$ adults including college age students and other adults was extracted from a total $N = 7304$ to determine the BE survey reliability. The items, derived from the Dunn and Dunn Learning Styles Model were created to measure responses within the context of business and higher education settings. The Cronbach alphas for each sub-scale and their variables are .70 and above, demonstrating internal consistency of each scale. The internal consistency of each of the perceptual elements is as follows: auditory (.91), visual picture (.92), visual text (.68), tactile and/or kinesthetic (.87), auditory-verbal (.87) (Rundle & Dunn, 2008). Please see Appendix G for a sample of the BE survey.

Outcome Measure

Cognitive Learning Outcomes is the result of conscious intellectual activity in the acquisition of knowledge (Merriam-Webster, 2007-2008). Two parallel 30-question multiple-choice custom exams, using psychometrically stable questions, designed by Elsevier Evolve (formerly Health Education Systems Incorporated [HESI]) were used to measure cognitive learning outcomes. The

change of scores between pre- and post-tests determined the cognitive learning outcomes for the participants in this study.

One exam was used as the pre-test and the other as the post-test. Elsevier nurse educators developed the custom exams using test items from the Elsevier database that best measure nursing knowledge and competencies that coordinated with the course content. The didactic faculty member and I examined each test question for content validity. The pre- and post-tests are secure computerized instruments and were administered immediately prior to and directly following the simulation experience respectively in a monitored computer laboratory environment. Each fundamental specialty exam test item has been used between 1136 and 19,693 times. Calculated using a Kuder Richardson Formula 20, the estimated reliability coefficient for exams, ranges between .86 - .99 (Morrison, Abramson, Nibert, & Hsia, 2004). The cumulative difficulty level of each test item is no less than 40% with a point biserial correlation coefficient of .15 or above (Morrison et al., 2004).

In an attempt to decrease sensitization, the pre- and post-tests were created to be in parallel forms. The Kuder Richardson Formula 20 for the pre-test for this study was .93 with a difficulty level of .71. Likewise, the post-test Kuder Richardson Formula 20 was .90 with a difficulty level of .71. This analysis for reliability and difficulty level demonstrate these tests were indeed parallel forms.

Each test took approximately 30 minutes to administer. All student answers were transmitted to Elsevier Evolve where they were scored and sent to the primary faculty member. The names of the students consenting to participate in this study were given to Elsevier Evolve. The results of only those students who consented to the study were sent to me; thereby eliminating any possible confidentiality violations. Only aggregate results are reported.

Mediating Variable and Measurement

State Anxiety is a brief, limited experience of apprehension and increased autonomic nervous system activity due to stressful or threatening stimuli (Spielberger, 1983). State anxiety was measured using Spielberger's S-Anxiety Scale Y Form, a 20-item four-point Likert scale inquiring how participants feel at a given moment in time (1 as *not at all* and 4 as *very much so*). The qualities measured by the S-Anxiety Scale Y Form consist of feelings of tension, nervousness, worry, and apprehension.

There are highly discriminate items in the scale for anxiety-absence such as 1 (I feel calm) and 16 (I feel content) and anxiety-presence such as 3 (I am tense) and 6 (I feel upset) (Spielberger, 1983). The scale has item-intensity sensitivity, which reflects some items are sensitive to variations in the intensity of S-Anxiety at lower levels of stress and other items are sensitive to high levels of stress. The scale can be used to measure S-Anxiety under broadly varying stress conditions (Spielberger, 1983).

Scores on the S-Anxiety Scale increase in response to perceived psychological or physiological stress and decrease following relaxation training (Spielberger, 1983). Cronbach's alpha for the S-Anxiety Scale in an examination scenario has yielded a reliability of .92 to .93 for college men and women respectively (Spielberger, 1983). Age does not affect the overall reliability in working adults. The Cronbach alpha for the STAI in this study was .93, demonstrating the STAI had excellent internal consistency with these participants.

Contrast groups were used to determine STAI construct validity. Scores differed significantly in military recruits who were tested shortly after they became embroiled in a highly stressful training session as opposed to high school and college students of comparable ages who were in reasonably non-stressful situations (Spielberger, 1983). The determination that college students score higher in examination scenarios and lower following relaxation training supports the construct validity of the S-Anxiety scale (Spielberger, 1983).

Study Procedure

All students in 29-NURS 202 completed the BE survey, the Web-based assessment of learning styles, as a homework assignment within the first two weeks of the term. Two weeks prior to the scheduled simulation experience, the Laboratory Director posted the simulation assignment on the course management system (Blackboard TM). The assignment included: the

simulation scenario, a brief summary of the patient's name, age, diagnosis, and an explanation of what was expected of the students in their role assignments.

The 33 students in each of the four sections of 29-NURS 202 began their clinical laboratory day as scheduled. Approximately 17 of these 33 students were administered the pre-test in the computer laboratory. Consented students also completed the Spielberger S-Anxiety Scale, and the Learner and Lifestyle Characteristic Questionnaire. I consistently referred to the S-Anxiety Scale as the Self-Evaluation Questionnaire, in an effort to minimize bias toward anxiety. I instructed participants in the study to respond to the items on the Self-Evaluation Questionnaire relevant to how they felt about the pending simulation experience.

The 17 students assigned to simulation were divided into three groups of approximately five to six students to each group. Each group completed the simulation experience at the appointed time. While waiting for the simulation experience, the remaining eleven to twelve students completed a documentation learning module, not included in this study, with a clinical instructor.

After the group was seated in the simulation laboratory, the Laboratory Director discussed the scenario and elicited questions. Students randomly selected participant roles and were then expected to immediately begin role playing. The Laboratory Director conducted the simulation for each group, eliminating concern about variations in individual instructors'

teaching styles. The simulation scenario was video recorded by the Laboratory Director using the simulator's computer Web cam. An additional camera and boom microphone captured the introduction and debriefing. The simulation scenario concluded following the students' identification of deteriorating "patient" vital signs and summoning the appropriate help or after a maximum of 15 minutes.

At the conclusion of the simulation scenario, the Laboratory Director conducted a post-simulation debriefing for a maximum of 15 minutes. Following the debriefing, each group proceeded to the adjacent computer laboratory where the post-test was administered. The subsequent student groups followed until all 17 students completed the simulation experience and testing. The simulations were conducted for four days over a two-week period.

Upon completion of the post-test, each consented participant was given a \$10 gift card. The principal investigator administered and proctored the pre-and post-tests for all students in 29-NURS-202.

Data Analysis

I coded and entered all data into SPSS 17.0 for Windows using a password protected computer. After entering the data, I screened each variable to assess the quality and accuracy of the data. Descriptive analyses were conducted to describe the participants and to assess for violation of assumptions required for statistical analyses. The means and standard deviations

were run for the continuous variables and the frequencies for the categorical variables were examined. Pearson correlations were run on the following variables: strong auditory-verbal learning style, strong hands-on learning style, readiness to learn, preparation for simulation, anxiety, and cognitive learning outcomes. These correlations were run to determine the presence and direction of relationships among variables or the degree of linear relationship among variables.

Each case was examined to determine if there were legitimate numerical codes for each variable and whether those codes appeared reasonable (Meyers et al., 2006). In the event the code did not appear reasonable, the original data were consulted in an attempt to determine authenticity. For instance, if the demographic data were coded one for females and two for males and the codes of the data were all twos I consulted the original data to determine if the group consisted of all males or whether the data were miscoded.

Next, the dataset was examined for missing data. There were 33% missing data on the ethnicity variable. The ethnicity variable was judged not reliable for analysis and was deleted from the dataset. The missing data in the remaining dataset ranged from 0% to 2%. The three variables with missing data were “Healthcare Work Experience,” “Expected Grade for Course,” and “Preparation for Simulation.” In each instance, the missing data was missing completely at random and was replaced with mean substitution, the most common and conservative type of

imputation (Meyers, et. al., 2006). Although, missing data is often ignored when it is less than 5% of the dataset, modification indices used in SEM requires imputation of missing data points.

Univariate outliers were screened by determining whether data fell outside four standard deviations from the mean. There were no univariate outliers detected. Multivariate outliers were screened by computing Mahalanobis distance for each case on the two continuous variables of which none were detected.

Descriptives, the Kolmogorov-Smirnov tests, as well as, histograms, Q-Q plots and boxplots were run to determine normality of the distribution of STAI, pre-test, post-test and cognitive outcome scores. Scatterplots were run on the continuous data and examined to visually assess the linearity between the sets of variables.

Factor Analysis

There were many variables assessed during the data collection period. An exploratory factor analysis was completed as suggested by Byrne (2001) to account for the covariation among these variables. An exploratory factor principal component extraction with varimax rotation was conducted using seven learner and lifestyle characteristic variables. Theory guided the variables used in the factor analysis.

The learning styles used in the factor analysis included auditory-verbal, kinesthetic and tactual. Dunn and Rundle (2008) report auditory-verbal learners understand and remember best

when they are actively involved with discussing the material presented. Auditory-verbal learners do this in an attempt to make connections and extract personal meaning from the material. Strong auditory-verbal learners use auditory, visual and tactile senses as their approach to learning. Because the auditory-verbal learning style encompasses visual, the visual learning style was not included. Whereas tactual and kinesthetic learners understand and remember material best when they are actively involved using small motor and gross motor skills respectively.

Theoretically, the simulation experience is an active approach to learning; whereas the debriefing period fosters the students' ability to synthesize and make personal connections through reflection and discussion. This debriefing period is an opportunity for students to synthesize what they learned and what they would do differently if faced with the same situation. Students are also encouraged to make connections and create personal meaning from the simulation they just encountered. Auditory-verbal learners thrive under these conditions (Rundle & Dunn, 2008).

