THE EFFECT OF VIRTUAL PATIENT SIMULATIONS ON STUDENT LEARNING OUTCOMES IN AN ASSOCIATE OF SCIENCE MEDICAL-SURGICAL NURSING COURSE

by

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A DISSERTATION

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ABSTRACT

The purpose of this study was to determine what the effects of virtual patient simulation instruction are on the learning outcomes of students in an Associate of Science medical-surgical nursing education course. Using a causal-comparative design, this study fills a gap in the literature and adds to the body of knowledge of this instructional strategy to bridge theory to practice in the classroom. Data were acquired from the HESI Exit Examination™, which is administered the last semester of the nursing program. Data were collected for the Summer 2014 through Spring 2016 academic semesters. Additionally, data were acquired from the HESI Mid-Curricular Exam™ during the Summer 2014 through Spring 2015 academic semesters prior to entering the 2nd year of nursing. A post-course “satisfaction with current learning” subsection of the Student Satisfaction and Self-Confidence in Learning survey was administered to assess student satisfaction with the virtual patient simulation. Participants were undergraduate 2nd-year medical-surgical nursing students at one rural public community college. Test scores were collected for students for the 6 semesters from Summer 2014 to Spring 2016. Students who took the course during Fall 2015 and Spring 2016 also completed the satisfaction survey. To be included in the study, students had a grade point average (GPA) of 2.0 or greater in nursing coursework, and had not failed out of the nursing program or the medical-surgical nursing course. Findings revealed no differences between students who received traditional instruction and virtual patient simulation instruction. Satisfaction with the virtual patient simulation instruction was mixed, with the Fall 2015 group being undecided and the Spring 2016 group being satisfied based upon the 5-point Likert-type survey. These results support the hypothesis
that virtual patient simulation is comparable to traditional instruction. This study provides evidence that virtual patient simulation is as good as traditional clinical instruction in achieving the student learning outcomes in an associate of science in medical-surgical nursing course.
DEDICATION

This dissertation is dedicated to my husband, Ricky Musgrove, and my children, Lance and Logan Fountain, for their support and encouragement. Their sacrifice of my time away from them provided me the opportunity to achieve my dream.
# LIST OF ABBREVIATIONS AND SYMBOLS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AACN</td>
<td>American Association of Colleges of Nursing</td>
</tr>
<tr>
<td>ACEN</td>
<td>Accreditation Commission for Education in Nursing</td>
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<tr>
<td>ADN</td>
<td>Associate Degree Nursing program</td>
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<td>ASN</td>
<td>Associate of Science in Nursing</td>
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<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
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<td>BSN</td>
<td>Bachelor of Science in Nursing</td>
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<td>( d )</td>
<td>Effect size</td>
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<td>DCE</td>
<td>Digital Clinical Experience</td>
</tr>
<tr>
<td>( df )</td>
<td>Degrees of freedom</td>
</tr>
<tr>
<td>DSP</td>
<td>Digital Standardized Patient</td>
</tr>
<tr>
<td>( F )</td>
<td>Within groups variances mean</td>
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<td>GPA</td>
<td>Grade Point Average</td>
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<td>HESI</td>
<td>Health Education Systems, Inc.</td>
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<tr>
<td>HESI A(^2)</td>
<td>HESI Admission Assessment</td>
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<tr>
<td>HESI MC</td>
<td>HESI Mid-Curricular exam</td>
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<td>HESI EXIT</td>
<td>HESI Exit exam</td>
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<tr>
<td>HFS</td>
<td>High-fidelity simulation</td>
</tr>
<tr>
<td>HOPE</td>
<td>Helping Outstanding Pupils Educationally federally funded grant</td>
</tr>
<tr>
<td>IOM</td>
<td>Institute of Medicine</td>
</tr>
<tr>
<td>LPN</td>
<td>Licensed Practical Nurse</td>
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</table>
\( M \) Mean

MANOVA Multivariate Analysis of Variance

\( n \) Sample size

\( n^2 \) Partial Eta Squared

NCLEX® National Council Licensure Exam

NCLEX RN® National Council Licensure Exam for Registered Nurses

NCSBN National Council of State Boards of Nursing

NLN National League for Nursing

OSCEs Objective Structured Clinical Examinations

\( p \) Significance level

PELL Federal Pell Grant

RN Licensed Registered Nurse

RN-BSN Registered Nurse with Bachelor of Science in Nursing

SACS Commission on Colleges of the Southern Association of Colleges and Schools

\( t \) \( t \) test value

TAI Triage Acuity Instrument

TI Traditional Instruction

VPS Virtual Patient Simulation

VPSI Virtual Patient Simulation Instruction

\( = \) Equal to

\( < \) Less than
ACKNOWLEDGMENTS

There are so many people to whom I have to give credit for helping me to achieve my dream. I give thanks to God, my family, my dissertation chair and committee, and the University of Alabama Capstone College of Nursing, Writing Center, and Graduate School. I give a special thanks to my husband, who gave me the courage to continue on when I wanted to give up and to my colleagues at South Georgia State College for providing encouragement to finish this journey. Lastly, I am humbled by the friendship that has been bestowed upon me by my colleagues in the Nurse Educator cohorts 4, 5, and 6. I am living proof that education, hard work, and perseverance do pay off.
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CHAPTER I
INTRODUCTION

The Shadow Health Digital Clinical Experience™ (DCE) is a web-based virtual patient simulation designed to simulate nursing clinical scenarios (Kleinheksel, 2014). The DCE provides nursing students with the opportunity to provide patient care to a digital standardized patient. The student is guided through the scenario by a virtual preceptor named Diana. The nursing student interviews and interacts with the digital standardized patient and the interdisciplinary team by typing words on the screen, and the computer provides the patient response verbally. The DCE allows the nursing student to perform and document nursing assessment, safety checks, nursing skills such as medication administration, and to reflect on the clinical experience. DCE was first used by several Master of Science nursing programs during Fall 2012 in advanced health assessment courses at several universities (Kleinheksel, 2014). Each nursing student is provided with an identical clinical scenario, which creates an objective learning environment.

In an attempt to provide clarification for the term “virtual patients,” Kononowicz, Zary, Edelbring, Corral, and Hege (2015) performed a literature review using a deductive content analysis approach. There were 234 articles included in the study that were published between 1991 and 2013. The aim of the study was to provide a taxonomy for the term “virtual patient” to provide clarity within the healthcare domain. The reason for the need for clarification is due to the term “virtual patient” being used for multiple technologies. Virtual patients can be classified into seven types: case presentation, interactive patient scenario, game, high fidelity software
Virtual patient simulation is an educational technology that provides interactive computer simulations of realistic clinical scenarios in which the learner emulates a healthcare role to obtain a health history, performs a physical exam, and makes clinical decisions [Association of American Medical Colleges (AAMC), 2007; Cook & Triola, 2009] in a risk-free environment (Kononowicz & Hege, 2010). Virtual patient systems were first described in the 1970s and have evolved due to advances in educational technologies (Cendan & Lok, 2012; Kononowicz & Hege, 2010). Advantages of virtual patient simulation include longitudinal and multidisciplinary format, multiple clinical scenarios, and easy access (AAMC, 2007; Kononowicz & Hege, 2010). Disadvantages of virtual patient simulation include limited physical interactivity and fidelity, and expense to produce (AAMC, 2007).

Virtual patient simulation provides each nursing student with an identical clinical scenario and objective learning environment (Bryant, Miller, & Henderson, 2015; Kleinheksel, 2014). Virtual patient simulation provides the exact scenario repeatedly (Cendan & Lok, 2012), which provides a knowledge base for the student to develop pattern recognition. Clinical scenarios in nursing are unfolding events that are realistic and mimic the real world of nursing practice (Mitchell, 2015). Clinical scenarios provide opportunities for safe practice and problem solving to prepare the learner to transition to the workplace (Mitchell, 2015). The student learning objectives include the evaluation of clinical reasoning skills (Cendan & Lok, 2012; Kleinheksel, 2014), skills acquisition, and knowledge transfer to the practice setting (Bryant et
Virtual patient simulations follow an algorithmic pattern to develop clinical decision making skills to promote safe and effective patient care (Cant, Young, Cooper, & Porter, 2015; Kleinheksel, 2014). Clinical decision making requires a nurse to assess, identify potential problems, provide appropriate nursing interventions, and communicate effectively with members of the healthcare team for the safety and welfare of the patient (Cant et al., 2015; De Gagne, Oh, Kang, Vorderstrasse, & Johnson, 2013).

Virtual patient simulation is a cost effective alternative to high-fidelity simulation (Bateman, Allen, Samani, Kidd, & Davies, 2013; Bryant et al., 2015; Cook & Triola, 2009; Liaw, Chan, Chen, Hooi, & Siau, 2014). Although the use of high-fidelity simulation has increased in nursing education over the past 15 years (Hayden, Smiley, & Gross, 2014), issues related to high-fidelity simulation include faculty time commitment, small simulation groups, expensive high-fidelity simulation equipment, and simulation facility availability (Liaw et al., 2014). Virtual patient simulation can be a viable option for nursing programs with large groups of students that cannot afford high-fidelity simulation equipment, facilities, and faculty (Liaw et al., 2014). Virtual patient simulation is affordable and accessible beyond the limited resources of faculty and physical space (Johnson et al., 2013; LeFlore et al., 2012). However, virtual patients are fairly new in nursing education and have gained popularity due to lower cost for budgets that are limited (Cook & Triola, 2009; Liaw et al., 2014).

Research on the use of virtual patient simulation on learning and assessment is lacking even though this type of simulation has been widely used in medical education (Botezatu, Hult, Tessma, & Fors, 2010b). The literature lacks randomized control studies and scarcely describes the use of virtual patient simulation for assessment and learning (Botezatu, Hult, Tessma, & Fors,
Research on simulation is “dominated by high-fidelity simulation and standardized patients” (Botezatu et al., 2010b, p. 845).

Positive aspects of virtual patient simulation are accessibility, repeatability, guided reflection, and interactivity with realistic systematic scenarios (LeFlore et al, 2012; Liaw et al., 2014). There have been no significant differences in student learning outcomes between virtual patient simulation and other forms of simulation (Consorti, Mancuso, Nocioni, & Piccolo, 2012; Cook, Erwin, & Triola, 2010). An evaluation of simulation in nursing education conducted by Foronda, Liu, and Bauman (2013) revealed gaps in the literature supporting simulation as an effective andragogy for nursing education. Much research on simulation in nursing has been limited, based on student perception or descriptive statistics (Foronda et al., 2013). The authors recommended research to validate that the implementation of simulation in the curriculum produces the intended student learning outcomes.

Clinical experiences need to be planned and aligned to student learning outcomes within the curriculum for the development of a deep understanding of complex nursing situations (Nielsen, Noone, Voss, & Mathews, 2013) and should begin in the first semester of the nursing program (Curl, Smith, Chisholm, McGee, & Das, 2016). Clinical experience is necessary to transition students from nursing education to practice in order to recognize and manage common medical problems of their clients (Weatherspoon, Phillips & Wyatt, 2015). The major impetus toward the use of simulation in nursing has been due to complex high-acuity care, shorter hospital stays, aging population, nursing shortage of faculty and staff, and decreasing clinical sites (Curl et al., 2016; Hayden, Smiley, & Gross, 2014; Weatherspoon et al., 2015). The National League for Nursing (NLN) recognizes that the future of nursing practice is providing nursing care in a technologically connected healthcare system (2015). Additionally, teaching
strategies need to incorporate technology that provides contextual learning experiences to prepare nursing students who have the technological skills to deliver safe, patient-centered care in a connected health care system (NLN, 2015).

The Georgia Board of Nursing does not specify an amount of simulation that can replace traditional clinical hours (Hayden, Smiley, & Gross, 2014). There are many state boards of nursing that allow simulation to replace some of the required clinical hours; however, they do not specify the type of simulation due to lack of evidence (Weatherspoon et al., 2015). Recommendations have been made that 1 hour of simulation is equivalent to 2 hours of traditional clinical instruction (Curl et al., 2016). The landmark simulation study conducted by Hayden, Smiley, Alexander, Kardong-Edgren, and Jeffries (2014) provided evidence that high-quality simulation experiences produce comparable student learning outcomes.

The NCSBN National Simulation Study was a controlled and randomized study of 10 prelicensure programs across the United States encompassing the nursing curriculum to provide evidence needed that simulation is an effective pedagogy (Hayden, Smiley, Alexander et al., 2014). There were no statistically significant differences between the three study groups that included a control group (traditional clinical experiences), 25% group (had 25% of clinical replaced with simulation), and 50% group (had 50% of clinical replaced with simulation) (Hayden, Smiley, Alexander et al., 2014). There were no statically significant differences between the three groups in clinical competency ($p=0.688$), comprehensive nursing knowledge assessments ($p=0.478$), and NCLEX® pass rates ($p=0.737$). Furthermore, the study groups were followed for 6 months ($p=0.527$) and there were not any statically significant differences in the manager ratings of clinical competency and practice as a new registered nurse (Hayden, Smiley, Alexander et al., 2014). Subsequently, it has been suggested that the use of high-fidelity
simulation in lieu of 50% of traditional clinical practicum is an effective pedagogical strategy for an ADN program (Curl et al., 2016).

The challenges in nursing education that prompted the NCSBN National Simulation Study include shorter patient stays, higher patient acuity, learning experience disparities, instructor time supervising skills, limited clinical sites, faculty shortages, students not having access to electronic medical records, and patient safety mandates that limit the number of students or restrict their activity on a patient unit (Hayden, Smiley, Alexander et al., 2014). Advances in technology, increased levels of patient acuity, and patient safety issues demand higher competency level for nurses (Onda, 2012).

Nursing education programs increased from 1,611 to 2,240 from 2002 to 2012 (Buerhaus, Auerbach, & Staiger, 2014). This increase has helped to produce more graduate RNs but at the same time has increased concerns over the quality of the nursing education and preparation for practice (Buerhaus et al., 2014). The use of simulation technology is needed as clinical agencies reach student capacity, and nurse preceptors have limited time to teach skills due to the increased number of students (Kilmon, Brown, Ghosh, & Mikitiuk, 2010). Many nursing curricula emphasize nursing care in acute care settings instead of an emphasis on current healthcare issues and trends such as prevention, healthcare reform, chronic conditions, care of clients outside of the hospital, and coordination of care and teamwork (Buerhaus et al., 2014).

There is an increase in the integration of simulation threaded throughout nursing curricula in all types of pre-licensure nursing educational settings (Hayden, 2010). Rizzolo (2012) reported an increase in the use of simulation in nursing programs from 3% in 2000 to 87% in 2010. There is a need for additional research on student outcomes related to the effect of simulation (Hayden, 2010). Associate degree programs (ADN) are the largest pre-licensure programs, yet little
research relates specifically to ADNs and simulations (Skrable & Fitzsimons, 2014). Despite the accolades regarding simulation and the potential pedagogical possibilities, limited research exists in ADN education to support simulation effectiveness on nursing students’ learning outcomes as compared with traditional clinical training as evidenced by exam performance.