A factor analysis was conducted to determine the structure of relationships among important learning variables. The variables in the factor analysis included: anticipated grade in course, sleep, nutrition, direct patient care experience, and preparation for simulation. These variables were important to include for several reasons. First, in his meta-analysis of test anxiety correlates, Hembree (1988) discovered the relationship between test anxiety and course grades

were inverse and significant. It is conceivable that the relationship between the student's expected grade in the course and the level of anxiety perceived, when contemplating learning in an evaluative environment, is inverse as well. Further, the grade one expects to earn in a given course could impact the amount of anxiety a person perceives in an effort to achieve the expected grade. Secondly, sleeplessness, even for a night, disrupts decision making abilities, the ability to pay attention to details, as well as flexible, innovative thoughts (Harrison & Horne, 2000). This in turn affects learning of procedural matter (Smith, 2001). Thirdly, nutrition affects these important factors in learning experiences: cognition, memory, and mood (Benton, Slater, & Donohoe, 2001; Smith, et al. 1999). As Smith et al. (1999) discovered eating breakfast produces a calming effect on mood. Those who eat report less anxiety. Eating prior to simulation and sleeping for six or more hours the night prior to simulation were combined to create the variable named health conscious. Lastly, it is my theoretical position that students who worked in a direct patient care role in a healthcare system would incur less anxiety when faced with a learning experience in which they were expected to perform.

Preparation for simulation, which included reviewing prior course material or studying new material for at least one hour, was also included in the factor analysis. A relationship may exist between anxiety and preparedness for the simulation experience. Stile et al. (2004) found the preparatory requirements required for courses in which interactive teaching was employed, as

well as, the interactive nature of the strategy being employed evoked fear in nursing students. It is probable the preparation requirement for a simulation scenario, an ultimate interactive teaching strategy where the student is expected to “put it all together,” would evoke anxiety.

The Kaiser-Meyer-Olkin measure of sampling adequacy was .571 demonstrating an adequate sample (Meyers, Gamst & Guarino, 2006). The factor analysis on these variables demonstrated sampling adequacy. Principle components consisting of eigenvalues greater than 1.0 were analyzed and three components were extracted. The screeplot was also examined for clear breaks to indicate the number of factors still contributing to the variance in a meaningful manner. The seven variables loaded on three extracted factors explaining 55% of the variance. The factor loadings were all greater than .50, consistent with Meyers, Gamst & Guarino’s (2006) recommendations. Table 3.1 demonstrates the factors loadings for the seven variables. The three learning styles loaded on the first component, anticipated grade, health conscious and direct patient care experience loaded on the second and preparation loaded on the third. I wanted to differentiate which learning style affected anxiety and cognitive learning outcomes. For this reason, I combined the tactual and kinesthetic learning styles into hands-on learning and kept the auditory-verbal learning style by itself. The second component was combined into one variable and named readiness to learn. The factor scores for readiness to learn were as follows: a) grade = .665, b) health conscious = .624, and c) direct patient care = -.681.

Table 3.1

Factor Loadings for Exploratory Factor Analysis with Varimax Rotation and Explained Variance

	Component		
	1	2	3
Item/Variance Explained	21.85 %	19.29 %	13.95%
Strong Auditory-Verbal Learning Style	.577		
Strong Tactual Learning Style	.737		
Strong Kinesthetic Learning Style	.766		
Anticipated Grade		.642	
Health Conscious		.668	
Direct pt care experience		-.628	
Preparation for simulation			.912

Path Analysis

It was important to determine causal relationships between the variables measured in this study. Thus, a path analysis was conducted using AMOS 17.0 (Arbuckle, 2008).

Prior to beginning the data analysis, the reliability and validity of the Elsevier Evolve custom parallel exams and the STAI were assessed. The difference in scores from the pre-test and post-test was calculated to assess for cognitive learning outcomes resulting from the simulation experience. Next, the following six iterative steps were used in the process of conducting the path analysis:

1. The initial model was constructed and relationships specified following the factor analysis. Path analysis employs a confirmatory rather than exploratory analysis; thus, the model and specifications were constructed based on a theoretical framework. The theoretical framework came from literature examined for this study, empirical research, and my practical experience.
2. The data were examined for missing data, multivariate normality and outliers to determine whether assumptions were met.
3. The model was then identified. To identify the model, the degree of freedom was calculated after determining the theoretical relationships between variables. The degree of freedom was determined using the formula, $(V(V+1)/2 - P)$, where V represented the number of measured variables used in the model and P was the number of parameters (Meyers, Gamst, Guarino, 2006). The model consisted of six observed variables and 2 unobserved error terms or six exogenous and two endogenous variables. As a result, there were 7 degrees of freedom with 14 parameters. The model was overidentified.
4. Model fit was assessed using the following absolute fit measures (Meyers, Gamst & Guarino, 2006; Steiner, 2006): chi-square (desired $p > .05$), goodness-of-fit index (GFI) (desired value $> .90$ for nonsignificant chi square and $.95$ for significant chi

square), and root mean square error of approximation (RMSEA) (desired value $< .08$).

The following incremental fit measures were assessed to compare the proposed model to the independence model: adjusted goodness-of-fit (AGFI) (desired value $> .90$ for nonsignificant chi square and $.95$ for significant chi square) and normed fit index (NFI) (desired value $> .90$ for nonsignificant chi square and $.95$ for significant chi square).

5. The path analysis coefficients were assessed for statistical significance. Nonsignificant indicators were deleted as necessary, given theoretical soundness. Standardized direct and indirect effects were determined by path coefficients.
6. Modification indices generated the expected reduction in the overall model fit chi-square for each identified relationship deleted from the model. Residual values of the estimated covariance (desired value < 2.58) were also assessed. Theory was used as the basis for all modifications.
7. Following modifications using the measures indicated above, the modified model was calculated to assess for goodness-of-fit.

Stage Two: Qualitative

The specific aim of the qualitative stage was to explore and explain the qualities and context of a high-fidelity human patient simulation experience affecting anxiety and cognitive learning outcomes that may be amenable to intervention.

Instruments

In an effort to allow participants' voice in this study, I used two self-reported questionnaires and a semi-structured group discussion during the debriefing period.

Learner and Lifestyle Questionnaire

In addition to providing quantitative data this survey contains open-ended questions to elicit comments from the participants.

Factors Affecting Learning Questionnaire

This questionnaire asked each participant to comment on any factors they perceived as having an effect on their learning during the simulated experience. Please See Appendix H for Factors Affecting Learning Questionnaire.

Debriefing Period

Debriefing, a standard procedure in all simulations, was conducted by the Laboratory Director. To maintain consistency, the same five questions were used for each group and were directed separately to each participant in his or her simulation role. The five questions included:

a) How did you feel about the scenario? b) If you had to do it differently, what would you do? c) How will you apply what you learned today when you start clinical? d) Did you learn anything in your role? e) Do you feel more confident now than when we started?

Study Procedure

The Learner and Lifestyle Characteristics Questionnaire was administered immediately following the pre-test but prior to the S-Anxiety Scale. At the conclusion of the simulation, the Laboratory Director conducted a post-simulation debriefing for fifteen minutes. The debriefing was video recorded, providing identification of each student who offered qualitative responses. This procedure enabled omission of responses of students who opted out of the study. The audio portion of each simulation was extracted to aid with transcription. Following the post-test, the participants in this study were given the Factors Affecting Learning Questionnaire, providing an opportunity to name any factors they believed affected their learning in the simulation experience.

Data Analysis

The qualitative data obtained during the debriefing period provided a deeper understanding of the relationships discovered in the quantitative stage (Creswell & Plano Clark, 2007). A transcriptionist, after signing a confidentiality agreement, transcribed the digital recordings containing the qualitative data from the debriefing period. Following the audio transcription, I

viewed the videos used for debriefing and added participant identifiers to the audio transcription data by cross referencing the list that identified participant names and simulation roles. This procedure was established to eliminate information provided by students who did not consent to participate in this study. The video used for this study will be in secure storage in the investigator's office for five years and will then be destroyed.

NVivo 8 ® (<http://www.qsrinternational.com>) software was used to organize and manage the qualitative data obtained during the debriefing period and from the Factors Affecting Learning Questionnaire. To analyze the debriefing transcripts, I grouped the answers to the debriefing questions. I also grouped the answers by participant role, to examine the effect the role had on the participants' answers to the debriefing questions. From this, I grouped them into the categories used in the path analysis. I then explored and queried the data for relationships among variables. To analyze the Factors Affecting Learning Questionnaire, I coded the answers using the tree node feature, assigning labels and themes in accord with the variables in the path analysis. I then explored relationships among the variables. Lastly, I explored all of the qualitative data for any other qualities and context of high-fidelity human patient simulation that affect anxiety and learning outcomes.

As inherent to all research, threats to the validity of the qualitative data conclusions are a concern. I enhanced the scientific rigor of this study using various criteria. I have certain biases

concerning student anxiety and learning. Consequently, I recorded my thoughts concerning anxiety and learning in a simulation experience in an NVivo journal prior to analyzing the data. Identifying my predispositions toward anxiety and learning was done to enhance the confirmability of the results. The journal was reviewed by a qualitative expert following my data analysis to compare the actual participant reflections against my personal reflections.

Dependability or consistency in data analysis is also important to qualitative investigations, as it affords other researchers an opportunity to replicate the study. An expert audit review was conducted by a colleague experienced in qualitative analysis, and was used to judge the dependability and confirmability of the study (Patton, 2002).

Credibility was enhanced by engaging in a systematic search for alternative themes and relationships (Patton, 2002). This was done using an inductive process. The data was organized in different groupings to explicate different findings. I continually looked for alternative possibilities and for data to support these possibilities. I took notes as I processed the data and reported these processes. The data extracted to explain the variables in the path analysis were validated through the use of peer checks. The peers included three faculty qualitative experts who were not involved with this study.

Finally, Maxwell (2005) explains that increasing the richness of the data decreases validity threats while increasing rigor to the study. This study included video recording the

simulation experience, which allowed for post scenario observation. The use of videotaping enriched the data otherwise lost.

Mixed Methods Analysis

Researchers using mixed method designs often make comparisons to explain the quantitative and qualitative data (Creswell & Plano Clark, 2007). The datasets in this study were compared to form a complete picture of anxiety's mediating effect on learning outcomes. The datasets were examined to confirm whether the qualitative data explained the survey and scaled data. I reported the statistical results followed by specific quotes or themes from the qualitative data that explained or disconfirmed the statistical result. Any dissonance among the results triggered a return to the data for further consideration. This is a strategy frequently used in mixed methods analyses and reports (Creswell & Plano Clark, 2007). This strategy facilitated an understanding of how well the qualitative data explained the quantitative results, thus lending confirmation to the quantitative results (Creswell & Plano Clark, 2007). Analyzing the qualitative data also led to discovery of other variables that influence simulation education not previously explored.

Data Management and Quality Control

The faculty member of 29-NURS 202 received all student test scores from Elsevier Evolve, and I only received the scores of those students who participated in this study. I coded

all participant tests, surveys, and anxiety scales with an identification indicator. The data entry and analysis were performed with identification indicators only. I am the only person with access to the data that link the names with the identification indicators. The list linking the participants' names with the identifiers and the hard data are securely stored in a locked cabinet in my office.

I input all of the data into the database and double-checked it for entry errors, correcting it as needed. For security purposes, a password-protected computer was used to analyze the data. I backed up the data on a flash drive daily, keeping it in a locked cabinet in my office. All data obtained in this study will be destroyed five years after completion of this study per IRB protocol. All results will be disseminated using aggregate data.

Human Subjects Protection

The participants in this study were nursing students at the UC CON. I was not a faculty member of UC CON and was not responsible for evaluating these students during their coursework. This aided in decreasing the inherent participant vulnerability when asking students to participate in this research study. To further decrease participant vulnerability, strict methods of data entry were implemented to prevent breaches of confidentiality and penalties resulting from either refusal to participate or answers given in the surveys. Participating in this study was voluntary. Neither the didactic nor the clinical faculty members of this course were informed of any student's decision to participate or not. The faculty members of the course only received the

results of the pre- and post-tests and learning style as these are part of the evaluation for a course grade. The investigator assured the participants of their ability to withdraw from the study at any time without penalty to their grades.

A transcriptionist was hired to transcribe the qualitative data. The transcriptionist signed a confidentiality agreement and the recordings used for transcription purposes will be destroyed after five years. The transcriptionist identified the speakers by their participant roles such as Student 1, Student 2, and so on. I then compared the video with the audio transcription and replaced the Student 1, Student 2, and so on with the participant roles and participant identifiers. The students were identified as consented participants by cross-checking the video of the students in debriefing with the list of consented participants, and the roles in which they participated.

All data collected during this study will be used for research purposes only. As previously stated, the videos and audio recordings will be saved in secure storage in a locked cabinet in the researcher's office for five years, at which time the videos and audio recordings will be destroyed.

Summary

This chapter discussed the methods of this study. The setting, participants, and sampling strategy were identified. The instruments, measurements, and data analysis were described, as well as, data management.

Chapter Four: Results

The purpose of this study was to test the hypothesized causal model using path analysis. The reliability and validity of the instruments used to determine state anxiety and cognitive learning outcomes are reported in this chapter, as well as, the findings of the path analysis used to determine the model's goodness of fit.

Participants

A total of 130 second-year college, first-year nursing students at UC CON were invited to participate in the study. One hundred and twenty five students consented to participate and one was ill the day of the simulation, leaving the sample size at a total of 124. Each participant completed the entire study. See Table 4.1 for the Descriptive Statistics of Participants.

Demographic Characteristics

The mean age of the participants was 21 years with a range between 19 to 49. There were 114 (91.9%) traditional students, defined as being 24 years of age or less. One hundred and ten participants were female (88.7%) and 14 male (11.3%). Of the total, 109 (87.9%) were white, six (4.8%) black or African American, four (3.2%) Asian, two (1.6%) Asian and White, 1 (0.8%) African American and White and 1 (0.8%) refrained from answering. The ethnicity variable was deleted as there were 36% missing data points.

Table 4.1

Demographic, Learner and Lifestyle Characteristics of Participants

Characteristics	Frequency	Percent
Age		
18-24	114	91.9%
25-35	6	4.8%
36-50	4	3.2%
Gender		
Male	14	11.3%
Female	110	88.7%
Race		
Asian	4	3.2%
Black or African American	6	4.8%
White	109	87.9%
Asian and White	2	1.6%
Black or African American and White	1	0.8%
Do not wish to share with researcher	1	0.8%
HPS Experience	3	2.4%
Direct Patient Caregiver Work Experience	21	16.9%
Preparation for Simulation Experience	78	62.9%
Active Role in Simulation Experience	46	37.1%
Anticipated Grade for Course		
A	94	75.8%
B	28	22.8%
C	1	0.8%
Learning Style		
Auditory	4	3.2%
Visual	37	29.8%
Tactual	8	6.5%
Kinesthetic	13	10.5%
Auditory-Verbal	61	49.2%
Slept more than 6 hours on the night prior to simulation experience	88	71%
Average hours of sleep each night		
4-6 hrs	21	16.9%
6-8 hrs	87	70.2%
8-10 hrs	16	12.9%
Ate food or drank nutrition supplement	103	83.1%
Health Conscious	75	60.5%

Learner Characteristics

Human patient simulation experiences are rare outside the realm of healthcare education. Only three participants had experience with HPS other than during competency testing, whereby the simulator is used as a mannequin to assess the student's ability to obtain vital signs. Twenty one (16.9%) of the participants were employed as direct patient caregivers. Of the total, 75.8% (n=94) anticipated receiving an A in the course while 22.6% (n=68) a B and 0.8% (n=1) anticipated a C. About 63% (n=78) of the students reported active preparation, reading new material or reviewing past notes, for one or more hours prior to the simulation experience. The Student Nurse 1 and Student Nurse 2 were responsible for decision making and critical thinking. To this end, the student nurse roles were considered active while the Family Member and Observer roles, non-active. Approximately 63% (n=78) were non-active while 37% (n=46) were active. The learning styles in which the participants scored "strong" were as follows: auditory 3.2% (n=4); visual (picture and word combined) 29.8% (n=37); tactual 6.5% (n=8); kinesthetic 10.5% (n=13), auditory-verbal 49.3% (n=61).

Lifestyle Characteristics

Seventy one percent of the participants slept six or more hours on the night prior to the simulation experience. When asked the nutrition consumed prior to the simulation experience, 83.1% (n=103) of the participants had either eaten or drunk nutritional supplements such as

protein shakes. As noted previously, I combined the two variables, “ate prior to simulation experience,” and “slept more than six hours prior to simulation experience,” to create the variable named “health conscious”.

Outcome Variables

Assumptions

The assumptions concerning normality and outliers when conducting path analysis were examined prior to running the model. Normally distributed variables hover around zero (Meyers et al, 2006). The skewness value of STAI and cognitive learning outcomes had a range from .143 and .190, respectively and the kurtosis value measured in a range from .226 and -.580, respectively. Thus these variables were normally distributed. Univariate outliers were screened by determining whether data fell outside four standard deviations from the mean. There were no univariate outliers detected. Multivariate outliers were screened by computing Mahalanobis distance for each case on the two continuous variables of which none were detected.

Correlations

Correlations between the study variables were examined. The Pearson product-moment correlations among the study variables are presented in Table 4.2. Using Cohen’s (1988) interpretation of small (.1), medium (.3), and large (.5) correlations, there were five statistically significant small to medium correlations between variables within this dataset. Readiness to

learn was inversely related to anxiety. Anxiety correlated with a strong auditory-verbal learning style, and preparation for the simulation experience. A strong auditory-verbal learning style was correlated with cognitive learning outcomes, while a strong hands-on learning style was inversely correlated with cognitive learning outcomes. Finally, a strong auditory-verbal learning style was correlated with a strong hands-on learning style.

Table 4.2

Correlations among Study Variables, Means, and Standard Deviations

Measure	1	2	3	4	5	6
1. Strong auditory-verbal learning style	-					
2. Strong hands-on learning style	.239**	-				
3. Readiness to learn	.074	-.009	-			
4. Prep for Sim	.088	.068	-.107	-		
5. Anxiety	.206*	-.026	-.318**	.273**	-	
6. Cognitive Learning Outcomes	.222*	-.105	.075	.011	-.014	-
<i>M</i>	.491	.000	.000	.629	44.45	-23.99
<i>SD</i>	.501	1.00	1.00	.458	10.55	168.82

* $p < .05$.

** $p < .01$.

Path Analysis

The initial model was a manifest of theoretical considerations. Because auditory-verbal learning style and hands-on learning style are dichotomous-type learning styles, they were placed as separate factors in the path analysis. This was important in distinguishing which of these learning styles contributed most to anxiety and cognitive learning outcomes. The model was tested using maximum likelihood estimation from AMOS 17.0.

Research Aim 1: To determine if the hypothesized model fits the observed data.

The initial model was run, resulting in the following fit indexes: $\chi^2 (7, N = 124) = 12.02, p = .099$; GFI = .968; RMSEA = .076; AGFI = .906; and NFI = .761. The results indicate a good fit. Chi square test is non-significant indicating the data fit the model. Likewise, the RMSEA, desired $<.08$, also indicates the study data does not deviate much from the model. The AGFI, desired value $>.90$, indicates the theorized model is superior to the null hypothesis. However, the NFI, desired value $>.90$, does not indicate the theorized model is superior to the null hypothesis.

The path coefficients were assessed for statistical significance. The paths from strong hands-on learning style and cognitive learning outcomes achieved statistical significance at $\alpha <.05$. The paths from preparation for simulation, readiness to learn and strong auditory-verbal learning style to anxiety and strong auditory-verbal learning style to cognitive learning outcomes

achieved statistical significance at $\alpha < .01$. The paths from readiness to learn, preparation for simulation and anxiety to cognitive learning outcomes failed to achieve statistical significance.

Please see Figure 4.1 for initial model.

Figure 4.1 Initial Model with Standardized coefficients

* $p < .05$. ** $p < .01$.

The model was revised using - both - the modification indices and theoretical considerations. The standardized residual covariance between strong hands-on learning style and auditory-verbal learning style was 2.650. Because it was theoretically probable that a relationship exists between these two variables, a path was added from strong hands-on learning style and auditory-verbal learning style. The path between simulation preparation and cognitive outcomes was non-significant. Cognitive learning outcomes were representative of the difference between

the pre- and post- test scores. Because it was a measure of learning taking place within the simulation experience rather than a priori to the experience, the path was deleted. The path from readiness to learn to cognitive learning outcomes was likewise deleted because food and drinks were consumed by some participants after the survey was administered but prior to the simulation experience.

The modified model was tested again to determine model fit. While the first model achieved model fitness, the modified model was yet a better fit. The fit indices of the final model are as follows: $\chi^2 (8, N = 124) = 5.00, p = .756$; GFI = .987; RMSEA = .000; AGFI = .966; and NFI = .900. The chi square, again, was non-significant, RMSEA < .08, and GFI, AGFI, and NFI were all > .90. Each of these measures indicates the model fit the observed data even better than the initial model. Please see Figure 4.2 for final model.