**Statement of the Problem**

There is limited research on virtual patient simulation effects on student learning outcomes in nursing. The majority of virtual patient simulation in nursing research has focused on procedural skills (Cant & Cooper, 2014). Further research is needed to evaluate student learning outcomes for the justification of virtual patient simulation in the nursing education curriculum (Cant & Cooper, 2014). Similarly, Green, Wyllie, and Jackson (2014) revealed research is needed in nursing education to explore the benefits of virtual simulation. Furthermore, pedagogical implications in nursing education curriculum need to be theory-led rather than technology driven (Green et al., 2014; Paige & Daley, 2009). There is a gap in research in nursing on the effectiveness of active learning methods that have been effective in other disciplines such as education and medicine (Waltz, Jenkins, & Han, 2014). There is a need for more nursing research studies on the effective implementation of active learning methods such as virtual patient simulation.

**Purpose of the Study**

The purpose of this study was to determine the effects of virtual patient simulation instruction on the learning outcomes of students and perceived satisfaction with current learning in an Associate of Science medical-surgical nursing education course. Virtual patient simulation may help students to apply knowledge to clinical context to integrate theory and practice (Georg & Zary, 2014). This study adds to the body of knowledge of this instructional strategy to bridge
the theory to practice gap in the classroom. Furthermore, learning that is structured within a situated cognition framework can close the gap “from theory to practice to social integration into professional nursing” (Paige & Daley, 2009, p. e100).

**Significance of the Study**

This study fills a gap in nursing education literature. There is limited research in nursing education on the effects of virtual patient simulation instruction on the learning outcomes of students (Cant & Cooper, 2014) in medical-surgical nursing education courses in an associate of science nursing program. The results of this study will contribute to the growing body of knowledge regarding virtual patient simulation and this educational technology’s effectiveness on nursing students’ level of knowledge. Furthermore, results from this study may provide evidence for nursing education stakeholders to use for decision-making with virtual patient simulation instruction integration in the curriculum.

**Research Questions and Hypotheses**

The research questions addressed in this quantitative study are as follows:

1. Did the introduction of virtual patient simulation delivery lead to equivalent educational outcomes when compared to traditional instruction?

*Null Hypothesis One:* There was no difference in the pre-instruction exam achievement scores (HESI Mid-Curricular Exam™) and post-instruction exam achievement scores (HESI Exit Examination™) between medical-surgical nursing students taught with virtual patient simulation instruction and students taught with traditional instruction. The independent variable of this study was the instructional strategy, and the dependent variable was the nursing students’ level of knowledge as evidenced by exam performance.
Null Hypothesis Two: There was no difference in the post-instruction course content exam scores between medical-surgical nursing students taught with virtual patient simulation instruction and students taught with traditional instruction. The independent variable of this study was instructional strategy, and the dependent variable was nursing students’ level of knowledge as evidenced by exam performance.

2. What was the post-instruction perceived satisfaction with current learning scores on the Student Satisfaction and Self-Confidence in Learning survey among medical-surgical students who received virtual patient simulation instruction during the Fall 2015 and Spring 2016 semesters?

Conceptual Framework

The conceptual framework to guide this study is situated cognition, which is also known as situated learning. Situated cognition is a learning theory in which the learner interacts in an authentic environment working on real-life activities, per Scheppke (as cited in National Council of State Boards of Nursing, 2005). Learning should be imbedded in authentic learning activities that help the learner obtain knowledge from theory for the application to real-life activities. The knowledge learned from the theory should be explicit and used in the authentic learning activities (Brown, Collins & Duguid, 1989; Paige & Daley, 2009). Learners participate in authentic activities that require higher-order thinking skills, thus applying knowledge to real-life scenarios that are relevant and applicable to nursing (Onda, 2012). Education technologies create healthcare environments in which the student interacts (Paige & Daley, 2009). A schematic of these components is displayed in Figure 1.
**Definition of Terms**

**ADN program**: A nursing program that is completed within 2-3 years at a junior or community college setting that allows for eligibility to complete the NCLEX-RN exam and apply for licensure as a Registered Nurse (RN) (Skrable & Fitzsimons, 2014). The degree that is awarded is an Associate of Science in Nursing (ASN).

**Clinical reasoning skills**: Clinical reasoning skills and/or clinical decision making skills are “the cognitive process and strategies that nurses use to understand the significance of patient data, to identify and diagnose actual or potential patient problems, to make clinical decisions to assist in problem resolution, and to achieve positive patient outcomes” (Fonteyn & Ritter, 2008, p. 236).

**Digital Standardized Patient (DSP)**: A standardized patient used to create an objective learning environment (Kleinheksel, 2014).

**HESI Exit Examination™**: A standardized nationally normed exam developed by Elsevier to assess students’ mastery of nursing content. The exam blueprint is aligned with the latest NCLEX-RN® test plan. The exam identifies the strengths and weaknesses of each student and
provides individualized remediation to address knowledge deficits. The exam provides nursing education stakeholders an objective measure for determining student readiness for entry-level professional nursing practice and for the NCLEX-RN® examination.

**HESI Mid-Curricular Exam™:** A customized specialty fundamentals exam designed from the course syllabus or curriculum. This exam is used to measure the ability of each student and provide a comprehensive evaluation after the first half of the nursing program of study.

**High-fidelity Simulation:** Involves a scenario that uses a standardized patient or a full-body simulator that can be programmed to respond to psychomotor and affective changes (Hayden, 2010). High-fidelity simulation uses computerized patient simulators, virtual reality, or standardized patients that are realistic and interactive (NLN-SIRC, as cited in Meakim et al., 2013). An example of a high-fidelity simulation is SimMan® by Laerdal, which made its debut in nursing education in the year 2000 (Skrable & Fitzsimons, 2014).

**Medium-fidelity Simulation:** Involves a scenario that uses a full-body simulator with various human characteristics such as lung sounds, heart sounds, and/or pulses; an example is VitalSim™ (Hayden, 2010). Medium-fidelity provides a more realistic experience than static, low-fidelity mannequins.

**Shadow Health Digital Clinical Experience™ (DCE):** A web-based virtual patient simulation where nursing students interview, examine, document, and reflect on their digital standardized patient (Kleinheksel, 2014). The simulation unfolds in response to student responses and interaction with the digital standardized patient.

**Simulation:** Defined based on the fidelity level of the mannequin or scenario. Hayden, Jeffries, Kardong-Edgren, and Spector (2009) defined simulation as an activity that simulates
clinical practice using various tools such as high-fidelity mannequins, medium-fidelity mannequins, scenarios, and skills stations.

Student Learning Outcomes: The cognitive, affective, or psychomotor domain demonstrated by the student at the end of the assessment to measure student learning (Wittmann-Price, & Fasolka, 2010).

Student Satisfaction and Self-Confidence in Learning survey: A 13-item instrument designed by the National League for Nursing (NLN) to measure student satisfaction and self-confidence in learning with simulation using a five-point scale. The NLN has established reliability of this tool using Cronbach's alpha: satisfaction = 0.94; self-confidence = 0.87 (Franklin, Burns, & Lee, 2014).

Traditional instruction: The nursing student receives didactic instruction in the classroom and technical skills to learn how to critically think and function in the role of the nurse in the clinical setting (Hayden, Smiley, Alexander et al., 2014). In traditional instruction, the clinical setting is where the student is assigned to a patient and provides nursing care under the supervision of a clinical instructor to develop and practice nursing skills, apply theory to practice, and prepare for entry-level into practice (Hayden, Smiley, Alexander et al., 2014).

Traditional clinical experience: Learning activities outside the classroom in nursing programs that include observation, direct patient care, and interdisciplinary communication (Hayden, Smiley, & Gross, 2014).

Virtual patient simulation: An interactive computerized clinical scenario (Guise, Chambers, & Välimäki, 2011). The learner plays the role of a healthcare professional to assess, make clinical decisions, and provide care in the context of a real patient.
Assumptions of the Study

This study assumed that the HESI Mid-Curricular Exam™ and HESI Exit Examination™ assess nursing content similar to the NCLEXRN®. It was assumed the participants answered all of the questions honestly on the Student Satisfaction and Self-Confidence in Learning survey and that the participants’ responses on both HESI exams and final content exam were representative of their knowledge.

Limitations of the Study

There were several limitations for this study. Participants consisted of nursing students pursuing an associate of science in nursing education from only one accredited nursing school. The population was a convenience sample. Consequently, the sample size for this study was small; the group sizes varied, and were limited to 2nd year associate of science in nursing education medical-surgical nursing students at one institution. Furthermore, the majority of the participants were non-traditional (over the age of 25), White, and female, who received some form of financial aid. Nursing education in Georgia lacks standardization of the curriculum for nursing degree programs. The virtual patient simulation software was chosen by the nursing faculty at the institution.

Summary

Nurse educators are challenged to implement teaching strategies that will prepare a nursing workforce that competently provides safe and effective care in a highly technical health care environment (Decker, Sportsman, Puetz, & Billings, 2008; Onda, 2012). Simulation instruction can provide students with real-life clinical scenarios with varying degrees of difficulty at the practice level of the student. Nurse educators are vital to the growth of nurses for the next generation. Nurse educators must utilize teaching strategies to enhance learning and
prepare the nursing workforce. *Shadow Health Digital Clinical Experience* is a tool that nurse educators can utilize to improve knowledge retention, advance student learning outcomes, and prepare nurse graduates for real world nursing.

Chapter II contains a review of the current literature regarding simulation in nursing education. Chapter III consists of the methodology of this study, which includes the setting, participants, instrumentation, data collection, and data analysis. Chapter IV reports the results of this study and Chapter V discusses the major findings, implications to practice, limitations, and recommendations that stem from this research study.
CHAPTER II
REVIEW OF THE LITERATURE

The purpose of a literature review is to formulate an argument that provides context and description of the importance of the proposed study (Rudestam & Newton, 2007). The literature review is a compilation of previous research to determine what is known about a topic; it also expands the discussion of virtual patient simulation as it relates to the future of nursing, medical and nursing education, student satisfaction with learning, and situated cognition.

Future of Nursing

The Institute of Medicine (IOM) report on Assessing Progress on the Institute of Medicine Report, The Future of Nursing (2015) reported there were more baccalaureate-prepared nurses graduating than associate-prepared nurses in 2012, with significant growth in RN-BSN graduates. There has been rapid growth in the number of nursing graduates over the past 10 years in both associate and baccalaureate programs (Buerhaus et al., 2014). Due to this rapid growth, a concern exists about the quality of the nursing education and preparation that graduates receive. The current healthcare delivery system focus is on prevention, management of chronic illness, payment reform, interprofessional communication and coordination of care, and shifting care delivery outside the hospital setting (Buerhaus et al., 2014). However, the nursing education paradigm is still highly oriented toward acute care instead of community-based settings (IOM, 2015). Currently, there is a lack of standardization of nursing curricula, as each nursing program is allowed to create its own curriculum. The quality of the curriculum can be affected by faculty shortage, lack of expertise in developing curriculum, ineffective delivery of the curriculum, and
lack of evaluation to ensure compliance with standards as established by nursing education accrediting agencies (Jeffries, 2015). Furthermore, the success or failure of virtual patient simulation integration into the curriculum can be impacted by the opinions of faculty and students (Botezatu, Hult, & Fors, 2010).

The National League for Nursing (NLN) statistics on the number of RN programs identified 1,084 associate degree programs, 59 diploma programs, and 696 baccalaureate programs in 2012 (NLN, 2013). The Institute of Medicine (IOM) report on The Future of Nursing: Leading Change, Advancing Health (2010) had implications for nursing education; specifically, “Key Message #2: Nurses should achieve higher levels of education and training through an improved education system that promotes seamless academic progression” (p. 163). Four recommendations linked to this key message include the following: implement nurse residency programs, increase the proportion of nurses with a baccalaureate degree to 80% by 2020, double the number of nurses with a doctoral degree by 2020, and ensure that nurses engage in lifelong learning (Orsolini-Hain, 2012). Shortages of nurses are expected to continue as the population ages and primary care continues to struggle to meet the healthcare needs of Americans and those who will receive healthcare coverage by the Patient Protection and Affordable Care Act (Orsolini-Hain, 2012).

Community colleges are often located in rural areas, which serve as pipelines for educating associate degree nurses, and with the IOM recommendations can provide a seamless transition to a baccalaureate degree either by partnership or offering on site (Orsolini-Hain, 2012). There are four barriers to meeting the undergraduate educational needs.

(1) [T]he aging and shortage of nursing faculty; (2) insufficient clinical placement opportunities of the right kind or duration for prelicensure nurses to learn their profession; (3) nursing education curricula that fail to impart relevant competencies needed to meet the future needs of patients and to prepare nurses
adequately for academic progression to higher degrees; and (4) inadequate workforce planning, which stems from a lack of the communications, data sources, and information systems needed to align educational capacity with market demands. (IOM, 2010, p. 179)

One strategy to increase the educational capacity of nurses is “technologies, such as the use of simulation and distance learning” (IOM, 2010, p. 173). According to the IOM (2010), many of the clinical hours do not provide productive learning because students spend their clinical time performing tasks instead of fostering clinical reasoning skills. New graduates feel unprepared for their management and leadership role in nursing due to shortened clinical rotation, increased patient acuity, and increased nurse-to-patient ratios (Yoder-Wise, 2012). Furthermore, students have reported functioning as aides and questioning the relevance of their clinical practicum to current clinical practice (Lovecchio, DiMattio, & Hudacek, 2015).

In summary, nursing education is currently undergoing critical reflection of curriculum and clinical practicum. Traditional education is limited in providing the knowledge and skills needed for health care professionals to practice in a complex healthcare environment. These limitations include limited clinical hours, clinical placement sites, and unpredictability of patient illness (Feng et al., 2013). Reform in nursing education is needed to ensure that nursing graduates are prepared to function in the current health care system that is technologically advanced with care delivery shifting away from acute in-patient care to preventive and community care.

Nursing education has been impacted by the increasing number of nursing students, which has led to issues of insufficient clinical placement sites and nursing faculty (Buerhaus et al., 2014). Virtual patient simulation is a way to provide current clinical practice preparation to foster clinical reasoning skills, prepare students to function in a technologically enhanced health care system, and meet student learning outcomes that are equivalent to traditional instruction in
nursing education. The following sections will provide evidence in medical and nursing education that virtual patient simulation is as good as traditional instruction and should be considered as a viable pedagogy in nursing education.

**Virtual Patient Simulation in Education**

The terminology and nomenclature on virtual simulation is inconsistent. Various terms that are used for virtual simulation are simulation-based e-learning, virtual patient simulation, virtual simulation, virtual clinical simulation, cybergogy, and e-simulation (Cant & Cooper, 2014). The use of virtual patient simulations creates opportunities to provide ubiquitous and asynchronous online training to multiple students in a variety of locations. Virtual patient simulations can provide multiple high-risk scenarios that may not be encountered in the clinical setting, can decrease concerns over legal issues involving students such as patient confidentiality and ethical issues encountered in the healthcare setting, and they also allow students to practice at their convenience (Zielke, LeFlore, Dufoud, & Hardee, 2010).

Clinical simulations can be grouped into three categories: high-fidelity, standardized patients, and virtual patients. High-fidelity simulators are “computerized mannequins,” standardized patients are real people who play an assigned role, and virtual patients are computerized standardized patients (Zielke et al., 2010, p. 3-4). While each of these clinical simulations can provide high-risk clinical scenarios, they each have advantages and disadvantages. The advantages of high-fidelity simulation include allowing the student a real-time clinical setting to experience patient problems in which the students can touch and perform an intervention such as administering an injection. The disadvantages of high-fidelity simulation include the cost, which limits the amount clinical scenarios available; inability for the student to practice with the simulator at their own time and pace; and the requirement of a physical space...
and a trained facilitator to run the clinical simulation (Zielke et al., 2010). Not only are high-fidelity patient simulators expensive and time intensive, but it also may take several days to schedule the students in a simulation experience due to the number of faculty required to facilitate the simulation and conduct debriefing afterwards (Weatherspoon & Wyatt, 2012). Due to large class size of nursing students, a student may only have one attempt at high-fidelity simulation (Weatherspoon & Wyatt, 2012). Innovative educational strategies, such as virtual patient simulation, are needed in nursing education to prepare nursing students for a complex healthcare environment to provide quality patient care with fewer poor patient outcomes or failure to rescue. The advantages of virtual patient simulation include decreased cost because a physical space and facilitator are not needed, independent practice can occur either synchronously or asynchronously, student exposure to more clinical scenarios, recorded documentation of each interaction, and possibility for reflections on the clinical experience. Disadvantages of virtual patient simulations are related to design challenges such as creating tactile situations virtually (Zielke et al., 2010).

Virtual Patient Simulation and Medical Education

In medical education, simulation is present throughout the curriculum and residency training (Botezatus, Hult, Tessma, & Fors, 2010a). Simulation has been in medical education since the 1960s and appeared in undergraduate nursing education programs in the late 1990s (Hayden, Smiley, Alexander et al., 2014). A meta-analysis of technology enhanced simulation was conducted in 2011 by Cook et al. The systematic review included 609 articles primarily from medical education, involved pretest and posttest intervention with only one institution, and documented improvement in knowledge and skills. However, they found inconsistencies among
studies and a need for more research in healthcare that has increased in power, minimal bias, and clarification of when and how to use simulation.

Simulation including virtual patients, high-fidelity patients, and standardized patients is a tool to support learning, knowledge retention, and to facilitate transfer of knowledge from the classroom to clinical settings. Virtual patients engage students to solve actual patient problems that they will encounter in the clinical setting by activating prior knowledge to generate new knowledge (Botezatus et al., 2010a). This new knowledge has to be practiced and applied in order to be retained in long-term memory. An advantage of virtual patient simulation is that it provides feedback which allows for repetition and reapplication of knowledge, which helps with knowledge acquisition and retention. Examination of the literature on virtual patient simulation and medical education revealed multiple advantages of this instruction on student learning outcomes. Virtual patient simulation does increase knowledge attainment (Benedict, Schonder, &McGee, 2013; Botezatus et al., 2010a, 2010b; Johnson et al., 2013), provides self-directed learning (Benedict et al., 2013), provides blueprints to assess student clinical reasoning skills (Benedict et al., 2013), and provides consistent clinical learning experiences (Botezatu et al., 2010; Ekblad, Mollica, Fors, Pantziaras, & Lavelle, 2013; Johnson et al., 2013).

To understand the impact of virtual patient simulation on student learning, Botezatu et al. (2010) identified five themes during a focus group study with 16 undergraduate medical students at a university in Columbia. The five themes that emerged were learning, teaching, assessment, authenticity, and implementation. In the learning theme, students felt that clinical reasoning was reinforced and provided transferable skills that would be used in clinical practice. Students believed that the ability to make a mistake in the virtual simulation would decrease the chance of making that mistake in clinical practice and would improve their knowledge retention. In the
teaching theme, students were able to provide care to clients in a virtual patient simulation experience that they might not encounter during their clinical rotation, such as a client with malaria. In the assessment theme, the virtual patient simulation provides a formative assessment that gives productive feedback and helps the student to identify strengths and weaknesses. Immediate positive feedback is important to traditional undergraduate students (Lovecchio et al., 2015). In the authenticity theme, students felt that the design and content of the virtual patient simulation should reflect clinical practice with scenarios created from real life records and should include sociocultural context when communicating. With the last theme, implementation, the students believed that more scenarios helped to build more knowledge and they preferred access that was not restricted to a particular location (Botezatu et al., 2010).

**Virtual Patient Simulation and Nursing Education**

The majority of web-based simulation programs used in nursing focus on procedural skills (Cant & Cooper, 2014). Due to physical space constraints and limited clinical sites, schools of nursing have to look at innovative ways to deliver education. One way of meeting this challenge is by moving didactic and clinical experiences to a web-based format (Foronda & Bauman, 2014). Virtual simulation provides students with the opportunity to develop nursing experience before working with a real patient. These experiences provide a platform for the student to build upon previous knowledge to develop critical thinking and clinical decision making skills. The benefits of using virtual simulation include the following: enhanced web-based instruction, hybrid simulation, augment lecture, assignments, high-stakes testing and/or capstone, clinical practicum, high-risk situations, documentation, entrance testing, train the trainer, and collaboration (Foronda & Bauman, 2014). As an example, Tilton, Tiffany, and Hoglund (2015) implemented a pilot project to demonstrate the potential for virtual patient
simulation in nursing education to provide clinical experiences in non-acute care settings for clients with chronic conditions. A total of four chronic care virtual patient simulations were created about for 79 students enrolled in an adult health course. Students received debriefing sessions after each virtual patient simulation. Students identified the role-play experience as positive and enjoyed being able to communicate with the virtual patient. Students identified debriefing as essential to help them to make connections between the clinical experience and the course content. The virtual patient simulation provided a consistent clinical encounter for all the students that they would not have received due to scarcity of clinical placements in the community.

Virtual simulation can enhance web-based instruction by placing the student in a virtual clinical setting, which requires the student to make clinical decisions that they would encounter as a nurse. Hybrid simulation is combining mannequin-based simulation with virtual simulation. An example provided by Foronda and Bauman (2014) included having the student provide acute nursing care with the mannequin-based simulation and then continue home health or follow-up office visits through virtual simulation to demonstrate continuity of care. To augment lecture, virtual simulation can be used in the classroom to engage the students to work together or alone on a specified topic.

Virtual simulation can be used as a formative assessment to evaluate and provide feedback to the students on their clinical performance and documentation. Virtual simulation can be used as a summative assessment to assess clinical judgment and readiness to practice as an entry-level graduate nurse. Clinical placement sites are becoming harder to schedule and more scarce due to increased student enrollment and lack of physical space (Foronda & Bauman, 2014). Therefore, virtual simulation is a viable option to count as clinical hours and provide
students with a clinical experience in high-risk situations such as mass-casualty disasters that the student may be otherwise denied due to lack of the event or patient condition, or safety or liability issues (Foronda & Bauman, 2014).

In a randomized controlled study conducted by Liaw et al. (2014), the authors compared virtual patient simulation with mannequin-based simulation with 57 3rd-year nursing students in Singapore. The simulation was a deteriorating situation with five scenarios including acute coronary syndrome, hypoglycemia, hypovolemic and septic shock, and sepsis leading to cardiopulmonary arrest. The experimental group (n=31) and control group (n=30) received a first posttest and a second posttest. The first posttest was administered 1 day after the simulation and the second posttest was administered 2.5 months after the simulation intervention. Both groups demonstrated improvement from the first posttest to the second posttest (p<.001). The repeated measures ANOVA performance means score was .17 between the experimental and control groups, which showed there was not a significant difference between the two groups.

LeFlore et al. (2012) developed a virtual patient simulation with four virtual pediatric patients on a virtual pediatric unit. After development of the virtual patient simulation, they conducted a randomized, controlled, posttest design to compare learning outcomes between traditional lecture and the virtual patient simulation to teach pediatric respiratory system content. The students were 93 Senior BSN students enrolled in a pediatric nursing course in the southern United States. All students completed assigned readings and received clinical simulation with medium- and high-fidelity simulation and standardized patients. The students were randomized into the experimental group (n=46) who received virtual patient simulation in lieu of classroom lecture and the control group (n=47) who received the traditional classroom lecture. The experimental group did receive lecture notes and a lecture after the virtual patient simulation. To
assess knowledge acquisition, the students received a 10-item multiple choice exam 1 week after the intervention. To assess knowledge application, the students participated in two infant respiratory distress simulation scenarios that were measured using the Objective Structured Clinical Examinations (OSCEs) tool 1 week after the intervention. The results were statistically significant for knowledge acquisition with the control group mean score = 75 and the experimental group mean score = 83.9, \( p=0.004 \) with internal reliability 0.90 using Cronbach’s alpha. The results were statistically significant for knowledge application with the experimental group intervening sooner \( p=0.001 \). Active learning through participation in the virtual simulation may have contributed to the improved achievement of learning outcomes.

In spite of the many advantages of virtual patient simulation, further research is necessary to evaluate learning outcomes in nursing on knowledge retention and clinical impact (Cant & Cooper, 2014; Tilton et al., 2015) and on the effectiveness of virtual patient simulation as an adjunctive and a primary pedagogy for nursing education in associate degree nursing students (Weatherspoon et al., 2015). Furthermore, faculty need to have adequate training to function effectively in virtual patient simulations in the role of facilitator and during debriefings (Tilton et al., 2015). An example of an innovative education strategy, virtual patient simulation that was implemented at one school of nursing in rural South Georgia, will be explained in the section below.

**Digital Clinical Experience™ and Nursing Education**

*Digital Clinical Experience™ (DCE)* by Shadow Health™ is a simulation software application originally developed for graduate level coursework in 2012. There are multiple poster and conference presentation abstracts involving graduate nursing students and DCE available on the Shadow Health website. However, research studies are lacking about DCE in associate of
science nursing programs. The benefits of the DCE for students are that it provides a safe practice environment, decreases anxiety, increases confidence, provides documentation examples, and prepares students for the real world of hands-on experiences through the interactive features of the software (King, 2014; Mawhirter & Klainberg, 2014). Another benefit is the price and the information technology support that students receive from Shadow Health (Gibson-Young, 2014). The benefits of the DCE for faculty are immediate feedback with a transcript of the student documentation and model documentation using correct medical terminology, ongoing formative assessment and summative evaluation with the ability to provide feedback to the students, and a comprehensive gradebook (King, 2014). The DCE helps to prepare students for clinical practice by providing a positive learning experience to enhance health assessment skills, communication, and patient safety (Mawhirter & Klainberg, 2014).

A quasi-experimental study by Bryant et al. (2015) included 65 Master of Science in Nursing Family Nurse Practitioner students in an online course utilizing Digital Clinical Experience™. The purpose was to determine if the DCE affected students’ learning and student perceptions of DCE as a learning strategy. The post hoc calculations were <80%, which indicated that the mean difference was insignificant between the groups. The mean was 3.83 for satisfaction with current learning from the NLN Student Satisfaction and Self Confidence survey. The findings from this study showed that there was no significant difference in learning between the group that received the DCE and the group that did not. The integration of virtual clinical simulation was prompted due to increasing competition for clinical sites, preceptor time constraints, and restriction of access to electronic medical records to the students.
In brief, there is limited research on the effectiveness of DCE in relation to student learning outcomes and student satisfaction with this simulation software in associate nursing programs. Moving forward, student satisfaction will be explored.

**Student Satisfaction With Learning**

Student satisfaction is associated with retention, program completion, grades, and career development (Lovecchio et al., 2015) and is a quality measure of the program (Hsiu-Chin & Huan-Sheng, 2015). Some nursing students have indicated that they are not prepared to function in the practice role and there is a difference between the ideal role that they were taught and actual clinical practice (Lovecchio et al., 2015). A national study investigating student satisfaction with associate nursing programs was conducted by Hsiu-Chin and Huan-Sheng in 2015. According to the researchers, students were most satisfied when the faculty were knowledgeable and the curriculum was relevant to current nursing practice, the syllabus had clear goals, and social interaction occurred between the faculty and students. Students were less satisfied when nursing skills labs were out of date.

An integrative review identified five main themes that contributed to nursing students’ satisfaction with their learning: authentic learning, motivation, resilience, support, and collaborative learning (Walker, Rossi, Anastasi, Gray-Ganter, & Tennent, 2016). Students are more satisfied with authentic learning during the clinical practicum when they receive support from faculty and clinical agency staff. Students’ internal motivation and goals, faculty support, and resilience to overcome stressors encountered in nursing school, all impacted satisfaction. Students who were supported by faculty, clinical staff, and family were more satisfied with their learning. Lastly, collaborative learning with the student engaging with faculty, clinical staff, peers, and teaching technologies contributed to student satisfaction (Walker et al., 2016).
Interestingly, Zulkosky (2012) found that students in an associate of science program were more satisfied with lecture and case study than simulation. Furthermore, they did not complete assigned readings, were unprepared for class, and were accustomed to the passive learning style of PowerPoint presentations. The advantages of lecture identified by the ASN students in the study were the following: learned the material in class, applied the material immediately in class with the case studies, and liked the PowerPoint handouts. Whereas things they did not like about the simulation were related to not being prepared prior to class, feeling rushed, and scenarios being too fast. According to Zulkosky, “the literature discussing satisfaction with simulation as a teaching modality is mixed” (2012, p. e27). Other studies have shown that students were satisfied with virtual patient simulation, as demonstrated by the following two examples.

Georg and Zary (2014) created two virtual patient simulations. The first case was a patient with rheumatoid arthritis that required students to manage the client’s pain, impaired mobility, insomnia, and skin integrity. The second virtual patient simulation was an older man with uncontrolled diabetes mellitus type 2, heart failure, and a diabetic foot, which required the students to manage the client’s fluid volume, blood glucose, self-care and knowledge, and skin integrity. The participants (n=102) were undergraduate nursing students in Sweden. The virtual patient simulation was integrated into part of a nursing course. The students completed a survey to evaluate their experiences of learning with the virtual patient simulation. The Cronbach alpha was calculated at .88, which provided overall reliability and correlation of positive responses. Therefore, the students were satisfied with the virtual patient simulations.