The coefficients are considered small at .1, moderate at .3, and large at .5. The path coefficients were assessed for statistical significance. The path from strong auditory-verbal learning style and anxiety achieved statistical significance at $\alpha < .05$. The path from strong hands-on learning style to cognitive learning outcomes achieved statistical significance at $\alpha < .05$. The following paths achieved statistical significance at $\alpha < .01$: preparation for simulation and strong auditory-verbal learning style to anxiety; strong auditory-verbal learning style to cognitive learning outcomes; strong auditory-verbal learning style to strong hands-on learning style.

Figure 4.2 Final Model with Standardized Coefficients

* $p < .05$. ** $p < .01$.

Mixed Methods Results

Research Aim 2: To determine whether individual and lifestyle characteristics (age, anticipated course grade, gender, learning style, nutrition, sleep, preparation, work, clinical, and prior simulation experience) directly affect anxiety and cognitive learning outcomes.

Readiness to Learn

The subsequent results emerged following rigorous analysis of the quantitative data. The standardized coefficient was moderate ($\beta = -.31$, $p < .01$) indicating readiness to learn inversely

affected anxiety. Specifically, as readiness to learn increased by 1 standard deviation, anxiety decreased by .31 standard deviation. Readiness to learn did not affect learning outcomes.

Explanation of readiness to learn from student comments. While the quantitative results suggest being health conscious, anticipating an A in the course, and having direct patient work experience decrease anxiety, there were no comments addressing this. A few students indicated that being tired or hungry directly affected their learning. Three of the six participants who reported their learning was affected by being tired or hungry, reported anxious feelings, but did not verbalize the relationship between the anxiety and hunger or tiredness. One participant commented on feeling anxious during the debriefing period, yet when asked for factors affecting learning she stated, “My learning was affected by my lack of sleep, hunger....”

Preparation for Simulation

Spending one or more hours preparing for the simulation directly affected anxiety. The standardized coefficient was low to moderate ($\beta = .22, p < .01$). As simulation preparation went up by 1 standard deviation, anxiety increased by .22 standard deviation.

Explanation of preparation for simulation from student comments. While the quantitative data indicate preparing for the simulation increased anxiety, students reported the opposite. The majority of participants were in consensus. They reported feeling being unprepared for the simulation experience. The simulation experience revealed the need to be prepared, to do

the homework. The inverse relationship between lack of preparation and the level of difficulty they experienced was very clear to them. A student in the role of Student Nurse 1 claimed, “I definitely would try to be better prepared, like just...I just felt uncomfortable...” This student reported that he spent 0 hours preparing for the simulation experience. His STAI was 59. A student in the Student Nurse 2 role admitted the same,

I think I would have just been a little more prepared. We knew he had a left inguinal hernia and I guess I could have maybe researched it and okay they could have low blood pressure and really high blood pressure because of this and maybe even be able to explain it a little better.

This student reported spending 1-2 hrs preparing for the simulation.

Exploration of student perceptions concerning preparation for simulation, sources of anxiety. While correlations between anxiety, cognitive learning outcomes, and number of hours spent preparing were examined, the participants revealed that preparation comes in forms other than hours spent studying. The qualitative data suggest the students’ perceived level of anxiety were the result of being inexperienced in clinical situations and ill-prepared to care for this particular simulated patient.

Students perceived much anxiety emanated from inexperience and self doubt. The simulation experience was the first clinical experience for these participants, and most participants felt ill prepared. At a minimum, one active role participant in nearly each group commented on experiencing difficulty or anxiety from inexperience. Comments such as,

“nervous, really nervous because I felt it was like really out of my scope of what I know and what I’ve learned so far” and “not prepared and I just didn’t know what to do. I couldn’t remember all of that stuff yet” were threaded throughout the debriefing and the Factors Affecting Learning questionnaire. Even though participants were distressed from their lack of experience, the simulation experience made them acutely aware of their learning needs. One student stated, “My level of inexperience and not having been in that situation before made the simulation an intimidating experience. I feel better having done it, but I know now more than ever that I have so much to learn.”

The students’ inexperience in responding to unexpected clinical situations was apparent.

One student exemplified this by commenting,

I was all right when I went in there, but when I started taking the vital signs it was all like his pulse was low and like we couldn’t even find a blood pressure and he was like dizzy and stuff and really I didn’t know what to do - an immediate action to help him.

They were expected to appropriately respond to abnormal vital signs, but felt ill-prepared to do so. Many disclosed their discomfort in responding to abnormal vital signs, family member interactions, and a patient who can converse while only having learned normal parameters of vital signs in a laboratory setting. Many felt, “unprepared to handle a situation I’d never faced.”

One student exclaimed,

I felt confident until we hit that block where the pulse and the blood pressure is and then I felt a little awkward not being able to do what they train us to do because they don’t really train us how to do, you know, plan B.

Another student made a similar comment, “The major factor was that we have never been in a situation like this before. It has always been in an “ideal” setting. So this made the situation very stressful after getting in there.”

Being ill-prepared to interact with family members also evoked anxiety in many. One student commented, “It was nerve wracking with the family there asking questions because I mean I knew something was wrong but I didn’t know what. I didn’t really know what to do.”

Juggling the timing between family concerns and performing assessments is an art not yet achieved by beginning nursing students. One student demonstrated this by stating, “Also, I didn’t know what to do when family members asked me a question while I was taking vital signs. I felt rude not answering, so I did, but it was hard to take the pulse and answer questions.”

Conversing with patients is natural to a seasoned nurse. But, these inexperienced nursing students found they were not prepared to communicate with the patient. The participants perceived this as another source of anxiety. One student remarked, “This was the first time that we have ever had a patient talk back to us. I was very nervous and not very self-confident in the steps I should have done next.”

There were numerous student comments concerning their preparedness to care for a simulated patient. One student exemplified the relationship specifically between simulation preparedness and anxiety when she stated, “There were no exact instructions to what was going

to happen during the simulation experience. This caused anxiety and anticipation which interfered with the process.” It appears the anxiety stemmed from fear of being presented with the unknown, similar to a true clinical situation. The student continued with offering a solution to decrease the fear, “I wish I could have seen a mock simulation experience by upperclassman to ease the unknown thoughts about the experience.”

Strong Auditory-Verbal Learning Style

Both, anxiety and cognitive learning outcomes are directly affected by having a strong auditory-verbal learning style. This is demonstrated by the low to moderate standardized coefficients ($\beta = .21, p < .01$) and ($\beta = .27, p < .01$), respectively. As strong auditory-verbal learning style increases by 1 standard deviation, anxiety increases by .21 standard deviation and cognitive learning outcomes increase by .27 standard deviation, respectively.

Explanation of strong auditory-verbal learning style from student comments, learning outcomes. There was consensus among the participants. They believed the discussion during the debriefing period, an auditory-verbal experience, was a valuable asset to their learning. Comments such as, “The discussion afterwards [debriefing period] furthered my learning,” and “I was nervous at the time, but after discussing the situation, I felt better” were consistently expressed. Another participant articulated the same sentiment,

The discussion at the end with the professor helped a lot. I learned several things that I didn’t know, like how we can call for help when needed and we aren’t expected to know

everything right now. The discussion helped me to understand and be comfortable with my scope of practice.

The discussions in the debriefing period were enlightening for many students. It was during this discussion that they realized they were not alone in their uneasiness. A student made this statement, “Also, it’s good to know that everyone, if they had been the nurse, would probably handle it all the same, with a little confusion, unsureness, and nervousness. But, it was really helpful to learning.”

While the simulation was a stressful experience for some, they readily agreed the debriefing period provided the space to discuss strengths and weaknesses and to ask questions. A participant in the Student Nurse 1 role, expressed the need to discuss the simulation during the debriefing period by saying,

I think it helped a lot to do that, like I was nervous, but now that we’re sitting down and talking about it you can go back and think about what you didn’t do and it helps you remember for the next time like oh...last time I forgot to do this so I should know to do that.

Students often expressed this period as one which enabled them to make connections between what occurred and what should have occurred. One such student stated, “It was also helpful to debrief at the end and discuss any changes we would have made.”

Students valued having other students on whom to rely. They found it helpful to discuss their thoughts aloud, facilitating connections and synthesizing their knowledge base. One such participant expressed, “Having the other student nurse there to collaborate with when making

decisions [was helpful].” When asked in debriefing about what they would do differently next time, one student commented, “It’s kind of nice having two nurses also, so I think...kind of collaborating.” Students in this experience were novices, inexperienced in clinical, but several felt empowered having other students with whom to discuss the process. One student wrote, “I didn’t know what to expect but worked through them with the help of my classmates.” And yet another stated, “Working with a group of students on a talking point helped.”

Strong Hands-On Learning

A strong hands-on learning style influences cognitive learning outcomes, demonstrated by a low standardized coefficient ($-.17, p < .05$). As strong hands-on learning style increased by 1 standard deviation cognitive learning outcomes decreased by .17 standard deviations. Finally, auditory-verbal learning style is directly related to strong hands-on learning style, as demonstrated by the low to moderate standardized coefficient ($.24, p < .01$).

Explanation of strong hands-on learning style from student comments, learning outcomes. Students reported the perception that their learning would have increased if they had hands-on experience in the simulation. A few students in the observer role reported, “I think that if I was a more active member I would have gained more experience. If I was a student nurse I think I would have learned more from the experience” and “Not being involved in the activities

and just watching the others perform the tasks may have hindered my ability to learn a great deal from this simulation.”

Yet, the remainder of observers who commented on the opportunity for hands-on learning stated their learning benefitted from being in a role in which they only observed. These students stated, “Not being able to perform hands-on but I still learned a lot from observing” and

By only being an observer watching, I didn’t get the full “hands-on” experience that the Student Nurse 1 and 2 received. However, it was at the same time good to be the Observer to realize what you, as a student nurse, may need to work on.

Research Aim 3: To determine if anxiety mediates cognitive learning outcomes.

The standardized indirect effect between anxiety and cognitive learning outcomes was $-.08$, indicating anxiety does not mediate cognitive learning outcomes as theorized.