Nurses have to be prepared to handle complex situations. Virtual patient simulation provides a realistic approach to expose students to complex situations that they may encounter in
clinical practice (Sunnqvist, Karlsson, Lindell, & Fors, 2016). The researchers conducted a study in Sweden to determine student satisfaction with a virtual patient simulation that was designed specifically for a mental health nursing course. The purpose of the virtual patient simulation was to prepare students for their clinical mental health rotation and determine their opinion on the use of this type of technology for assessment. The virtual simulations included a patient with major depressive disorder, psychotic behavior, substance abuse, bipolar disorder in manic phase, and schizoaffective disorder. The experimental group included two groups \( (n=66) \). These students worked with the virtual patient simulation for 10 weeks; after 10 weeks, the experimental group \( (n=22) \) took a virtual patient-based exam and the control group \( (n=44) \) completed written and oral exams. Of the experimental group, 20 out of 22 passed the virtual patient exam whereas the control group had 21 out of 44 to pass the written and oral exams. The exams taken by the control and experimental group required the students to use the nursing process and develop a plan of care based on the patient case presented. A manifest content analysis was conducted which resulted in the following findings: the virtual patient simulation was easy to use, innovative, produced knowledge through activity, and had a high potential for use in nursing education. According to Sunnqvist et al. (2016), virtual patient simulation is a pedagogic model that can provide innovative and interactive clinical training for nursing students that promotes lifelong learning through reflection and critical thinking. Nursing students find it difficult to translate their classroom content into the clinical context (Georg & Zary, 2014); virtual patients are a pedagogy that can help students to integrate theory to practice. Virtual patient simulation “has been proposed to support nursing students in their acquisition of scientific knowledge as a way to integrate theory and practice and promote clinical reasoning” (Georg & Zary, 2014, p. 2).
Consequently, DCE has received positive responses from students in an online nursing program (Gibson-Young, 2014), and from distant online graduate nursing education (Miskovsky & Miller, 2014). Reflections from students about the DCE included pulling content together, practicing on the patient virtually prior to hands on, feeling prepared for clinical practicum, being organized, knowing how to perform an assessment and document, and increasing confidence in skills (Gibson-Young, 2014; Miskovsky & Miller, 2014). Virtual patient simulation provided a real-life replication through which the students can learn and practice their skills. This immersion learning in an authentic environment is part of situated cognition, which will be explored next.

**Situated Cognition**

Situated cognition educational learning theory can be applied to virtual simulation. Learning is embedded in the virtual scenarios to enable students to apply and transfer knowledge gained to real life situations (Green et al., 2014); it occurs as the student is using problem solving to explore real-life situations and develop a plan of action (Lamont & Brunero, 2014). Learning happens in simulations because students are immersed in real-life situations in which they may be required to participate (Lamont & Brunero, 2013). Technologies can be used to enhance the learning process and provide students the opportunity to develop nursing skills in a safe environment (Woolley & Jarvis, 2007). Authenticity is critical for the representation of the patient encounter (Ekblad et al., 2013; Wyrostok, Hoffart, Kelly, & Ryba (2014). Virtual patient simulations provide reliable representations of live patients including interactive features for conducting a health history, physical exam, diagnostic tests, and treatments that are parallel to clinical practice.

Ekblad et al. (2013) created a virtual patient simulation to train primary care professionals to identify and treat mental health problems among culturally diverse traumatized
refugee clients in primary care. Paige and Daley (2009) identified principles with the situation cognition framework as the following: thinking and learning occurs within particular situations, meaning is constructed from daily life and communities in which one lives, and acquiring knowledge is dependent upon artifacts and tools from prior knowledge. When situated cognition principles are applied to nursing education, the interacting components include the people, tools, and activity.

**Summary**

In summary, this chapter contains pertinent review of the literature for this research study. The review of the literature provides evidence that measuring student learning outcomes to support virtual patient simulation effectiveness in ADN education is limited. The research does suggest that virtual patient simulation increases student performance on examinations, clinical reasoning, and is an effective pedagogy that is as impactful as traditional instruction. There is a need for more evidence of the impact of virtual patient simulation on knowledge retention and practice in ADN education.
CHAPTER III

METHODOLOGY

This chapter presents the research design, a description of the research setting, population, and sampling. Instrumentation, data collection and recording, and analysis of data are discussed.

Research Design

A quantitative causal-comparative descriptive design was used for this study. The purpose of causal-comparative research is to determine a cause-and-effect relationship between two or more groups and one independent variable (Turner, Balmer, & Coverdale, 2013). Causal-comparative research is also known as ex post facto research because the event of study has already occurred (Brewer & Kubn, 2010). The “defining characteristic of causal-comparative research is that the independent variables are (a) categorical and (b) not experimentally manipulated” (Schenker & Rumrill, 2004, p. 118). In a causal-comparative design, the manipulation of the independent variable (instructional strategy) has already occurred (Fraenkel & Wallen, 2006). This research design was used to describe the differences and infer causes in variables among two or more groups (Brewer & Kubn, 2010; Creswell, 2014; Schenker & Rumrill, 2004; Turner et al., 2013) taught with and without virtual patient simulation. The groups were pre-existing or derived based on demographic or status characteristics to infer differences (Schenker & Rumrill, 2004). To establish differences among groups, independent and dependent variables were determined for each research question.
Setting

This research was conducted at one state college located in rural South Georgia. The state college is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools (SACS). The School of Nursing at this institution offers an Associate of Science in Nursing program, Associate of Science in Nursing LPN to RN bridge program, and RN to BSN program. The Associate of Science in Nursing program has full approval by the Georgia Board of Nursing and is accredited by the Accreditation Commission for Education in Nursing (ACEN).

Participation in the study was voluntary and the outcomes of the study were not used in the grading process. Inclusion criteria were nursing students who were enrolled in the final medical-surgical nursing course during the Summer 2014 through the Spring 2016 semesters and who completed the HESI Mid-Curricular Exam™ and the HESI Exit Exam™. Exclusion criteria were students who failed out of the nursing program or failed the final medical-surgical nursing course.

Nursing students at this state college receive traditional instruction. Traditional instruction is where the nursing student receives didactic instruction in the classroom (Feng et al., 2013) and technical skills to learn how to critically think and function in the role of the nurse in the clinical setting (Hayden, Smiley, Alexander et al., 2014). In traditional instruction, the clinical setting is where the student is assigned to a patient and provides nursing care under the supervision of a clinical instructor to develop and practice nursing skills, apply theory to practice, and prepare for entry level into practice (Hayden, Smiley, Alexander et al., 2014). Traditional clinical experiences are learning activities outside the classroom that include
observation, direct patient care, and interdisciplinary communication (Hayden, Smiley, & Gross, 2014).

Many nursing schools educate students for acute care with the curriculum focused around traditional medical content such as pediatrics, medical-surgical, and obstetrics (IOM, 2010). Classroom lecture has been used traditionally to disseminate large amounts of content in higher education (Benedict et al., 2013). The IOM (2010) recommended that nursing curricula be reexamined and updated. The curriculum needs to “undergo continuous evaluation and improvement based on new evidence and a changing science base, changes and advances in technology, and changes in the needs of patients and the health care system” (IOM, 2010, p. 191).

The nursing program at this state college began in 1968. The last curricular revision was in 2013. The students who start in the summer semester are licensed practical nurses (LPN) and they complete the 1st year of nursing didactic over the course of 10 weeks. They take the HESI MC at the end of the summer semester in the month of July prior to entering the 2nd year. The generic students complete the 1st year of nursing in the fall and spring semesters and take the HESI MC at the end of the spring semester in the month of April prior to entering the 2nd year. The summer semester students are divided and take either medical surgical nursing in the fall or spring and they are integrated with the generic students. All students in the 2nd year of nursing complete the HESI Exit exam during the last month of the final semester in the month of April prior to graduation. The students in the 2nd year of nursing take the final medical-surgical nursing course either in the fall or the spring; all students alternate medical-surgical nursing with obstetrics and pediatrics.
The curriculum (Appendix A) for the medical-surgical course includes medical-surgical and critical care content. The DCE was added as a pilot to the medical-surgical course for Fall 2015 and Spring 2016. The curriculum remained the same for both the 2014-2015 and 2015-2016 academic years. The only difference in the curriculum was the addition of the DCE to the 2015-2016 academic year group. The faculty had a division meeting in April 2015 with a representative from Shadow Health, who provided an overview of the DCE. Due to issues with clinical placement and lack of high-fidelity simulation, the faculty agreed to pilot this software. It was agreed upon by the faculty to pilot the DCE in the final medical-surgical course because the students should have the knowledge base to complete an assessment, provide safe nursing care, document the care, and communicate with their client and members of the healthcare team. Another factor was the relative inexpensive cost of $99 per student for lifetime access to the DCE.

To establish that the groups were equal, historical data from the 2014-2015 academic year group were compared to data from the 2015-2016 academic year group, including the HESI Admission Assessment (A²), age, gender, race, ethnicity, and financial aid status. The HESI A² is a preadmission examination to predict success in nursing and other healthcare fields (Chen & Voyles, 2013). The assessment is composed of multiple exams including math, reading, grammar, vocabulary, and science (Chen & Voyles, 2013). The components of the personalized HESI A² at this state college include grammar, math, reading, and vocabulary; students need a minimum score of 75 for each area. Manieri, Lima, and Ghosal (2015) revealed the HESI A² was a better predictor of success in an associate degree nursing program compared to other admission assessment examinations. The HESI A² mean score for 2014-2015 academic year group was
81.53% (n=164) and the mean score for the 2015-2016 academic year group was 79.94% (n=171).

According to the American Association of Colleges of Nursing (AACN)’s position statement, *Diversity and Equality of Opportunity* (1997), diversity includes race, ethnicity, socioeconomic status, gender, age, religion, sexual preference, and disability. According to the *National Sample Survey of Registered Nurses* (U.S. Department of Health & Human Services, 2010), only 16.8% of Registered Nurses (RN) represent diverse populations, and only 9.6% represent men. A slight increase in diverse student populations has resulted from strategies to increase enrollment, retention, and graduation of underrepresented groups in nursing, which were recommendations by the NLN diversity task group (NLN, 2009). To establish that groups for this study were equal prior to the study, the demographic data of the two academic year groups were compiled. The groups were similar and representative of diverse populations. Table 1 is a frequency distribution table of the ASN graduates including gender, age, race/ethnicity, and financial aid status. This table was created based on the following information:

1. Spring 2016 graduate data were for students who had applied for graduation.

2. Age was calculated as of 2/23/15 for Spring 2015 graduates and 2/23/16 for Spring 2016 graduates to be consistent.

3. Since the distribution among race/ethnicity was not equal, Black/African American, Hispanic, and any other non-White were classified into “Minority.”

4. Pell recipient represented students who at some point received a PELL grant.

5. Financial Aid Recipient included any kind of financial aid the student may have received at some point at the research institution which included HOPE, PELL, federal loans, and institutional scholarships. This did not include third party loans.
Table 1

ASN Demographic Information

<table>
<thead>
<tr>
<th>ASN Graduates</th>
<th>Spring 2015</th>
<th>Spring 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Total</td>
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</tr>
<tr>
<td>Gender</td>
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<tr>
<td>Female</td>
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<td>91.30%</td>
</tr>
<tr>
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</tr>
<tr>
<td>Age</td>
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<td></td>
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<tr>
<td>24 &amp; Under</td>
<td>23</td>
<td>33.33%</td>
</tr>
<tr>
<td>25 &amp; Over</td>
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<td>Financial Aid Status</td>
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<tr>
<td>Pell Recipient</td>
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</tr>
<tr>
<td>Financial Aid Recipient (includes Pell)</td>
<td>65</td>
<td>94.20%</td>
</tr>
</tbody>
</table>

Population and Sampling

The population studied was nursing students enrolled in their last year of a medical-surgical nursing course at a state college, associate-degree granting nursing school located in rural South Georgia. The students were a mix of genders, ethnicities, and ages. The sample was a convenience sample size of 135 students (70 of whom had received traditional instruction and 65 of whom had received virtual patient simulation instruction). To establish internal validity of a causal-comparative research design, the participants need to be representative of the broader population to which they belong with the largest sample size possible (Schenker & Rumrill, 2004).

Due to the small sample size, *a priori* power analysis was used to determine the sample size needed to reduce the risk of committing a Type 1 error (Gaskin & Happell, 2014). In order
to control the risk of making a Type I error (rejecting the null hypothesis when it is true), the level of significance was .05. The minimal level of significance was at .05, which is analogous with a confidence interval of 95% (Polit & Beck, 2014). The estimate of the expected effect for this research study was an effect size of .80. A large sample size is not needed for large effect sizes; but to predict small effect sizes, a large sample size is needed (Polit & Beck, 2014). The sample size needed for this study was 42 based upon a significance level = .05, effect size = .80, power level = .80, and $\alpha = .05$ (Lomax & Hahs-Vaughn, 2013; Polit & Beck, 2014). A Type II error (accept the null hypothesis when it is false) can occur due to small sample size (Polit & Beck, 2014); a minimal power level of .80 was used to help reduce the risk. In nursing research, the effect size may have more of an impact on nursing practice than on the statistical significance, which may or may not be present (Gaskin & Happell, 2014).

To calculate a sample size for this research study, a power analysis was completed using G*Power software version 3.1.9.2. The following steps were used to project the sample size of 42 participants. In other words, if there is a sample size of 42 individuals in the study testing at an alpha level of .05 and achieving an effect size of .80, then the power of this test was .80, which means the probability of rejecting the null hypothesis when it is really false was 80% (Lomax & Hahs-Vaughn, 2012).

1. Significance level = .05.
2. Effect size = .80 for large effect size (Lomax & Hahs-Vaughn, 2012, p. 139).
3. Desired power level = power level of .80 was used because this is the desired level or higher in education (Lomax & Hahs-Vaughn, 2012, p. 151).
4. Number of groups = 6.
Sample for Research Question One—Hypothesis One

For Research Question One—Hypothesis One, the sample size was 135 medical-surgical students who received virtual patient simulation (VPSI) or traditional instruction (TI) from the Summer 2014 through Spring 2016 academic semesters. The measurement of achievement pre-instruction was the HESI Mid-Curricular Exam™ and post-instruction was the HESI Exit Exam™ scores. The medical-surgical students were part of six instruction sample subgroups:

1. Summer 2014 TI group n = 21
2. Fall 2014 TI group, n = 24,
3. Spring 2015 TI group, n = 25,
4. Summer 2015 VPSI group, n = 18
5. Fall 2015 VPSI group, n = 25, and

Sample for Research Question One—Hypothesis Two

For Research Question One—Hypothesis Two, the sample size was 135 medical-surgical students who received virtual patient simulation (VPSI) or traditional instruction (TI) from the Summer 2014 through Spring 2016 academic semesters. The measurement of achievement was the final exam content scores for the last semester medical-surgical nursing course. The medical-surgical students were part of six instruction sample subgroups:

1. Summer 2014 TI group n = 21
2. Fall 2014 TI group, n = 24,
3. Spring 2015 TI group, n = 25,
4. Summer 2015 VPSI group, n = 18
5. Fall 2015 VPSI group, n = 25, and
Sample for Research Question Two

The sample size of students for Research Question Two was 65 medical-surgical students who received VPSI for the Fall 2015 and Spring 2016 semesters. The measurement of perceived satisfaction with current learning was from the *Student Satisfaction and Self-Confidence in Learning* survey for the last semester medical-surgical nursing course.

1. Fall 2015 VPSI group, n = 32, and
2. Spring 2016 VPSI group, n = 33.

Research Questions and Hypotheses

The research questions addressed in this quantitative study are as follows:

1. Did the introduction of virtual patient simulation delivery lead to equivalent educational outcomes when compared to traditional instruction?

   **Null Hypothesis One:** There was no difference in the pre-instruction exam achievement scores (HESI Mid-Curricular Exam™) and post-instruction exam achievement scores (HESI Exit Examination™) between medical-surgical nursing students taught with virtual patient simulation instruction and students taught with traditional instruction.

   **Null Hypothesis Two:** There was no difference in the post-instruction course content exam scores between medical-surgical nursing students taught with virtual patient simulation instruction and students taught with traditional instruction.

2. What was the post-instruction perceived satisfaction with current learning scores on the *Student Satisfaction and Self-Confidence in Learning* survey among medical-surgical students who received virtual patient simulation instruction during the Fall 2015 and Spring 2016 semesters?
**Intervention**

The intervention used in this study was virtual patient simulation used to deliver medical-surgical nursing content. Nursing faculty at a state college located in rural South Georgia adopted virtual patient simulation software, Digital Clinical Experience (DCE) developed by Shadow Health, Inc., which was integrated into a pilot section of the final year medical-surgical nursing course during the 2015-2016 academic school year. The curriculum (Appendix A) for the course was the same for the 2014-2015 academic year and the 2015-2016 academic year. The only change was the addition of the virtual patient simulation to the 2015-2016 academic year. The students purchased access to the DCE either directly from Shadow Health, Inc. or from the college bookstore at a cost of $99 for the semester. The students completed the undergraduate-level learning modules using DCE during the 15-week term in addition to the standard course activities.

Due to lack of network bandwidth in the classroom and computer lab space, the DCE virtual patient simulation was assigned outside of the classroom. Computers in the library were designated for the students to complete the assignment. These computers had the Unity Web Player software loaded that was required to run the DCE. The DCE modules are aligned with the course content by body systems. The participants completed an orientation and a conversation concept lab to become familiar with the DCE platform. The 17 DCE modules were divided into the following topic areas: (a) health history; (b) head, ears, eyes, nose, and throat (HEENT); (c) respiratory concept lab and respiratory; (d) cardiovascular concept lab and cardiovascular; (e) abdominal concept lab and abdominal; (f) musculoskeletal; (g) neurological; (h) skin, hair, and nails; (i) focused exam for cough; (j) focused exam for chest pain; (k) focused exam abdominal pain; and (l) comprehensive assessment.
The body specific assessment modules involved a clinical simulation with a digital standardized patient (DSP) named Tina Jones. The students could ask the DSP questions via typed text, and the DSP responded to the student verbally and by typed text. The students’ interaction with the DSP mimicked real-life patient interaction, including obtaining subjective data by patient interaction (conversation), obtaining objective data through health assessment and history, providing interventions such as medication administration after reviewing the medication administration records and the health care provider orders, and conducting interdisciplinary interaction with other members of the health care team. The DCE was a course requirement for the final year medical-surgical nursing course. The students did not receive a grade for this assignment; however, they were required to complete all of the assigned modules (Appendix A) and document mastery with a score equal to or greater than 75 on the comprehensive assessment module. The DCE replaced one-third of the clinical hours (45 hours).

The Student Satisfaction and Self-Confidence in Learning survey was administered at the end of the course for Fall 2015 and Spring 2016. Permission was obtained from the NLN and the Dean of the School of Nursing to use this tool as part of the course to evaluate student satisfaction with the DCE. This tool was given to students in the Fall 2015 semester as part of the normal evaluation process in the medical-surgical course to evaluate student satisfaction with the virtual patient simulation. The School of Nursing adopted the Shadow Health Digital Clinical Experience (DCE) virtual patient software as a pilot in the final medical-surgical course. This survey, HESI exams, and the DCE are requirements of the course. The Summer 2014 through Fall 2015 group data were exiting data and were provided in a de-identified format by the college. The research procedure is listed in Figure 2.
**PRIOR TO Data Collection**  
- Obtain permission for research from appropriate sources.

**Recruitment of Participants**  
- Explanation of study’s purpose, framework, and satisfaction survey via script by colleague.  
- Extend an invitation to participate and obtain written informed consent from Spring 2016 cohort. Summer 2014 through Fall 2015 is historical data.  
- Obtain historical data in de-identified format from the Dean of the School of Nursing

<table>
<thead>
<tr>
<th>Summer 2014</th>
<th>Fall 2014</th>
<th>Spring 2015</th>
<th>Summer 2015</th>
<th>Fall 2015</th>
<th>Spring 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPN’s complete the first year of nursing over the course of 10 weeks during the Summer.</td>
<td>Generic students complete the first year of nursing over the course of two semesters (fall and spring)</td>
<td>Generic students complete the first year of nursing over the course of two semesters (fall and spring)</td>
<td>LPN’s complete the first year of nursing over the course of 10 weeks during the Summer.</td>
<td>Generic students complete the first year of nursing over the course of two semesters (fall and spring)</td>
<td>Generic students complete the first year of nursing over the course of two semesters (fall and spring)</td>
</tr>
<tr>
<td>This group of LPN’s is divided at the end of summer and integrated into Fall 2014 or Spring 2015 cohort</td>
<td>Medical-Surgical Nursing Course Fall 2014</td>
<td>Medical-Surgical Nursing Course Spring 2015</td>
<td>This group of LPN’s is divided at the end of summer semester and integrated into Fall 2015 or Spring 2016 cohort</td>
<td>Medical-Surgical Nursing Course Fall 2015</td>
<td>Medical-Surgical Nursing Course Spring 2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Digital Clinical Experience</td>
<td>Digital Clinical Experience</td>
<td></td>
</tr>
</tbody>
</table>

*Participants will rate individual satisfaction using the Student Satisfaction and Self-Confidence in Learning tool.*  
*Participants will rate individual satisfaction using the Student Satisfaction and Self-Confidence in Learning tool.*

*Figure 2. Flowchart of research procedure*
Prior to data collection, the Spring 2016 students were verbally informed about the study procedures and provided the opportunity to participate in the study. At the conclusion of the Spring 2016 class, a colleague entered the classroom and introduced the study from the script (Appendix B), then handed out the consent form (Appendix C) and the letter of invitation to participate (Appendix D), and instructed the students to turn the consent form back in if they wanted to participate.

Approval for this study was obtained by the state college Institutional Review Board (IRB) (Appendix E) and by the University of Alabama’s Institutional Review Board (IRB) (Appendix E) to conduct this study. Permission was obtained from the Dean of the School of Nursing at the institution where the study took place.

**Instrumentation**

Data collection instruments used in this study included two HESI examinations, a final medical-surgical exam, and a survey. The examinations used to collect data on student achievement were the nationally normed standardized HESI Mid-Curricular Exam™ and HESI Exit Exam™ developed by Elsevier, Inc., and the final content exam for the course. The survey used to collect data on student satisfaction was the “satisfaction with current learning” section on the Student Satisfaction and Self-Confidence in Learning survey developed by the National League for Nursing (NLN).

The HESI Exit Exam™ is considered a reliable and valid tool based on the ninth HESI exit validity study. Using a group of 3,790 nursing students, HESI calculated Welch–Satterthwaite's t-test at \( p \leq .0001 \) to determine predictive accuracy to pass the NCLEX-RN for first time test takers at 96.61%. The predictive accuracy for this ninth validity study was within the range of the eight previous validity studies. The predictive accuracy of the HESI Exit exam
can be used by nursing faculty as a remedial guide to help at-risk students and can serve as a tool to evaluate curricular effectiveness for inclusion in schools' accreditation reports (Zweighaft, 2013).

The HESI Exit exam is administered during the last semester prior to graduation. To establish that there was not a difference on the HEIS Exit Exam based upon which semester a student was enrolled in the final medical-surgical nursing course at this state college, historical data were obtained for the past 3 academic years and are shown in the Table 2 below.

Table 2

<table>
<thead>
<tr>
<th>HESI Exit Conversion Scores for the Past 3 Academic Years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Academic Year</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>2015-2016</td>
</tr>
<tr>
<td>2014-2015</td>
</tr>
<tr>
<td>2013-2014</td>
</tr>
<tr>
<td><strong>Average</strong></td>
</tr>
</tbody>
</table>

The HESI Mid-Curricular Exam™ is a form of progression testing within the curriculum to identify students who are at risk for failure in the nursing program (Harding, 2012). A systematic review concluded that the scores attained on this exam were a valid predictor of academic success in nursing school; students who scored less than 800 on this exam were unsuccessful (Harding, 2012). The HESI Mid-Curricular Exam™ is a customized exam designed to evaluate the student mastery of the first half of the nursing curriculum (Harding, 2012). A study conducted by Harding, Rateau, and Heise (2011) validated the HESI Mid-Curricular Exam™ scores as a predictor of success (statistically significant at $p < .01$) when correlated with the HESI Exit Exam™ and the score attained in the final medical-surgical nursing course. This exam is administered at the completion of the 1st year of nursing at the state college.
The Student Satisfaction and Self-Confidence in Learning survey developed by the NLN has been widely used since 2006 to evaluate students’ satisfaction in learning with simulations (Franklin et al., 2014). The purpose of this survey in this study was to explore students’ perceptions of virtual patient simulation as a learning strategy. This instrument uses a 5-point scale to evaluate 13 items divided into (a) satisfaction with current learning and (b) self-confidence in learning. The “satisfaction with instruction” section contains five items measuring satisfaction with teaching methods, variety of learning materials and activities to promote learning, and the facilitation and suitability of simulation (Franklin et al., 2014).

The 5-point Likert-type scale provided the students with the following response options to describe their opinion about the statement: (1) strongly disagree, (2) disagree, (3) undecided, (4) agree, and (5) strongly agree (Franklin, Burns, & Lee, 2014). A study conducted by Franklin et al. (2014) established psychometric properties of the Self-Confidence in Learning Scale. The authors reported Cronbach’s alpha as 0.94 for the satisfaction subscale and 0.83 for the self-confidence subscale (Franklin et al., 2014). The purpose of evaluating the psychometric properties was to establish reliability and validity (Connelly, 2011). One form of establishing reliability was Cronbach’s alpha, and a measurement closer to 1 indicated high internal consistency (Connelly, 2011). There is sufficient reliability and validity of this instrument to be used in research (Franklin et al., 2014).

The 100-item final medical-surgical content exam was the same for both the 2014-2015 and 2015-2016 academic years in the fall and spring semesters. The Dean of the School of Nursing at the state college reviewed the final exam to validate that it did meet the course objectives and test items were at the cognitive level of application and higher. Furthermore, the Dean has experience as a test item reviewer with the NCSBN.
Data Analysis

The data were acquired from scores on the HESI Mid-Curricular Exam™, the HESI Exit Exam™, and the final content exam for Research Question One. The data were acquired from survey responses from The Student Satisfaction and Self-Confidence in Learning survey for Research Question Two. The statistical data analysis was conducted with the Statistical Product and Service Solutions (SPSS®) for Windows software version 23.0. Multivariate analysis of variance (MANOVA) is an analysis of variance that has two or more dependent variables and is a member of the General Linear Model that quantifies the relationship between variables (Warne, 2014). The purpose of MANOVA is to prevent committing a Type I error and to determine if the independent variable was the cause for change in the dependent variable (Warne, 2014). One-way analysis of variance (ANOVA) was used to compare means of two or more groups to determine significance (Heavey, 2015).

Limitations with a causal-comparative design include the following: inability to manipulate variables because the event has already occurred, groups are already formed and lack randomization, and weaker evidence of causation (Fraenkel & Wallen, 2006). Threats to internal validity are the chance that the groups are not equivalent other than on the identified group variable (Fraenkel & Wallen, 2006).

Research Question One—Hypothesis One

The data collected for Research Question One—Hypothesis One were analyzed using one-way MANOVA to determine significant differences in the pre-instruction (HESI Mid-Curricular Exam™) and post-instruction (HESI Exit Exam™) scores among medical-surgical nursing students taught with or without VPSI during the Summer 2014 to Spring 2016 semesters. A p value of .05 was set as the test of significance. For Research Question One—Hypothesis
One, the independent variable was the instructional strategy (virtual patient simulation instruction or traditional instruction) manipulated by the group during the Summer 2014 to Spring 2016 semesters. The dependent variable was achievement pre-instruction measured using the HESI Mid-Curricular Exam™ scores and achievement post-instruction measured using the HESI Exit Exam™ scores.

**Research Question One—Hypothesis Two**

The data collected for Research Question One—Hypothesis Two were analyzed using one-way ANOVA to determine significant differences in the post-instruction final content medical-surgical exam mean scores among medical-surgical nursing students taught with or without VPSI during the Summer 2014 to Spring 2016 semesters. For Research Question One—Hypothesis Two, the independent variable was the instructional strategy (virtual patient simulation instruction or traditional instruction) manipulated by groups from the Summer 2014 to Spring 2016 semesters. The dependent variable was achievement measured using the final content medical-surgical exam scores.

**Research Question Two**

The data for Research Question Two were analyzed using descriptive statistics. For Research Question Two, the independent variable was the instructional strategy manipulated by groups (after virtual patient simulation). Perceived satisfaction with current learning is the dependent variable to be measured as summative scores from the subsection “Satisfaction with Current Learning” (Questions 1-5) on the Student Satisfaction and Self-Confidence in Learning survey (Appendix F).

Table 3 provides a graphic summary of the research question, instrument of measure, and the statistical test for the research question. There are a variety of statistical tests that can be used
to answer a research question; however, it is the responsibility of the principle investigator to choose the one statistical test that will best answer their research question (Bettany-Saltikov & Whittaker, 2014).

Table 3

Research Question, Instrument of Measure, and Statistical Test

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Hypothesis</th>
<th>Instrument of Measure</th>
<th>Statistical Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did the introduction of virtual patient simulation delivery lead to equivalent educational outcomes when compared to traditional instruction?</td>
<td><em>Null Hypothesis One:</em> There was no difference in the pre-instruction exam achievement scores (HESI Mid-Curricular Exam™) and post-instruction exam achievement scores (HESI Exit Examination™) between medical-surgical nursing students taught with virtual patient simulation instruction and students taught with traditional instruction. <em>Null Hypothesis Two:</em> There was no difference in the post-instruction course content exam scores between medical-surgical nursing students taught with virtual patient simulation instruction and students taught with traditional instruction.</td>
<td>HESI MC and HESI Exit scores</td>
<td>one-way MANOVA</td>
</tr>
<tr>
<td>What was the post-instruction perceived satisfaction with current learning scores on the Student Satisfaction and Self-Confidence in Learning survey among medical-surgical students who received virtual patient simulation instruction during the Fall 2015 and Spring 2016 semesters?</td>
<td>Likert-type student survey of satisfaction of current learning.</td>
<td>final content exam scores</td>
<td>one-way ANOVA</td>
</tr>
</tbody>
</table>
Summary

This chapter outlined the quantitative causal comparative design and research procedures that were used in the research study. The research population for this study was students from one associate of science nursing program enrolled in the final medical-surgical nursing course from the Summer 2014 through the Spring 2016 semesters. Data analysis included the students’ knowledge as evidenced by exam performance and student satisfaction with the virtual patient simulation. Major findings are reported in Chapter IV.
CHAPTER IV

RESULTS

This study was designed to determine whether the use of virtual patient simulation was equivalent to traditional instruction. This chapter presents the results and the statistical analysis of data obtained.