Explanation from student comments concerning anxiety mediating cognitive learning outcomes. While the quantitative data do not indicate anxiety, measured prior to the simulation experience, affected cognitive learning outcomes, thirty three percent ($n=41$) of the participants claimed anxiety negatively affected their learning and ability to perform. Comments such as “Nerves caused me to think slower, and I couldn’t participate to the best of my ability” and “Nerves, I feel, affected me from performing what I knew because it almost felt like a test” were echoed throughout participant comments.

Students experienced the cognitive interference often cited in the literature. This cognitive interference was exemplified through student comments such as, “I was also very nervous which affected my ability to think clearly,” “I felt like I was just nervous and kind of sporadic,” and “...my nervousness and anxiety which make it hard to think straight.” When asked about factors affecting their learning, a student stated, “I was nervous, and felt as if I should have been better prepared. Also this was our first simulation experience with an actual patient who was talking back.”

Anxiety was infectious. A student in the Observer role, sensing anxiety from others, reported anxiety’s affect on his overall learning when he stated, “Factors that affected the simulation ... the anxiety that everyone had over doing it ‘right’.”

Explorations of student perceptions concerning anxiety mediating learning.

Students made many comments about the qualities and context of high-fidelity human patient simulation affecting anxiety. The cause of their anxiety was not limited to the lack of preparation for the simulation or their novice role. Rather, the predominate source of anxiety originated from the active role they played during the experience and the worry of failing in front of others. Students were anxiously anticipating which role they would draw. They illustrated this anxiety by stating, “Anxiety and nervousness were big factors that affected my learning. I was

very nervous prior to the simulation, [STAI 37] but after I learned I was just an observer I felt a lot better.”

Students in active roles were in accord. Being in the active roles of Student Nurse 1 and Student Nurse 2 was anxiety provoking. Comments such as, “There were no factors that affected my learning other than nerves” and “having my peers watch , as well as, my instructor was nerve wracking” were threaded throughout.

Participants in the Student Nurse 1 role felt the pressure of being “put on the spot,” bearing the responsibility. “It’s a lot easier to sit outside and look at it like you’re doing this, this, and this wrong but when you're doing it everything is running through your mind” was a comment echoed by many students in active roles. Some comments such as “nerves caused me to think slower,” “I guess I didn’t introduce myself either. I felt like I was just nervous and kind of sporadic and just try to calm myself more and like think about things more,” and “it’s hard when you’re so worried ... you forget to listen to what your patient is saying to you” reflected the cognitive interference experienced by many students in active roles.

Students in the Student Nurse 1 role were not alone in their anxiety. Participants in the Student Nurse 2 role were to assist Student Nurse 1 in the care of the patient. They too felt the pressure of responsibility. Comments such as, “I felt definitely like I had so much pressure on me that I felt like I should have been there for help, but when they asked for help I didn’t have any

answers”, represented many of those in the role of Student Nurse 2.

Students in often voiced their perceptions that the simulation was a performance test judged by those in the room. They believed their worry, of being judged or tested, negatively affected their performance. This is exemplified by the following observation made by a student nurse in the Family Member role:

I think the biggest factor was nerves. I feel like we were all so nervous to mess up or fail that we approached the experience as a test rather than a simulation. I feel like we knew what we were supposed to do but when Simman started giving us feedback we were unable to adjust the way we should be able to. We were more focused on passing than taking care of the patients.

It is interesting to note, many participants in Observer, non-active roles, reported learning much “because I didn’t have to worry about getting nervous and actually having to do it. I was able to sit here and watch and say okay well what would I do having the luxury seeing what he did.” They believe having a stress-free mindset resulted in a positive learning experience. The comment, “being an observer, I didn’t experience the stress that nurse 1 and 2 felt, so I was able to identify solution to problem quicker,” characterized this thinking. Clarity of thought was achieved by being in a role in which there were no expectations.

Students in non-active roles did not encounter the cognitive interference experienced by students in active roles. This was manifested by comments such as,

I felt that observing the situation allowed me to think more clearly because I was not so nervous and I was able to see the mistakes made and what I would do in a similar situation. When you are on the outside looking in, it makes it easier to see what could be

done better. The simulation experience taught me what to do when I am faced with an emergency situation.

Students in the Family Member role were surprised by the anxiety they encountered when the anxiety was consequential to being a family member. Many expressed, “I wasn’t feeling any easier being a family member” and “It is kind of nerve wracking because they [the students] don’t really know.” They experienced what it would be like to have a loved one sick, stating, “and you want them to help and it’s like well, fix him and you know you wish they could do more but you know they can’t.”

Perhaps the most daunting revelation made by students in this experience was their hesitation to request help. Students refrained from asking for assistance for various reasons. First, students are fearful of being reprimanded for their lack of knowledge. A student exemplified this when he stated,

I think sometimes it’s intimidating because I think our instructors expect us to know so much and it’s kind of like you don’t want to call them because you don’t want them to get here and be like, “why don’t you know this?” You were supposed to know this day two of validations and you don’t know them.

While another student stated, “I know we’ve all heard more than once, “you should know the symptoms”...”

Further, students were anxious, believing they should be competent, “should know everything.” Statements such as this were threaded throughout the debriefing period. They expressed their distress that they have “learned so much in class and stuff.” They believed they

“should be really good.” When faced with a clinical situation for which they were not prepared, they felt “conflict(ed) like I should have known what to do right away.” Beliefs such as these hindered their ability to seek help for their patient. One student demonstrated this by stating,

I feel like probably the reason why I wouldn't have been okay calling for help, I should know what to do, whereas obviously we're not that far long in nursing so I'm not going to know, but I would have felt like I should know.

Furthermore, anxiety, evoked by the fear of being wrong, impeded them from calling for help. One student, echoed by others, illustrated this fear by stating,

So I guess my anxiety would come in like what if you did call a code or the Rapid Response Team or whatever and people come in and are like, ‘Oh my god are you serious. Did you really call us?’

However, subsequent to the discussion in the debriefing period, students conceded the simulation was valuable in that it taught them “that when the situation gets to the point where we feel uncomfortable, we should ask for help” and “If I am unsure of something I should not go ahead and try to intervene.”

Lastly, a few students acknowledged the importance of intervening when anxiety is interfering with performance. This is illustrated by comments such as, “When you get nervous you need to do what works for you and calm down the situation and you will probably remember more of what you need to do than, like worrying about doing something wrong.”

While most students claimed anxiety impeded learning, a few stated anxiety was beneficial. In fact, a few students perceived anxiety enhanced their learning. When asked which factors affected their learning, a participant in the Student Nurse 1 role made this comment,

Being in that position I was shaky, not really confident, unsure and second guessing myself but by the time the simulation was over I had experienced a real life situation and I learned how to handle it better and more correctly. I can call RRT [Rapid Response Team] to intervene, as well as, my nurse to help the care of an uncertain patient. I really enjoyed this and I feel it has enhanced my ability to think critically and correctly.

Summary

In summary, the initial model fit the observed data. To determine the best fit, revisions were made to the initial model using both modification indices and theoretical considerations. These revisions yielded a better fit between the final model and the observed data. Coefficients were examined. Two non-significant paths were deleted using theoretical considerations and one path was added. The quantitative findings were as follows: a) a strong auditory-verbal learning style directly affects anxiety and cognitive learning outcomes, b) readiness to learn inversely affects anxiety, c) simulation preparation directly affects anxiety, d) a strong hands-on learning style directly affects cognitive outcomes, e) anxiety does not mediate cognitive outcomes.

The quantitative data were supported and explained by the qualitative data. The debriefing period was an essential element in student learning. The debriefing period provided a time to connect the dots, foster confidence, identify strengths and weaknesses, and participate in

group collaboration. Yet, dissonance between quantitative and qualitative data was found in areas concerning readiness to learn, preparation for simulation and anxiety's mediation to learning. Students verbalized their perceptions of being tired, hungry and feeling ill as having negatively affected their learning, but not their anxiety. Students vocalized their perceptions about the relationships among learning, anxiety, and being ill prepared for simulation. Few students reported that being in non-active roles negatively affected their learning. Most observers commented on the benefit of being in a role in which anxiety was low, providing them an opportunity to examine a clinical scenario while being relaxed. Thirty three percent (n=41) of the participants commented on their perceptions of anxiety negatively affecting their learning. Anxiety was predominately induced by the responsibility of being in an active role, the impression that the simulation was a testing situation, and fear of asking for help.

Chapter Five: Discussion

The primary purpose of this study was to test a hypothesized model describing the direct effects of learning variables on anxiety and cognitive learning outcomes, as well as, the mediating effects of anxiety on cognitive learning outcomes in a high-fidelity human patient simulation experience. The sample studied was beginning, undergraduate nursing students (n=124) enrolled in a fundamental nursing class. The learning and lifestyle variables included readiness to learn, preparation for simulation, strong audio-verbal learning style, and strong hands-on learning style. A path analysis was used to determine the effects of learning and lifestyle variables on anxiety and cognitive learning outcomes. The secondary purpose of this study was to explain and explore the qualities of human patient simulation that affect anxiety and cognitive learning outcomes that may be amenable to intervention.

An integrated discussion of the study findings and their connection to previous literature will be presented. This chapter is structured as follows: a) a synthesized discussion of the research aims related to the quantitative and qualitative findings, b) implications to nursing education using high-fidelity human patient simulation as a teaching tool, c) limitations of the study, and d) recommendations for future research.

Research Aim One

To determine if the hypothesized model fits the observed data.

An exploratory factor analysis was completed to account for the covariation among the variables extracted from the data collection. Theory, derived from existing literature, empirical research, and my experience with students, was used to choose variables for the factor analysis. Path analysis was employed to test the theoretical relationships, established a priori, between preparation for simulation, readiness to learn, strong auditory-verbal learning style, strong hands-on learning style, anxiety and cognitive learning outcomes. The model was identified and model fit was assessed using absolute fit measures (Meyers, Gamst & Guarino, 2006; Steiner, 2006). While the initial model indicated a good fit between the model and the sample data, the model was modified given theoretical considerations and modification indices. According to Schumacker & Lomax (2004), the goal of using path analysis is to find a statistically significant theoretical model with practical and substantive meaning. The good fit of this model indicates the goal was met. Figure 5.1 represents the initial model with modifications.

Figure 5.1: Modifications with the initial model

Note: The dotted line represents the path removed from the initial model. The **bold** line represents the path added in the final model.

Research Aim Two

To determine whether individual and/or lifestyle characteristics (age, anticipated course grade, gender, learning style, nutrition, sleep, preparation, work, and prior simulation experience) directly affect anxiety and cognitive learning outcomes.