Background

The purpose of this study was to examine virtual patient simulation effectiveness on student learning outcomes and student satisfaction. The purpose of this quantitative research was to answer the following two research questions and hypotheses:

1. Did the introduction of virtual patient simulation delivery lead to equivalent educational outcomes when compared to traditional instruction?

   Null Hypothesis One: There was no difference in the pre-instruction exam achievement scores (HESI Mid-Curricular Exam™) and post-instruction exam achievement scores (HESI Exit Examination™) between medical-surgical nursing students taught with virtual patient simulation instruction and students taught with traditional instruction.

   Null Hypothesis Two: There was no difference in the post-instruction course content exam scores between medical-surgical nursing students taught with virtual patient simulation instruction and students taught with traditional instruction.

2. What was the post-instruction perceived satisfaction with current learning scores on the Student Satisfaction and Self-Confidence in Learning survey among medical-surgical students
who received virtual patient simulation instruction during the Fall 2015 and Spring 2016 semesters?

The independent variable for this research was the method of instruction: traditional instruction and virtual patient simulation instruction. The virtual patient simulation was introduced as part of the final year medical-surgical course content in the 2015-2016 academic year. The dependent variables for this research were the HESI MC exam, HESI Exit exam, and the final content exam for the medical-surgical course. These exams were part of the medical-surgical course curriculum. The HESI MC is taken at the end of the 1st year of the nursing program. The HESI MC is a comprehensive evaluation of the student’s knowledge prior to entering the 2nd year of the nursing program. The HESI MC and the HESI EXIT are not the same exam. The HESI MC is an exam over the 1st year nursing content and the HESI EXIT is an exam over all of the content in the nursing program. The medical-surgical curriculum was unchanged and was the same for both the 2014-2015 and 2015-2016 academic years. The only change in the curriculum was the addition of the virtual patient simulation in the 2015-2016 academic year. This research was designed to examine if the introduction of virtual patient simulation in the final medical-surgical nursing course had any impact on student learning outcomes as evidenced by exam performance on the HESI and final content exam. In addition, the research was designed to evaluate if students were satisfied with this type of learning.

Demographic Data

The sample for this study was a convenience sample of associate degree nursing students in the final year of the nursing program at a community college in Southeast Georgia. The population for this study was 135 students.
For Research Question one—Hypotheses One and Two, the sample consisted of 135 medical-surgical student subjects who received virtual patient simulation instruction (VPSI) or traditional instruction (TI) from the Summer 2014 through Spring 2016 semesters. Participants were placed into six sample subgroups, Summer 2014 TI group \((n = 21)\), Fall 2014 TI group \((n = 24)\), Spring 2015 TI group \((n = 25)\), Summer 2015 VPSI group \((n = 18)\), Fall 2015 VPSI group \((n = 25)\), and Spring 2016 VPSI group \((n = 22)\).

For Research Question Two, the sample consisted of 65 medical-surgical student participants who received virtual patient simulation instruction from the Fall 2015 through Spring 2016 semesters. Participants were placed into three sample subgroups including: Summer 2015 VPSI group \((n = 18)\), Fall 2015 VPSI group \((n = 25)\), and Spring 2016 VPSI group \((n = 22)\).

**Major Findings**

Data were obtained from the standardized HESI MC and HESI Exit™ scores for Research Question One and the NLN “satisfaction with current learning” component of the *Student Satisfaction and Self-Confidence in Learning* (Appendix G) for Research Question Two. Using SPSS® 23.0, the data were analyzed using descriptive and inferential statistics. Results for each research question are reported.

**Research Question One—Hypothesis One**

*Did the introduction of virtual patient simulation delivery lead to equivalent educational outcomes when compared to traditional instruction?* To answer Research Question One—Hypothesis One, data were analyzed from 135 medical-surgical nursing students using descriptive statistics and one-way MANOVA.
Descriptive statistics. Summer 2014 through the Spring 2016 HESI MC and HESI Exit scores for the traditional instruction intervention and the virtual patient simulation intervention—means and standard deviations—are displayed in Table 4.

Table 4

Means and Standard Deviations on the HESI Exams for the Intervention

<table>
<thead>
<tr>
<th>Intervention</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HESI MC TI group</td>
<td>70</td>
<td>77.41</td>
<td>7.58</td>
</tr>
<tr>
<td>HESI MC VPSI group</td>
<td>65</td>
<td>76.86</td>
<td>9.40</td>
</tr>
<tr>
<td>Total</td>
<td>135</td>
<td>77.14</td>
<td>8.48</td>
</tr>
<tr>
<td>HESI EXIT TI group</td>
<td>70</td>
<td>77.84</td>
<td>7.29</td>
</tr>
<tr>
<td>HESI EXIT VPSI group</td>
<td>65</td>
<td>77.92</td>
<td>8.17</td>
</tr>
<tr>
<td>Total</td>
<td>135</td>
<td>77.88</td>
<td>7.69</td>
</tr>
</tbody>
</table>

The HESI MC mean score for the TI group was 77.41 (SD = 7.58) and for the VPSI group was 76.86 (SD = 9.40). The HESI Exit mean score for the TI group was 77.84 (SD = 7.27) and for the VPSI group was 77.92 (SD = 8.17). The mean scores are represented in Figure 3 by the lines in the colored bars.

The boxplot in Figure 3 provides a graphic display of the results. The results revealed no significant difference between the intervention (virtual patient simulation) and the HESI MC and the HESI Exit.
Figure 3. Distributions of the HESI MC and HESI EXIT scores for the traditional and virtual patient simulation groups.

**One-Way MANOVA.** A one-way multivariate analysis of variance (MANOVA) was conducted to determine the effect of the independent variable (instructional strategy, traditional instruction and virtual patient simulation) on the two dependent variables, the HESI MC and the HESI EXIT. No significant differences were found among the instructional strategy and exam scores. Levene’s test of equality of error variances was obtained to determine equal variance among groups. Based on the $p = .181$ for the HESI MC exam and the $p = .178$ for the HESI Exit exam, the groups were similar and could be compared (Lomax & Hahs-Vaughn, 2012). Therefore, homogeneity of variance was assumed.

A one-way MANOVA revealed no significant effect for virtual patient simulation between HESI MC and HESI EXIT scores, Wilks’ $\lambda = .998$, $F (2,132) = .117^b$, $p = .890$, and partial eta squared $=.002$. To control for type I error, a Bonferroni procedure was conducted. The univariate ANOVA for the HESI MC was $F (1, 133) = .141$, $p = .708$, $n^2 = .001$ and for the
HESI EXIT was $F(1, 133) = .004, p = .949, n^2 = .000$. The Bonferroni procedure verified that the HESI MC and HESI EXIT scores were nonsignificant for type of instruction received.

The HESI scores for the traditional instruction and virtual patient simulation groups were not significantly different from each other. Therefore, the hypothesis failed to be rejected.

**Research Question One—Hypothesis Two**

*Did the introduction of virtual patient simulation delivery lead to equivalent educational outcomes when compared to traditional instruction?* To answer Research Question One—Hypothesis Two, data were analyzed from 135 medical-surgical nursing students using descriptive statistics and one-way ANOVA.

**Descriptive statistics.** Summer 2014 through the Spring 2016 final content exam scores for the traditional instruction intervention and the virtual patient simulation intervention—means and standard deviations—are displayed in Table 5.

<table>
<thead>
<tr>
<th>Intervention</th>
<th>$n$</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Exam TI group</td>
<td>70</td>
<td>83.09</td>
<td>4.89</td>
</tr>
<tr>
<td>Final Exam VPSI group</td>
<td>65</td>
<td>82.92</td>
<td>4.94</td>
</tr>
<tr>
<td>Total</td>
<td>135</td>
<td>83.01</td>
<td>4.90</td>
</tr>
</tbody>
</table>

The mean score for the TI group was 83.09 (SD = 4.89). The mean score for the VPSI group was 82.92 (SD = 4.94).

**One-way ANOVA.** Data were analyzed using one-way ANOVA to determine if differences between final content exam scores were significant based upon the type of instruction received. The independent variable was instructional strategy (traditional instruction and virtual
patient simulation instruction). The dependent variable was the final content exam scores. The ANOVA did not reveal any significant effect from the type of instruction $F(1, 129) = .028, p = .866$. Therefore, the null hypothesis failed to be rejected.

The strength of the relationship between the intervention and final exam content scores, as assessed by $\eta^2$, was weak, with the virtual patient simulation instruction accounting for 0% of the variance of the dependent variable. Levene’s test of equality of error variances was obtained to determine equal variance among groups. Based on the $p = .866$ for the final content exam, the groups are similar and can be compared (Lomax & Hahs-Vaughn, 2012). Therefore, homogeneity of variance was assumed. The 95% confidence intervals for the pairwise differences, as well as the means and standard deviations for the groups, are reported in Table 6.

Table 6

<table>
<thead>
<tr>
<th>Intervention</th>
<th>M</th>
<th>SD</th>
<th>TI</th>
<th>VPSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>TI</td>
<td>83.09</td>
<td>4.89</td>
<td>81.92 to 84.28</td>
<td></td>
</tr>
<tr>
<td>VPSI</td>
<td>82.92</td>
<td>4.94</td>
<td></td>
<td>81.72 to 84.19</td>
</tr>
</tbody>
</table>

In summary, one-way MANOVA revealed that there was not a significant difference in HESI MC and HESI Exit scores among students with TI or with VPSI from Summer 2014 to Spring 2016. The one-way ANOVA revealed that there was not a significant difference in final content exam scores among students with TI or with VPSI from Summer 2014 to Spring 2016. Therefore, the null hypotheses two for Research Question One failed to be rejected.

**Research Question Two**

Research Question Two: *What was the post-instruction perceived satisfaction with current learning in learning scores on the Student Satisfaction and Self-Confidence in Learning survey among medical-surgical students who received virtual patient simulation instruction*
during the Fall 2015 and Spring 2016 semesters? Descriptive statistics were calculated to determine student satisfaction with the virtual patient simulation instruction.

Students were asked to complete the Student Satisfaction and Self-Confidence in Learning survey developed by the NLN. The reliability coefficient, Cronbach’s alpha, for the “satisfaction with current learning” subscale is 0.94 (Franklin et al., 2014). A Cronbach’s alpha of .879 was obtained for the current study on the “satisfaction with current learning” subscale. A copy of the survey, completed by the students \((n=65)\) is attached as Appendix G. The score for each response were 1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, and 5 = Strongly Agree. The results indicated that the students in the Spring 2016 \((n=33)\) group were satisfied with the virtual patient simulation instruction. However, the Fall 2015 \((n=32)\) group was undecided. Overall, the mean score for both groups = 3.864.

The results from the satisfaction with current learning from the NLN survey tool are listed in Table 4.5. The Fall 2015 group was undecided with a mean score 3.587. However, the Spring 2016 group was satisfied with a mean score of 4.1485. The overall mean score for both groups was 3.864.

Table 7

<table>
<thead>
<tr>
<th>Statement</th>
<th>Clinical Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The teaching methods used in this simulation were helpful and effective.</td>
<td>Fall 2015</td>
<td>3.5938</td>
<td>1.07341</td>
</tr>
<tr>
<td></td>
<td>Spring 2016</td>
<td>4.0303</td>
<td>.63663</td>
</tr>
</tbody>
</table>
Table 7 (con’t)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Clinical Group</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. The simulation provided me with a variety of leaning materials and activities to promote my learning the medical-surgical curriculum.</td>
<td>Fall 2015</td>
<td>3.8125</td>
<td>1.02980</td>
</tr>
<tr>
<td></td>
<td>Spring 2016</td>
<td>4.0909</td>
<td>.63066</td>
</tr>
<tr>
<td>3. I enjoyed how my instructor taught the simulation.</td>
<td>Fall 2015</td>
<td>3.5313</td>
<td>1.07716</td>
</tr>
<tr>
<td></td>
<td>Spring 2016</td>
<td>4.2727</td>
<td>.97701</td>
</tr>
<tr>
<td>4. The teaching materials used in this simulation were motivating and helped me to learn.</td>
<td>Fall 2015</td>
<td>3.5625</td>
<td>1.04534</td>
</tr>
<tr>
<td></td>
<td>Spring 2016</td>
<td>4.1212</td>
<td>.73983</td>
</tr>
<tr>
<td>5. The way my instructor(s) taught the simulation was suitable to the way I learn.</td>
<td>Fall 2015</td>
<td>3.4375</td>
<td>1.07576</td>
</tr>
<tr>
<td></td>
<td>Spring 2016</td>
<td>4.2121</td>
<td>.85723</td>
</tr>
</tbody>
</table>

Fall 2015 mean 3.587
Spring 2016 mean 4.145
Overall mean 3.864

Summary

In summary, two research questions were addressed in this study. Data were examined from the first research question to determine if virtual patient simulation leads to equivalent educational outcomes as evidenced by differences in HESI MC and HESI Exit scores and final medical-surgical content exam scores for the Summer 2014 through Spring 2016 groups. The data analysis was conducted using one-way MANOVA to answer the first hypothesis and one-way ANOVA to answer the second hypothesis. The data analysis did not reveal any statistical significance on the use of virtual patient simulation on student learning outcomes.
CHAPTER V

DISCUSSION

The purpose of this study was to determine if the use of the instructional strategy of virtual patient simulation (VPSI) had an equivalent effect on the learning outcomes of students in an ASN medical-surgical nursing course. A causal comparative research design was used to test the effect of virtual patient simulation instruction on nursing students’ level of knowledge and satisfaction. Discussion of relevant literature will be embedded to integrate the results of the study (Rudestam & Newton, 2007). Descriptive and inferential statistics were utilized in the data analysis to test the hypothesis. Significant findings, discussion of the findings, implications for nursing education, limitations and recommendations for future research, and conclusions are presented in this chapter.

Findings

Research Question One: Did the introduction of virtual patient simulation delivery lead to equivalent educational outcomes when compared to traditional instruction?

For Null Hypothesis One, the one-way MANOVA was conducted to determine any statistical differences between the groups that were taught with traditional instruction versus the groups that were taught with virtual patient simulation as evidenced by performance on the HESI MC and HESI Exit exams. A one-way ANOVA was conducted for Null Hypothesis Two in order to determine any statistically significant differences between the groups taught with traditional instruction versus the groups that were taught with virtual patient simulation as evidenced by exam performance on the final content exam scores. The HESI MC assessed student’s prior
knowledge and verified that the groups were equal. The pre-instruction mean scores for the traditional groups were 77.41 and 76.86 for the virtual patient simulation groups. The post-instruction mean scores for the traditional instruction groups were 77.84 and 77.92 for the virtual patient simulation instruction groups on the HESI Exit exam. The post-instruction mean scores on the final content exam were 83.09 for the traditional instruction group and 82.92 for the virtual patient simulation groups. Furthermore, the one-way MANOVA verified that there was not a significant difference ($p = .890$) for Null Hypothesis One, and the one-way ANOVA verified that there was not a significant difference ($p = .866$) between the traditional instruction and the virtual patient simulation groups.

Findings showed that there were not any differences on exam scores between the groups taught with or without the virtual patient simulation. This is consistent with a study conducted by Bryant et al. (2015), research which focused on whether the Digital Clinical Experience (DCE) affected students’ learning outcomes among nurse practitioner students. Their study revealed no significant difference in learning between the group that received the DCE and the group that did not. A literature review by Skrable and Fitzsimons in 2014 on simulation in associate of science in nursing education revealed that research was limited and mainly reported in doctoral dissertations.

Reviews were mixed about virtual patient simulation in nursing education. In two studies examining virtual patient simulation in nursing (LeFlore et al., 2012; Liaw et al., 2014), student learning outcomes were analyzed to determine the effectiveness of this instruction. When virtual patient simulation was compared to mannequin-based simulation, Liaw et al. (2014) found no significant difference. When virtual patient simulation was compared to traditional lecture to teach pediatric respiratory system content, LeFlore et al. (2012) found statistical significance in
knowledge acquisition and application. When face-to-face simulation was compared to web-based simulation, no significant differences were found in knowledge or clinical reasoning (Cooper, Cant, Bogossian, Kinsman, & Bucknall, 2015). Overall, the literature supports virtual patient simulation as an effective pedagogy that is comparable to other forms of simulation. In the LeFlore et al. (2012) study, both groups of students received the same course content; however, the difference was that the students in the simulation group had classroom lecture replaced with simulation. In the other studies, simulation was compared to or replaced with virtual patient simulation. In this study, 45 traditional clinical hours were replaced with virtual patient simulation. This study adds support for virtual patient simulation because the student learning outcomes were unchanged regardless of the simulation strategy used.

Research Question Two: What was the post-instruction perceived satisfaction with current learning scores on the Student Satisfaction and Self-Confidence in Learning survey among medical-surgical students who received virtual patient simulation instruction during the Fall 2015 and Spring 2016 semesters?

Descriptive statistics were gathered to determine perceived satisfaction with the virtual patient simulation instruction. Students completed the 5-item Likert-type scale of the subsection satisfaction with current learning from the NLN tool titled Student Satisfaction and Self-Confidence in Learning. The overall results were 3.86, which were consistent with the findings from Bryant et al. (2015) who used the Student Satisfaction and Self-Confidence in Learning survey and the Digital Clinical Experience (DCE) simulation. In their study, the mean score was 3.83 for the satisfaction with current learning involving the DCE and students enrolled in a Family Nurse Practitioner program. Zulkosky (2012) conducted a study comparing simulation to lecture with case studies in the classroom. The satisfaction scores for the students who received
the simulation were 3.03 and were 3.84 for the lecture with case studies group. The feedback from the students was that they preferred lecture over any other teaching strategy (Zulkosky, 2012). Students’ preference for lecture could have impacted this study as the virtual patient simulation is an active learning strategy that requires participation. Furthermore, the researcher being naïve to the DCE software and new to virtual patient simulation could have impacted the perceived satisfaction. The researcher was more knowledgeable with the virtual patient simulation during the Spring 2016 semester. This may have contributed to the improved scores in satisfaction with the virtual patient simulation.

Discussion of the Findings

The results of this study are consistent with Bryant et al.’s (2015) findings of no significance on student learning outcomes for students taught with the Digital Clinical Experience (DCE). Their sample size was small, which failed to detect any differences between groups. In addition, the satisfaction scores of the present study were also consistent with their study. On the basis of these findings, it appears that virtual patient simulation instruction is comparable to traditional instruction as evidenced by no significant differences between the mean scores of the HESI exams and the final content exam between the two groups. These non-significant findings are huge and provide evidence that virtual patient simulation is as good as traditional instruction. These findings provide support needed for schools that are considering using virtual patients in lieu of high-fidelity simulators. The DCE is cost effective because the cost is incurred by the student (at a nominal fee for lifetime access) and not the nursing school, software updates and technical support are managed by Shadow Health, physical space is not required, computer labs and clinical sites do not have to be scheduled, and the simulation can be asynchronous.
There is a lack of consensus on the terminology and nomenclature for virtual patient simulation (Cant & Cooper, 2014; Kononowicz et al., 2015). An integrated review of virtual patient simulation revealed a lack of evidence “relating to knowledge retention and clinical impact” (Cant & Cooper, 2014, p. 1440). However, the benefits that virtual simulation has over traditional instruction include that it can be delivered by World Wide Web, has the ability to be available and repeatable (Bryant et al., 2015; Cant & Cooper, 2014; Cendan & Lok, 2012), is accessible by multiple students at multiple locations at any time (Cant & Cooper, 2014; Feng et al., 2013), provides motivation for students to be self-learners and be accountable (Jeffries, 2005), provides feedback (Botezatu et al., 2010a; Cendan & Lok, 2012), and fosters interdisciplinary education (Foronda & Bauman, 2014). Virtual patient simulation has numerous benefits that can help ease the burden of increased enrollment, limited faculty, limited physical space, and limited clinical sites. Furthermore, virtual patient simulation can be an option for nursing schools that lack funding and support to obtain or maintain high-fidelity simulation labs.

An active learning environment may be new to students who have been exposed only to passive pedagogy such as lectures (Benedict et al., 2013). Active learning facilitates the development of skills that are needed in nursing (Heinrich, Pennington, & Kuiper, 2012; Wolfram & O’Leary, 2012). Simulation actively engages the learner in an authentic environment to solve real-life problems, which is representative of situated cognition (Lamont & Brunero, 2013). Educational technologies can create authentic healthcare environments (Paige & Daley, 2009). The interactive format of this educational technology plays a key role in engaging the students, which can influence their learning (Lamont & Brunero, 2013). Students in the current study did not like having to type their responses and this may have impacted their learning and satisfaction scores. Cant and Cooper (2014) reported that students had lower
satisfaction with text-only format when compared to educational technologies with drop-down menus.

Virtual patient simulation has many possibilities in nursing education to help alleviate barriers of increased enrollment, limited physical space and clinical sites (Foronda & Bauman, 2014). The virtual patient simulation should be integrated into the curriculum (Botezatu et al., 2010a) with other pedagogies such as lecture, high-fidelity simulation (Cook & Triola, 2009), mannequin-based simulation, and clinical practicum (Foronda & Bauman, 2014). An educator naïve to virtual patient simulation may use this pedagogy ineffectively which can place undue burden on the students without learning being facilitated (Cook & Triola, 2009). In the current study, the DCE was incorporated into one course instead of integrated into the curriculum and this could have played a role in the results of this study. The virtual patient simulation was integrated into one course over the period of 15 weeks and should have been integrated throughout the curriculum over 4 semesters instead of 1 semester. Only the essential virtual patient simulation modules should have been incorporated into the medical-surgical course. Initially, students voiced satisfaction with the virtual patient simulation, but as the semester progressed, students began to voice concerns that the modules were “too much busy work,” and they did not like the fact that the software did not recognize voice-to-text.

Faculty needs motivation and support to implement virtual patient simulation into the curriculum (Guise et al., 2012). The nursing school where this study took place is in the process of curriculum revision. In this revision, the DCE modules can be integrated in the curriculum over 4 semesters with each module aligned to a specific course and student learning objective, rather than only having them in one course. Virtual patient simulation should be incorporated for the student learning objectives that are hard to achieve within a specific course (Foronda &
Implications for Nursing Education

This study did not demonstrate statistical significance; however, it does make a contribution to support to the current body of literature that virtual patient simulation does produce comparable student learning outcomes to traditional instruction. Generalization is limited to associates of science in nursing and cannot be generalized beyond this population.

The landmark study conducted by Hayden, Smiley, Alexander et al. for the NCSBN in 2014 did not reveal any statistical significance between the traditional instruction group and the other two groups who had 25% and 50% of the clinical experience replaced with high-fidelity simulation. Therefore, the use of high-fidelity simulation in lieu of 50% of clinical practicum is considered an effective pedagogy for ASN programs (Curl et al., 2016). When mannequin-based simulation was compared to virtual patient simulation (Liaw et al., 2014), no significant differences were found between the two groups. A systematic review conducted by McCutcheon, Lohan, Traynor, and Martin in 2015 found that online learning for clinical practicum was no less effective than traditional instruction. Virtual patient simulation is a cost-effective and convenient solution that can provide students with access to clinical experiences (Kleinheksel, 2014).

Limitations

Limitations of the study included a small convenience sample at one ASN program in South Georgia. A finding of non-significance can be due to the small sample size and small power effect. For quantitative descriptive research studies, a sample size of hundreds or thousands is needed to establish a relationship between variables (Bettany-Saltikov & Whittaker,
2014), and a low power can be due to a low effect size (Lomax & Hahs-Vaughn, 2012). A convenience sample has more risk of bias and less generalizability but is an easy way to obtain a sample size (LoBiondo-Wood & Haber, 2010).

Another limitation of the study was the incorporation of a new product (virtual patient simulation) during the final year of the nursing program in one medical-surgical nursing course. Any new product should be incorporated into the curriculum early in the program. A study conducted by Forsberg, Zieger, Hult, and Fors (2016) of post-graduate nursing students enrolled in a yearlong pediatric course demonstrated the impact of virtual patient simulation integrated early in the program. Their findings indicated that students were initially uncertain and had gaps in knowledge, midway through the course the students were more certain, and by the end of the course the students were confident in their clinical reasoning abilities.

Assessments in connection with self-evaluation early in the education resulted in a gain of students’ own identification of the concept of clinical reasoning; awareness of what to focus on regarding theoretical knowledge, and what to pay attention to during clinical practice. (Forsberg et al., 2016, p. 102)

The delivery of the virtual patient simulation was a limitation due to the inclusion of the entire product being integrated into one course over the period of 15 weeks. The virtual patient simulation should have been integrated throughout the curriculum over 4 semesters instead of 1 semester. Only the essential virtual patient simulation modules should have been incorporated into the medical-surgical course.

Lastly, a limitation of the study was the software itself. The students did not like having to type all of their responses. The software does not have a drop down menu for the students to select an option and the software does not have voice-to-text built in to type what the students’ state. The software was chosen by the nursing school. Learning outcomes can be affected by course materials and it is imperative that nursing faculty select quality course material based
upon validity and reliability (Kala, Isaramalai, & Pohthong, 2010). Furthermore, the technology by itself will not produce the desired learning outcomes (Kala et al., 2010).

**Recommendations for Future Research**

No other nursing research studies were located that have compared the effects of the Shadow Health Digital Clinical Experience (DCE) on student learning outcomes in an Associate of Science Nursing course. The two published studies on DCE (Bryant et al., 2015; Kleinheksel, 2014) were conducted with nurse practitioner students at the Master’s degree level. Recommendations for the future research include conducting a quasi-experimental study with a pretest and posttest design with a larger sample size, integrating the virtual patient simulation instruction throughout the curriculum, and conducting quantitative and qualitative studies to evaluate student progression and satisfaction. Another recommendation is to replicate this study with a larger and randomized sample with modules that are pertinent to the final medical-surgical course. Future research to further explore the use of virtual patient simulation on student learning outcomes in associate of science in nursing program is warranted to provide more evidence that this pedagogy is comparable to traditional instruction.

**Summary**

Due to limited clinical space, increases in nursing student enrollment, time constraints for nurse preceptors (Hayden, Smiley, Alexander et al., 2014; Kilmon et al., 2010), sicker patients with shorter hospital stays and early discharge (Nielsen et al., 2013), shortage of nursing faculty, lack of access to electronic medical records, and patient safety mandates (Hayden, Smiley, Alexander et al., 2014), issues have arisen concerning the quality of nursing education and preparation of new graduates (Buerhaus et al., 2014). The use of simulation technology is a viable option to address these issues in nursing. In summation, the future of nursing education is
teaching with and about technologies to produce nurses who can provide safe, patient-centered care in a highly technological work environment (NLN, 2015).
REFERENCES


Simulation in Nursing, 11(2), 97-105. doi:http://dx.doi.org.libdata.lib.ua.edu/10.1016/j.ecns.2014.10.010


APPENDIX A

Medical-Surgical Nursing Curriculum
### Medical-Surgical Curriculum

<table>
<thead>
<tr>
<th><strong>Care of Adults II Curriculum 2014-2015 and 2015-2016</strong></th>
<th><strong>Shadow Health Digital Clinical Experience</strong> added 2015-2016 curriculum in lieu of 1/3 of the clinical hours (45 hours out of 135 hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation to class</td>
<td>Orientation to class Orientation to Shadow Health-Overview of the course, how to enroll into the course, assignments and due dates, and technical assistance.</td>
</tr>
<tr>
<td></td>
<td><strong>Digital Clinical Experience Orientation</strong> - Learn to navigate the Shadow Health Digital Clinical Experience. The time to complete this activity is 1 hour.</td>
</tr>
<tr>
<td></td>
<td><strong>Conversation Concept Lab</strong> - These activities and exercises will introduce you to the functions of open and closed questions in effective nursing communication. The time to complete this activity is 1 hour.</td>
</tr>
<tr>
<td></td>
<td><strong>Health History</strong> - Interview Tina Jones, an African American female and document her comprehensive health history, and complete post-exam activities. The time to complete this activity is 2 hours.</td>
</tr>
<tr>
<td></td>
<td><strong>Nursing care of clients with alterations in cardiovascular responses</strong> Cardiovascular assessment Angina Myocardial Infarction Congestive Heart Failure Cardiovascular Pharmacology Cardiovascular and electrical physiology EKG, Arrhythmias, Dysrhythmias Hemodynamic Monitoring Coronary Arterial Revascularization and Reconstruction (Thrombolytics, PTCA, Stents, CABG)</td>
</tr>
<tr>
<td></td>
<td><strong>Cardiovascular Concept Lab</strong>- Learn about the differences between normal and abnormal heart sounds. Time for this activity 1 hour.</td>
</tr>
<tr>
<td></td>
<td><strong>Cardiovascular</strong>- Assess the Cardiovascular system of Tina Jones. Interview and examine the patient, document your findings, and complete post-exam activities. Time for this activity is 2 hours.</td>
</tr>
<tr>
<td></td>
<td><strong>Focused Exam: Chest Pain</strong>- This assignment provides the opportunity to conduct a focused exam on a male client presenting with chest pain and requiring</td>
</tr>
<tr>
<td>Campus Lab: 12 Lead EKG Monitoring, EKG Arrhythmias &amp; Dysrhythmias, Dosages and Solutions</td>
<td>emergency intervention. Interview the patient, assess the related body systems, and then transfer care to your preceptor. Time for this activity is 2 hours.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| **Nursing care of clients with alterations in respiratory responses**  
Acute Respiratory Failure  
Mechanical Ventilation  
Adult Respiratory Distress Syndrome  
Ventilator Associated Pneumonia (VAP)  
Nursing care of clients with alterations in metabolic functions  
Acid-Base Balance and Imbalances  
Campus Lab: Tracheostomy Care, In Line Suctioning | **Respiratory Concept Lab** - Learn about the differences between normal and abnormal lung sounds with the Respiratory Concept Lab. Time for this activity is 1 hour.  
**Respiratory** - Assess the Respiratory system of Tina Jones. Interview and examine the patient, document your findings, and complete post-exam activities. Time for this activity is 2 hours.  
**Focused Exam: Cough** - This assignment provides the opportunity to conduct a focused exam on a patient presenting with a cough. Interview the patient, assess the related body systems, and then transfer care to your preceptor. Time for this activity is 2 hours. |
| **Nursing care of clients with alterations in compensatory responses**  
Hypovolemic shock  
Cardiogenic shock  
Neurogenic shock  
Anaphylactic shock  
Septic shock |  
**Skin, Hair, Nails**- Assess the Skin, Hair, and Nails of Tina Jones, Interview and examine the patient, document your findings, and complete post-exam activities. Time for this activity is 2 hours.  
**Campus Lab: Closed Chest Drainage System** |
### Nursing care of clients with alterations in endocrine responses
- Thyroid (Myxedema and Graves’ Disease)
- Parathyroid (Hyperparathyroidism and Hypoparathyroidism)
- Adrenal (Addison’s Disease and Cushing’s Disease)
- Antidiuretic Hormone (Diabetes Insipidus and Syndrome of inappropriate antidiuretic hormone)

### Nursing care of clients with alterations in immunologic responses
- HIV – AIDS
- Tuberculosis

### Nursing care of clients with alterations in metabolic functions
- Fluid and Electrolyte balance

### Nursing care of clients with alterations in renal responses
- Renal Calculi and Urinary tract infections
- Acute renal failure
- Chronic renal failure
- Dialysis: peritoneal and hemodialysis
- Transplantation
- Nursing care of clients with alterations in neurologic responses
- Neurologic Assessment
- Head Injury and ICP
- Spinal Cord Injury and Rehabilitation
- Parkinson's Disease
- Multiple Sclerosis
- Myasthenia Gravis

### Nursing care of clients with alterations of the hepatic responses
- Liver Dysfunction
- Hepatic Encephalopathy
- Hepatitis A, B, and C

### Neurologic
- Assess the Neurological system of Tina Jones. Interview and examine the patient, document your findings, and complete post-exam activities. Time for this activity is 2 hours.