Readiness to learn. Readiness to learn included the variables: health conscious, anticipated grade in course, and direct patient care experience. In this study of undergraduate, beginning, nursing students, readiness to learn directly affected anxiety but not cognitive learning outcomes. More specifically, students with an increased readiness to learn were more likely to experience a decrease in anxiety yet, had no effect on cognitive learning outcomes. These findings were consistent with the literature concerning readiness to learn and anxiety (Benton, Slater, & Donohoe, 2001; Smith et al., 1999)

Qualitatively, the students reported sleepiness and hunger negatively affected their learning. When asked for factors affecting learning, one student commented, “One factor might be that I didn’t eat enough before taking part in the simulation. Also, maybe having more to drink.” Another student noted a potential correlation between nutrition and learning when she reported, “It helped to eat directly prior.” And still another student noted being tired affected his learning when he stated, “Probably didn’t get enough sleep last night so I was a little tired.”

Many studies have reported being ready to learn increases cognitive learning outcomes (Benton, Slater, & Donohoe, 2001; Drummond, S. P. A. et al., 2000; Harrison & Horne, 2000; Smith, et al., 1999). Students in this study commented the same, yet the quantitative data did not support that relationship.

Preparation for simulation. Preparation for simulation did not affect cognitive learning outcomes. These results are consistent with the literature. Research indicates a relationship does not exist between time spent studying and exam performance (Moshe, et al., 1977; Schuman, Walsh, Olson, and Etheridge, 1985). Rau and Durand (2000) found, rather than time spent studying, a relationship existed between exam performance and how and when students study.

On the other hand, this study did find a positive relationship between preparation for the simulation experience and anxiety. Specifically, as students increased preparation for the simulation, their anxiety increased. Perhaps, the more the student prepared, knowing the

expectation was for them to apply what they learned over the quarter, the greater their anxiety became.

Another possibility exists. It is possible student preparation for simulation was ineffective, leading to anxiety. The participants may have used a surface approach to learning that includes a reliance of rote memorization, unconnected to other ideas, rather than a more effective deep approach, in which the learner looks for meaning while relating ideas to one another (Duff, Boyle, Dunleavy, & Ferguson, 2004). This was exemplified in the many students who reported having prepared for the simulation for 1-2 hours but stated, “I read over the situation and took notes in my notebook” or “I read over my notes.”

In turn, the inadequate preparation may have become apparent during the pre-test or the simulation, resulting in increased anxiety. One student suggested she realized she was ill-prepared during the simulation commenting, “Going in I was more confident than coming out.”

Even though 62% of the participants reported having actively prepared for the simulation for more than one hour, they repeatedly reported feeling ill-prepared for the simulation experience. Their comments consistently stated the pre-simulation homework assignment was inadequate in guiding them to study. They also reported increased anxiety due to inadequate directions about the simulation experience. One student exemplified this when she stated,

I feel that this was not explained thoroughly beforehand. When I walked into the simulation room, I felt like I had no idea as to what was really happening and what I should be doing. I was unsure of how to prepare for both the pre- and post-tests.

These findings are not surprising. Moshe et al. (1981) found anxious students experienced difficulty with preparation, specifically with encoding information. Moshe et al. also discovered anxious students reported longer hours spent studying than their non-anxious counterparts. Likewise, this study revealed a positive relationship between preparation for simulation and anxiety (.273, $p < .01$). It is important to note, the findings also revealed a negative correlation (-.330, $p < .01$) between anticipating an A for the course and anxiety. In other words, in the event a student anticipated an A in the course, the student was likely to have less anxiety. These findings suggest, similar to Moshe et al. (1981) and Hembree (1988), students feeling less able than their peers may have been more anxious, enticing them to prepare longer.

Another possibility exists. Rather than ineffective preparation increasing anxiety, it is possible, anxiety evoked by anticipating the simulation experience caused students to resort to a surface approach to learning, similar to what Fransson (1971) found. Further, the highly-anxious student may have also had difficulty with encoding (Moshe et.al., 1981; Tobias, 1977). These students may have consequently been even more anxious when facing the simulation experience.

Finally, similar to Kleehtamer et al. (1990) an overwhelming number of participants declared their anxiety also stemmed from inexperience in caring for patients who speak, for

patients whose vital signs are deteriorating, and for family members who ask questions for which they do not have answers. One student clearly illustrated this when she stated, “We have never been in a situation like this before. It has always been an “ideal” setting. So this made the situation very stressful after getting in there.” These findings confirm the importance of beginning nursing students engaging in more experiential learning in simulated situations where the fidelity is truer than a sterile laboratory.

Strong auditory-verbal learning style. A student with a strong auditory-verbal learning style was more likely to achieve an increase in cognitive learning outcomes. This finding supports the evidence that, auditory-verbal learners learn best when they are afforded the opportunity to discuss the material presented in a learning environment, in this case, a simulation experience. These learners, through verbalization, make connections and synthesize the information in an effort to extract personal meaning. This connection process leads to retention of learned information (Rundle & Dunn, 2008). Students repeatedly exclaimed the discussion during the debriefing period facilitated their learning. This is demonstrated by the many comments such as, “Debriefing at the end of the session was also very helpful;” “Talking over the simulation with Professor Grant at the end was helpful,” and “The discussion afterwards furthered my learning.”

On the other side of the debate concerning learning styles, the evidence may also support Willingham's (2005) theory that academic achievement occurs when the modality with which to teach is driven by the content. Perhaps simulation followed by a debriefing, or reflective discussion, is the most appropriate modality to teach students how to "put it all together", as was the objective of this learning experience.

The quantitative data suggested having a strong auditory-verbal learning style likely resulted in increased anxiety when anticipating a simulation experience. There were no participants who commented on being auditory-verbal learners. They were more likely to state they were kinesthetic learners. Yet, it is conceivable if a student perceived being an auditory-verbal learner, yet believed the simulation experience was a kinesthetic learning opportunity, the student's anxiety may have increased.

It is also possible students are unfamiliar with their true learning style. In example, a student commented, "I was the student. This was good for me because I learn best through hands- on experiences. I was nervous, which made my mind race a bit, but looking back this didn't impede my learning experience." Her quantitative results suggest she was right in that she was anxious (STAI=50). Likewise, the data suggests she did learn, as her cognitive learning outcome increased by 31 points. However, her learning style preferences suggest she is a low to moderate hands-on learner and a strong auditory-verbal learner. Perhaps it was her auditory-

verbal learning style that improved her learning.

Intuitively, one may believe simulation is a tactile and kinesthetic activity. This may be true if a debriefing period does not occur as part of the simulation experience. This study adds to the growing evidence that the debriefing period, a period in which students are provided the opportunity to process the learning experience in reflective discussion, is essential to the learning process (Jeffries, 2007).

Strong hands-on learning. The findings indicated having a strong hands-on learning style negatively influenced cognitive learning outcomes. Having only 32 students in active participant roles out of a total of 124 students may have influenced this result.

Again, one may surmise that learning occurs in simulation experiences as a result of the hands-on experience provided to students. The evidence suggests the opposite, especially when combining these results with the strong auditory-verbal learning findings mentioned above. Further, the relationship between strong hands-on learning and strong auditory-verbal learning suggests students have dual learning styles. For this reason, one may question the validity of the theoretical perspective that students should be taught using their specific learning styles.

Research Aim Three

To determine if anxiety mediates cognitive learning outcomes.

The quantitative findings suggest that anxiety does not mediate cognitive learning outcomes as theorized. These findings are perplexing for various reasons. First, many students commented on being anxious such as one student stated,

Really nervous because like some things they were asking I just didn't know the answer to and it's kind of like, a little bit embarrassing because I didn't want them to think like you were incompetent like you really don't know what you're doing.

Others stated, "It was a little nerve wracking with people watching you - especially people who know what we're supposed to be doing ."; "I was worried about doing well rather than just going in thinking of it as a learning experience;" "I feel like we were all so nervous to mess up or fail that we approached the experience as a test rather than a simulation;" and "Nerves, I feel, affected me from performing what I knew because it almost felt like a test." Again, these comments exemplify what the literature cites as cognitive interference, intrusive thoughts concerning fear of failure or negatively being compared with others (Sarason, 1984). Cognitive interference occurs in those with test anxiety. In this case, the simulation is a representative of the test. Research has demonstrated cognitive interference, or test anxiety, leads to poor learning outcomes (Sarason, 1973; Sarason & Stoops, 1978; Sarason, 1984).

Many students also made comments such as “I was also very nervous which affected my ability to think clearly,” “I felt like I was just nervous and kind of sporadic,” and “...my nervousness and anxiety which make it hard to think straight,” demonstrating anxiety’s interruption to their thought processes. The mean post-test scores decreased when compared with the pre-test showing cognitive learning outcomes diminished in this sample of beginning nursing students. Yet, the custom pre- and post-tests were parallel and examined for validity prior to administration. These results prompted an exploration for possible reasons.

It is conceivable that if anxiety was measured during the simulation rather than prior to, the results would have yielded different findings. Students commented the following experiences evoked anxiety: a) being ‘put on the spot’ in an active participant role, b) hearing the simulated patient speak, c) being exposed to deteriorating vital signs for the first time while being expected to know what to do, d) being fearful of asking for help from the instructor or the Rapid Response Team, and e) fielding questions from family members. These experiences occurred during the simulation. Perhaps they were not anxious prior to entering the simulation experience, believing they prepared sufficiently. But, when they were faced with the simulation experiences mentioned above, their anxiety increased. If anxiety was measured during the simulation or prior to the debriefing, the anxiety scores might have revealed this. The anxiety may have then correlated to a drop in cognitive learning outcomes. These results would then be similar to Seipp’s (1991)

findings in her meta-analysis of anxiety and academic performance. Seipp found anxiety, measured after the test, was more likely to be higher than anxiety measured prior to the test. Again, this suggests students believe they were prepared prior to the test only to discover their preparation was inefficient.

Students stated the debriefing calmed their nerves, “I felt like I wasn’t sure what I was doing at first, but after the debriefing I felt much better.” It is likely measuring anxiety after the simulation experience would not yield heightened anxiety either. Anxiety was purposefully measured prior to the simulation experience in this study, rather than interrupting the simulation experience as could have been done to capture the anxiety provoked by the simulation itself. Measuring anxiety prior to the experience was done in an attempt to maintain the fidelity of the simulation.

While the students in active roles declared an increase in anxiety, participant roles were not included in the model for two reasons. First, the students were not assigned roles until after the surveys were completed. They did not know they were going to be in active roles, so the anticipation of which role they would assume during the simulation was identical for everyone. Second, according to the findings of the NLN study, the largest research study to date concerning nursing students and human patient simulation, no cognitive learning outcome differences exist

between students in the observer roles versus those in active roles. Thus, for theoretical and empirical reasons, participant roles were not included in the model.

Implications to Nursing Education

Many administrators of schools of nursing are purchasing high-fidelity human patient simulators with the mindset that using these simulators will enhance student ability to critically think, increase student confidence and competence, and meet the learning needs of the digital-age student. The purchase and use of these simulators comes at a steep cost. They are expensive to purchase and maintain. Additionally, faculty find high-fidelity simulators are time intensive to learn how to use.

There is little empirical evidence demonstrating gains in cognitive learning outcomes. Nor is there evidence concerning mediating variables with the potential to affect learning outcomes when using this teaching modality. This study provides evidence to better understand the direct and indirect effects of learning variables on both anxiety and cognitive learning outcomes and the mediating effects of anxiety on learning outcomes. This study also provides invaluable insight concerning student perspectives about what will facilitate their learning.

The findings from this study illustrate the need to prepare students prior to the simulated experience. Assignments given to prepare students for simulation experiences need to contain enough detail to calm the fear of the unknown. Doing so will allow the student to concentrate on

the material necessary to be successful in the simulation. Giving students a thorough orientation to the simulation room prior to the experience, including the sounds the simulator makes, where supplies are kept, and their roles is important in maintaining the fidelity of the simulated experience.

The findings also suggest the importance of teaching students how to prepare - how to study for deep learning. This is especially important for students with high test-anxiety.

Perhaps one of the most interesting points to note concerning preparation for simulation was the difference in the meaning of preparation. According to the participants, being prepared for simulation did not simply mean the number of hours one studied. Preparation for simulation meant being ill-prepared for a clinical situation. Participants expressed much self doubt, originating from their inexperience in clinical situations. The experience these students had thus far was in the laboratory where the vitals were normal and the patient was another nursing student. This was the first time they were exposed to abnormal vital signs where they were expected to act accordingly. This was exemplified when one student commented,

I felt confident until we hit that block where the pulse and the blood pressure was abnormal and then I felt a little awkward not being able to do what they train us to do because they don't really train us how to do, you know, plan B.

Time spent learning in clinical laboratories needs to be devoted to learning both normal vital signs while discussing measures to implement in the event the student assesses abnormal vital signs.

The findings of this study also illustrated the need to spend time practicing the art of interacting with family members. One student exemplified this when she said, “It was nerve wracking with the family there asking questions.” It is possible offering students the opportunity to be the Family Member in simulated experiences will enhance their empathy toward families of patients for which they care.

The findings from this study also suggest, similar to existing literature, it is imperative nurse educators include a debriefing period with all simulations. Students stated the discussion in the debriefing period was the most important factor affecting their learning.

Participant roles are important to students. Many students voiced concerns such as, “Not being involved in the activities and just watching the others perform the tasks may have hindered my ability to learn a great deal from this simulation.” It is important that faculty members assure students that empirical evidence demonstrates there is no difference in cognitive learning outcomes between students in non-active roles versus active roles.

Inexperience was not the only reason students were hesitant to seek help when the simulated patient's vital signs were deteriorating. They stated they were fearful of the faculty member's reaction to their seeking help. One student exclaimed,

I think sometimes it's intimidating because I think our instructors expect us to know so much and it's kind of like, you don't want to call them because you don't want them to get here and be like, "why don't you know this?" You were supposed to know this day two of validations and you don't know them.

This finding adds to the literature in support of using simulation in healthcare education, as it is probable that discovering students do not call for help when in distress would not be illuminated while conducting a case study in a classroom. Clearly, failing to seek appropriate resources is a significant risk to patient safety. Perhaps with this discovery, instructors will find the benefits of high-fidelity simulation are worth the time it takes to learn how to use simulators.

Lastly, many students reported being anxious, worried of failing. They perceived it as a variable having affected their learning. Interventions to lower their debilitating anxiety are needed. Perhaps, as a few students commented, demonstrating a simulation where faculty members and upperclassmen model working together to care for the simulated patient would be helpful.

In an effort to empower students, it is also important nurse educators provide students the tools with which they can use to decrease their anxiety to a level of optimal functioning. Practicing the use of these tools in a safe simulation experience is equally important. Nurse

educators could purposefully provoke anxiety in a simulated experience while teaching students the skills needed to lower anxiety. In the event simulation was used for this purpose, it would be important to adequately prepare students, informing them of the objectives of this type of experience.

Limitations of Study

The findings in this study provide valuable insight into the variables affecting learning outcomes while using human patient simulation. But, as with all research, there were limitations. The sample included undergraduate, beginning nursing students at a large-sized university taking a fundamental nursing course. This sample limits the generalizability of this study to this population. A convenience sample was used, also limiting the generalizability of the study.

There were some limitations with data collection. First, hours spent studying, nutritional status, and hours of sleep were acquired through student self-report. The accuracy of the self-report information could not be confirmed. It is conceivable that the participants overestimated their hours spent studying. Secondly, when students were asked to report time spent studying, rather than beginning with 0 minutes followed by 1 hour, beginning with 0 minutes, then 30 minutes followed by 1 hour may have produced different results. Thirdly, anxiety was measured prior to the experience. Given the students' qualitative reports of anxiety, measuring anxiety during the simulation experience may have yielded a more accurate representation of student

anxiety. Finally, simultaneous collection of quantitative and qualitative data limited the ability to ask participants for clarification.

Another limitation may be measuring cognitive learning outcomes immediately following the simulation experience. Allowing time for reflection could have altered the findings.

Recommended Future Research

Studying best practices in educating nursing students is important. Research is needed to determine the affect of using various teaching modalities on student learning outcomes. The use of high-fidelity human patient simulation in nursing education is growing without data to guide its use. This study provides the platform on which to advance the science of teaching using high-fidelity human patient simulation. To this end, the following research is recommended.

The participants in this study experienced a decrease in cognitive learning outcomes following the simulation experience. Further research should be conducted to determine the cause of decline in the learning outcomes. Measuring anxiety during the simulation rather than prior to the experience could yield different results and should be investigated. Further, experimental studies should be conducted to evaluate the effectiveness of interventions used to decrease anxiety to the optimal level.

The model proposed in this study fit the observed data of undergraduate beginning students in a fundamental nursing course. The study should be replicated to determine model fit

using different levels of nursing students. Investigating variables affecting student learning using a longitudinal design would also be interesting.

Lastly, the ultimate determinant of the effectiveness of simulation lies with whether what students learn in simulation experiences is transferable to the clinical arena. Studies are needed to determine if the use of high-fidelity human patient simulation impacts patient care outcomes.

Conclusion

This study provides evidence for best practice when using high-fidelity human patient simulation as a teaching tool. The model was a good fit to the observed data. Many variables affect anxiety and learning in a human patient simulation experience. Using a mixed methods design to explore these variables was imperative to investigating these learning variables.

There were, at times, dissonances found between the quantitative and qualitative data. But, having used only a quantitative approach would have led to different, possibly erroneous, conclusions. Further, a quantitative approach alone would have failed to provide a complete picture of student perceptions concerning anxiety and preparation for simulation. Acquiring student perceptions about factors that affected their learning allowed for thorough exploration of variables affecting learning in a simulation experience. The multiple media used to attain student perceptions was likewise invaluable. Using video during the simulation to capture student expressions as they discussed the experience enriched the research while lending validity to the

interpretation of the qualitative data. There was no discord found between the participants' nonverbal and verbal communication. This mixed method study adds to the literature in that the findings present needed evidence, informing those who use high-fidelity human patient simulation as a tool to teach nursing.

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Appendix A
Simulation Scenario

29- NURS 202 Simulation Experience

Scenario Overview: Estimated Scenario time 15 Minutes

Debriefing Period: 15 Minutes

Brief Summary: The case is a post surgical patient 45 year old male with a left inguinal hernia repair. The student is to prepare the patient for AM care and to take the patients vital signs. The student will be expected to recognize abnormal vital signs and intervene appropriately.

Students are to interact with Mr. Sim Man as a human patient. The students are to stay in character during the scenario. We will reflect on the simulation experience during the debriefing.

What happens in Mr. Sim Man's room stays in Mr. Sim Man's room. You are to observe HIPPA regulations after you are finished with the scenario.

Each student has a different role:

1. Student assign to Mr. Sim Man.
2. Student to help student #1 assigned to Mr. Sim Man
3. Two Family Members
4. Two Observers (You will assist with information during the debriefing process)

Role assignments are selected randomly out of a hat, before you enter the room.

Student #1 assigned to Mr. Sim Man: While preparing Mr. Sim Man for AM care you are asked by Professor Grant to obtain the patient's vital signs stat.

Student nurse # 2 will be coming in to help with AM care and will ask you the vital signs before you came on duty. You will be responsible for knowing if the vital signs obtained are within normal range for an adult and what actions are to be taken.

Student #2 to assist Student #1: You come into the room to assist with AM care and assist with obtaining information from the chart. If Student #1 does not give the appropriate answers do not be afraid to speak up to offer suggestions or supply information that could assist the team.

Observers: You are to observe the simulation. During the debriefing period, you will discuss what you saw and how you feel the team could improve.

Family Members: Enter the room of your Brother, Mr. Sim Man, and sit next to the bed. Your brother is not alert. You do not see anything wrong at the present time. You are to ask questions and be a concerned family member.

The Whole Team: Do not be afraid to offer advice to Student #1 while staying in character.

This is to be a fun learning experience so relax and realize how much you have learned.

Appendix B
Debriefing Tool

- 1) How did you feel about the scenario?
- 2) If you had to do it differently, what would you do?
- 3) How will you apply what you learned today when you start clinical?
- 4) Did you learn anything in your role?
- 5) Do you feel more confident now than when we started?