### HEENT
- Assess the HEENT system of Tina Jones. Interview and examine the patient, document your findings, and complete post-exam activities. Time for this activity is 2 hours.

### Abdominal Concept Lab
- Learn about the elements of an abdominal exam. Time for this activity is 1 hour.

### Abdominal
- Assess the Abdominal system of Tina Jones. Interview and examine the patient, document your findings, and
Focused Exam: Abdominal Pain - Conduct a focused exam for Esther Park, an elderly client who presents with abdominal pain. Interview the patient, assess the related body systems, and then transfer care to your preceptor. Time for this activity is 2 hours.

Nursing care of clients experiencing alterations of the musculoskeletal functions and responses
Systemic Lupus Erythematous Arthritis: Rheumatoid, Osteoarthritis, Gouty Osteoporosis Soft Tissue Injury Total Joint Reconstruction Fractures, Hip Fractures and Traction Osteomyelitis Herniated Disk and Laminectomy Amputation

Musculoskeletal - Assess the Musculoskeletal system of Tina Jones. Interview and examine the patient, document your findings, and complete post-exam activities. Time for this activity is 2 hours.

Comprehensive Assessment - This assignment provides the opportunity to plan and conduct a full health assessment on a patient in a single clinic visit. Time for this activity is 4 hours.
APPENDIX B

Script
“You are being asked to take part in a research study. This study is called THE EFFECT OF VIRTUAL PATIENT SIMULATIONS ON STUDENT LEARNING OUTCOMES IN AN ASSOCIATE OF SCIENCE MEDICAL-SURGICAL NURSING COURSE. The study is being done by BOBBY JEAN MUSGROVE, who is a graduate student at the University of Alabama. Ms. Musgrove is being supervised by Dr. Margaret Rice, who is Associate Professor of Instructional Technology at the University of Alabama.

This study is being done to explore the application of virtual patient simulation on student learning outcomes. The investigator is trying to determine the best strategies to improve student learning outcomes in nursing students with the application of virtual patient simulations.

You have been asked to be in this study because you are enrolled in a nursing course in a registered nursing program and have a cumulative grade point average equal or greater than 2.0.

If you meet the criteria and agree to be in this study, you will be asked to do the following:

1. Allow the investigator to use your data from the Student Satisfaction and Self-Confidence in Learning survey results for this study.
2. Allow the investigator to use your data (test scores) from the HESI Mid-Curricular Exam, the HESI Exit exam, and the final exam content score for the last medical-surgical nursing course. Dr. Thigpen will provide the data in a de-identified format.

This study is looking at data. Your name will not be used. Only your data will be used. It will not take up any of your time. It will not cost you anything and you will not be compensated. There is little to no risk foreseen for participating in this study.

Your information will be kept confidential by using only your data. No names or codes will be associated with the data. The data will be stored in a locked file cabinet in the investigator’s office for five years. After five years, all data will be shredded, deleted, and permanently discarded. The results of this research study will be published in the researcher’s dissertation and possibly in journals or books.

Your participation is voluntary, it is not mandatory. Your participation will not affect your course grade. The consent will be housed until after grades are posted. If you want to participate, sign and turn back in the consent form. Thank You.”
APPENDIX C

Informed Consent
Informed Consent

**Study title:** The effect of virtual patient simulations on student learning outcomes in an associate of science of medical-surgical nursing course.

**Investigator’s Name:** Bobby Jean Musgrove

**Institution if other than or collaborating with UA:**
You are being asked to take part in a research study. This study is called THE EFFECT OF VIRTUAL PATIENT SIMULATIONS ON STUDENT LEARNING OUTCOMES IN AN ASSOCIATE OF SCIENCE MEDICAL-SURGICAL NURSING COURSE. The study is being done by BOBBY JEAN MUSGROVE, who is a graduate student at the University of Alabama. Ms. Musgrove is being supervised by Dr. Margaret Rice, who is Associate Professor of Instructional Technology at the University of Alabama.

**Is the researcher being paid for this study?** No

**Is this research developing a product that was sold, and if so, will the investigator profit from it?** No

**Does the investigator have any conflict of interest in this study?** No

**What is this study about? What is the investigator trying to learn?**
This study is being done to explore the application of virtual patient simulation on student learning outcomes. The investigator is trying to determine the best strategies to improve student learning outcomes in nursing students with the application of virtual patient simulations.

**Why is this study important or useful?**
This study will add to the limited research data related to the application of virtual patient simulations in nursing. This study’s data will help nursing educators make decisions about the application of virtual patient simulations to enhance learning outcomes.

**Why have I been asked to be in this study?**
You have been asked to be in this study because you are enrolled in a nursing course in a registered nursing program and have a cumulative grade point average equal or greater than 2.0.

**How many people will be in this study?**
Approximately 160 people will be in this study.

**What will I be asked to do in this study?**
If you meet the criteria and agree to be in this study, you will be asked to do the following:
1. Allow the investigator to use your data from the Student Satisfaction and Self-Confidence in Learning survey results for this study.
2. Allow the investigator to use your data (test scores) from the HESI Mid-Curricular Exam, the HESI Exit exam, and your final exam content scores for the last semester medical-surgical nursing course.
How much time will I spend being in this study?
This study is looking at data. It will not take up any of your time.

Will being in this study cost me anything?
No.

Will I be compensated for being in this study?
You will not be compensated for being in this study.

What are the risks (dangers or harms) to me if I am in this study?
There is little to no risk foreseen for participating in this study.

What are the benefits (good things) that may happen if I am in this study?
You may feel good about knowing you helped in determining if application of virtual patient simulation improves student learning outcomes.

What are the benefits to science or society?
This study will help nursing educators to understand the importance of virtual patient simulation and student learning outcomes. This study will help to continue reform in nursing education.

How will my privacy be protected?
Your name will not be used. Only your data will be used.

How will my confidentiality be protected?
Your information will be kept confidential by using only your data. No names or codes will be associated with the data. The Dean of the School of Nursing will provide the data in a de-identified format. The data will be stored in a locked file cabinet in the investigator’s office for five years. After five years, all data will be shredded, deleted, and permanently discarded. The results of this research study will be published in the researcher’s dissertation and possibly in journals or books.

What are the alternatives to being in this study? Do I have other choices?
The alternative to being in this study is not to participate.

What are my rights as a participant in this study?
Taking part in this study is voluntary. Your participation will not affect your course grade. The consent will be housed until after grades are posted. You can refuse to be in the study at any time. If you start the study, you can stop at any time. There will be no effect on your relations with your nursing program or the University of Alabama.

The University of Alabama Institutional Review Board (“the IRB”) is the committee that protects the rights of people in research studies. The IRB may review the study at any time to insure compliance of the stated plan of study and fair treatment of the participants in the research study.
**Who do I call if I have questions or problems?**

If you have questions about the study, please ask them now. If you have questions, concerns, or complaints about the study later on, please call the investigator BOBBY JEAN MUSGROVE at 912-850-8007 (investigator’s cell phone number).

If you have questions about your rights as a person in a research study, call Ms. Carpentato Myles, the Research Compliance Officer of the University of Alabama, at 205-348-8461 or toll-free at 1-877-820-3066. You may also ask questions, make suggestions, or file complaints and concerns through the IRB Outreach website at http://osp.ua.edu/site/PRCO_Welcome.html or email us at participantoutreach@bama.ua.edu.

After you participate, you are encouraged to complete the survey for research participants that is online at the outreach website or you may ask the investigator for a copy of it and mail it to the University Office for Research Compliance, Box 870104, 152 Rose Administration Building, Tuscaloosa, AL 35487-0104.

**I have read this consent form. I certify that I am over 18 years of age, and I agree to the terms and conditions listed above. I have had a chance to ask questions. I agree to take part in this research study. I have received a copy of this consent form to keep.**

Name of the participant (please print)

________________________________________
Signature of Research Participant Date

________________________________________
Signature of Investigator Date
APPENDIX D

Letter of Invitation to Participate
Letter of Invitation to Participate

I am a doctoral student at the University of Alabama and I am conducting a research study of the effect of virtual patient simulations on student learning outcomes in an associate of science of medical-surgical nursing course. The purpose of my study is to explore the application of virtual patient simulation on student learning outcomes. I am trying to determine the best strategies to improve student learning outcomes in nursing students. More specifically, I am evaluating the application of virtual patient simulations on student learning outcomes.

Your participation in this study will provide useful information on this topic and add to the body of knowledge in nursing research. You qualify for participation if you are over the age of 18, are currently enrolled in a nursing course in a registered nurse program, and have a grade point average equal or greater to 2.0.

Your participation will entail your data being used. The study will not take up any of your time. Your participation in this study is strictly voluntary. You may withdraw at any time. Your participation is not associated with your class grade. All data from this research study is confidential.

Thank you for your assistance.

Bobby Jean Musgrove
912-850-8007
APPENDIX E

Institutional Review Board (IRB) approval
April 27, 2016

Bobby Jean Musgrove
ELPTS
College of Education
The University of Alabama
Box 870302

Re: IRB # EX-16-CM-041 “The Effect of Virtual Patient Simulations on Student Learning Outcomes in an Associate of Science Medical-Surgical Nursing Course”

Dear Ms. Musgrove:

The University of Alabama Institutional Review Board has granted approval for your proposed research. Your protocol has been given exempt approval according to 45 CFR part 46.101(b)(1) and (4) as outlined below:

1. Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

2. Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Your application will expire on April 26, 2017. If your research will continue beyond this date, complete the relevant portions of Continuing Review and Closure Form. If you wish to modify the application, complete the Modification of an Approved Protocol Form. When the study closes, complete the appropriate portions of FORM: Continuing Review and Closure.

Should you need to submit any further correspondence regarding this proposal, please include the assigned IRB application number.

Good luck with your research.

Sincerely,
Ms. Dobby Jean Musgrove,

Your proposed research project, titled "The effect of virtual patient stimulation (VPS) on student learning outcomes in an associate of science medical surgical nursing course" was received on February 12 and has been reviewed. Two members of the South Georgia State College IRB judged it to qualify as Exempt, thus negating the need for full review. You may proceed with your research in the manner describe in your submission. This approval extends from 2/12/2016 until 12/31/2016. If any substantive changes are made to the proposed research the IRB must be immediately notified. Further, if you intend to continue data collection beyond 12/31/2016 you must resubmit your proposal to the IRB prior to collecting any data past that date.

Please feel free to contact me with any questions or concerns.

Yours,
Frank Holowki, IRB Chair
APPENDIX F

Permission to use Student Satisfaction and Self-Confidence in Learning
Dear Bobby Jean,

It is my pleasure to grant you permission to use the "Educational Practices Questionnaire," "Simulation Design Scale" and "Student Satisfaction and Self-Confidence in Learning" NLN/Laerdal Research Tools. (I typically send all 3 tools together, so you don’t have to make another request).

In granting permission to use the instruments, it is understood that the following caveats will be respected:

1. It is the sole responsibility of (you) the researcher to determine whether the NLN questionnaire is appropriate to her or his particular study.
2. Modifications to a survey may affect the reliability and/or validity of results. Any modifications made to a survey are the sole responsibility of the researcher.
3. When published or printed, any research findings produced using an NLN survey must be properly cited. If the content of the NLN survey was modified in any way, this must also be clearly indicated in the text, footnotes and endnotes of all materials where findings are published or printed.

I am pleased that materials developed by the National League for Nursing are seen as valuable, and I am pleased that we are able to grant permission for the use of the "Educational Practices Questionnaire," "Simulation Design Scale" and "Student Satisfaction and Self-Confidence in Learning" instruments for your important work to advance the science of nursing education.

Warm Regards, Amy

Amy McGuire | Administrative Coordinator, NLN Chamberlain Center | National League for Nursing | www.nln.org | amcguire@nln.org | Tel: 202-909-2509 | The Watergate | 2600 Virginia Avenue NW, 8th Fl, Washington, DC 20037
APPENDIX G

Student Satisfaction and Self-Confidence in Learning
Student Satisfaction and Self-Confidence in Learning

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

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

<table>
<thead>
<tr>
<th>Satisfaction with Current Learning</th>
<th>SD</th>
<th>D</th>
<th>UN</th>
<th>A</th>
<th>SA</th>
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<tbody>
<tr>
<td>1. The teaching methods used in this simulation were helpful and effective.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>2. The simulation provided me with a variety of learning materials and activities to promote my learning the medical surgical curriculum.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>3. I enjoyed how my instructor taught the simulation.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>4. The teaching materials used in this simulation were motivating and helped me to learn.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<td>5. The way my instructor(s) taught the simulation was suitable to the way I learn.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<th>Self-confidence in Learning</th>
<th>SD</th>
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<tr>
<td>6. I am confident that I am mastering the content of the simulation activity that my instructors presented to me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>7. I am confident that this simulation covered critical content necessary for the mastery of medical surgical</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>5</td>
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<tr>
<td>8. I am confident that I am developing the skills and obtaining the required knowledge from this simulation to perform necessary tasks in a clinical setting</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>9. My instructors used helpful resources to teach the simulation.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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10. It is my responsibility as the student to learn what I need to know from this simulation activity.

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<td>O4</td>
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11. I know how to get help when I do not understand the concepts covered in the simulation.

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12. I know how to use simulation activities to learn critical aspects of these skills.

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13. It is the instructor's responsibility to tell me what I need to learn of the simulation activity content during class time.

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