Appendix C
Course Coordinator Letter of Assent

From: "Hicks, Nikole (hicksnk)" <hicksnk@ucmail.uc.edu>
Date: January 28, 2009 4:05:32 PM EST
To: Kelly Beischel <beischelk@gmail.com>
Subject: Dissertation Study

Kelly,

I am thrilled to be working with you on your research study related to simulation interventions and student anxiety. Not only does it give me an opportunity to support a fellow doctoral student and advance our knowledge in this area, but it provides an excellent means for modeling professional behavior to students. It is so important to involve students in nursing research early in their careers.

Thank you for approaching me with this exciting project. I look forward to working with you.

Nikole Hicks, MSN, RNC, CNE
Assistant Professor of Clinical Nursing
University of Cincinnati
College of Nursing
513-558-5316 (Office)
513-558-3600 (College)
Nikole.Hicks@uc.edu
Procter Hall 260C

Appendix D
Script to Consent

Information Concerning Participation in a Research Study
University of Cincinnati

Variables that Affect Learning Outcomes in a Human Patient Simulation Experience: A Mixed
Methods Study

Description of the research and your participation

My name is Kelly Beischel. I am a third year doctoral nursing student here at UC CON. I am inviting you to participate in a research study that I am doing as part of my doctoral degree program. The purpose of this research is to explore and explain the variables that affect learning outcomes in high fidelity human patient simulation scenarios.

Your participation will involve the following:

In addition to class expectations:

1. During your assigned simulation module, you will complete a learner characteristic questionnaire and a self-evaluation questionnaire prior to participating in the assigned human patient simulation experience. This will take approximately 15 minutes.
2. After the simulation experience you will answer an open-ended question which will take about 1- 3 minutes to complete.
3. You will be video and audio recorded for use in my analysis.
4. I will use the results from the Building Excellence Survey you have already completed as an assignment as well as your pre and post-test scores as part of my analysis.
5. Following the open-ended questionnaire, you will receive a \$10.00 gift card to Starbucks to compensate you for your time.

The simulation experience is a course assignment and the pre and post-tests are course evaluation methods. If you consent to participate in this study, the only additional time required will be approximately 20 minutes. If you choose not to participate you will still be required to participate in the simulation experience and to take the pre and post-tests.

Risks and discomforts

There are no known risks associated with this research.

Potential benefits

This research may help us to understand the elements that affect learning in a simulation experience thus advancing the science of nursing education.

You will be given a \$10.00 gift card to Starbucks as compensation for the additional 20 minutes of time required to participate in this research.

Protection of confidentiality

I will do everything I can to protect your privacy. Your faculty members will not know if you choose to participate in this study and will not have access to your answers on any of the study questionnaires. Your identity will not be revealed in any publication that might result from this study.

Voluntary participation

Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study.

Contact information

If you have any questions or concerns about this study or if any problems arise, please contact Kelly Beischel at 513-931-5177. If you have any questions or concerns about your rights as a research participant, please contact the University of Cincinnati Office Chair of the Institutional Review Board at the University of Cincinnati – Social and Behavioral Sciences at 513-558-5784

Appendix E
Informed Consent

University of Cincinnati
Consent to Participate in a Research Study
College of Nursing
Kelly P. Beischel MSN, MEd, RN, NCSN, CNE
513-931-5177 (beischelk@gmail.com)

Title of Study:

Variables Affecting Student Learning in a Human Patient Simulation Experience: A Mixed Methods Study

Introduction:

Approximately 132 second year students are being asked to participate in this research study. Please read the following explanation carefully and feel free to ask questions about anything you do not understand.

Purpose:

You are being invited to participate in a research study to examine the variables that affect learning outcomes in a high-fidelity human patient simulation experience.

Duration:

The simulation experience is a course assignment. The pre and post-tests are course evaluation methods. If you consent to participate in this study, the additional time required of you will be a total of approximately 20 minutes.

Procedures:

In addition to class expectations, participation in the study will include the following:

1. During your assigned simulation experience, you will complete a learner characteristic questionnaire and a self-evaluation questionnaire prior to participating in the assigned human patient simulation experience. This will take approximately 15 minutes.
2. After the simulation experience you will answer an open-ended question. This will take approximately 1-3 minutes.
3. You will be videotaped and digitally audio recorded during the simulation experience for use in my analysis.

4. The results from the Building Excellence Survey, the learning preference assignment you have completed and your pre and post-test scores will be used.

Risks/Discomforts:

It is unlikely you will experience any discomfort. None of the questionnaires ask for sensitive personal information and you may choose not to answer any questions.

Benefits:

You will not receive any benefit from participating in this research study. This research aids us in understanding the elements that affect learning in a simulation experience thus advancing the science of nursing education.

Payment for Participation:

You will be given a \$10.00 gift card to Starbucks as compensation for the additional 20 minutes of time required to participate in this research.

Alternatives:

There are no other activities planned if you do not want to participate.

Confidentiality:

Your privacy will be protected. Your faculty members will not know if you choose to participate in this study and will not have access to your answers on any of the study questionnaires.

Your research data will be scanned and stored as PDF files on the restricted server for research data. The paper-based data will be shredded in five years after data collection. Only the PI, Kelly Beischel, and her faculty advisor, Dr. Pettigrew, will have access to your data.

A transcriptionist, after signing a confidentiality agreement, will transcribe the digital audio and video recording into written format. The recordings will then be erased. The transcript will not contain your name or other individually identifying information. Your identity will not be revealed in any publication that might result from this study.

Offer to Answer Questions:

If you have any questions about this research study, you may contact Kelly Beischel at 931-5177. The University of Cincinnati Institutional Review Board – Social and Behavioral Sciences reviews all non-medical research projects that involve human participants to be sure the rights

and welfare of participants are protected. If you have questions about your rights as a research participant, you may contact the University of Cincinnati Institutional Review Board – Social and Behavioral Sciences at (513) 558-5784. If you have a concern about the study you may also call the UC Research Compliance Hotline at (800) 889-1547, or you may write to the Institutional Review Board-Social and Behavioral Sciences, G-08 Wherry Hall, ML 0567, 3225 Eden Avenue, PO Box 670567, Cincinnati, OH 45267-0567, or you may email the IRB office at irb@ucmail.uc.edu.

Voluntary Participation:

Your participation in this research study is voluntary. You may choose NOT to participate and you may withdraw your consent to participate AT ANY TIME. You will not be penalized in any way should you decide not to participate or to withdraw from this study. If you choose not to participate you will still be required to participate in the simulation experience and to take the pre and post-tests. You will receive a signed and dated consent form for your records.

Agreement:

I have read this consent document. I voluntarily agree to participate in this study.

_____ Participant Signature	_____ Date
_____ Signature and Title of Person Obtaining Consent	_____ Date

Appendix F
Learner and Lifestyle Characteristics Questionnaire

1. Date _____

2. Time _____

3. Age _____

4. Gender:

_____ Male _____ Female

5. Have you ever participated in high fidelity human patient simulation experiences in your role as a learner?

_____ No

_____ Yes

If yes, approximately how many hours have you participated in high-fidelity human simulation experiences?

_____ 1-3 hours

_____ 4-6 hours

_____ 7-10 hours

_____ Greater than 10 hours

If yes, please comment on the experience.

6. Have you ever or are you currently working in a health care facility?

_____ No

_____ Yes

If yes, what was/is your position at this facility?

If yes, on **average** how many hours a week did/do you work at this facility?

_____ 8 hours

_____ 8-12 hours

_____ 12-20 hours

_____ 20-24 hours

_____ 24-28 hours

_____ 28-32 hours

_____ 32-40 hours

7. Ethnicity:

Do you consider yourself to be Hispanic or Latino?

Select one.

Hispanic/Spanish/Latino. A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin.

_____ Hispanic/Spanish/Latino

_____ Non Hispanic/Spanish/Latino

8. Race:

What race do you consider yourself to be? **Select all that pertain to you.**

_____ ***American Indian or Alaska Native*** refers to persons having origins in any of the original peoples of North, Central, **or** South America, and who maintain tribal affiliation or community attachment.

_____ ***Asian*** refers to persons having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian sub-continent, this includes those who consider themselves Asian Indian, Chinese, Korean, Japanese, Vietnamese, Burmese, Hmong, Pakistani, Thai, or Cambodian.

_____ ***Black or African American*** refers to persons having origins in any of the black racial groups of Africa.

_____ ***Native Hawaiian or Other Pacific Islander*** refers to persons having origins in any of the original peoples of Hawaii, Guam, Samoa, or **other** Pacific Islands.

_____ ***White*** refers to persons having origins in any of the original peoples of Europe, the Middle East, or North Africa.

_____ ***Other*** Check this if you do not wish not to provide the researcher with this information.

9. How did you prepare for this human patient simulation experience?

10. How much time did you spend preparing for today's human patient simulation experience?

_____ 0 hours

_____ 1 – 2 hours

_____ 2 – 4 hours

_____ 4 - 6 hours

_____ More than 6 hours

11. Indicate the **AVERAGE** number of hours you sleep **per night**.

_____ 4 – 6 hours

_____ 6 – 8 hours

_____ 8 – 10 hours

_____ 10 – 12 hours

12. Indicate the number of hours you slept **last night**.

_____ 0 - 2 hours

_____ 2 – 4 hours

_____ 4 – 6 hours

_____ 6 – 8 hours

_____ 8 – 10 hours

_____ 10 – 12 hours

13. Please circle each item that most closely represents what you ate and/or drank prior to coming to this simulation:

No drink
Coffee

Caffeinated cola product
Decaffeinated cola product

Water

No food

Bagel, biscuit, muffin, or toast

Breakfast bar

Breakfast sandwich

Breakfast meat – bacon, ham, or sausage

Cereal (hot or cold)

Donut, pastry

Eggs, egg substitute, omelet

Fruit

Pancake, waffle, French toast

Shake, smoothie

Other _____

Other _____

French fries

Frozen meal (Banquet, Lean Cuisine, Stouffer's, etc)

Fruit

Pizza

Salad, with or without protein (meat, fish, beans, etc)

Sandwich, wrap (hot or cold)

Snack chips (potato, corn, pretzels, etc)

Soup

Vegetables (raw or cooked)

Yogurt

7. What grade are you anticipating to receive in **this course**?

_____ A

_____ B

_____ C

_____ D

_____ F

Appendix G

BE Survey

Appendix H

Factors Affecting Learning Questionnaire

Please identify any factors that you believe may have affected your learning in this simulation experience.