CURRICULUM VITAE
Luster Fowler

EDUCATION

Indiana State University, Doctor of Philosophy, Educational Leadership, 2013

Indiana Wesleyan University, Master of Business Administration, 2003

Indiana Wesleyan University, Bachelor of Science, Business Administration, 1999

CERTIFICATIONS

National Board for Respiratory Care: Registered Respiratory Therapist

American Heart Association Certification: Advanced Cardiac Life Support

American Heart Association Certification: Pediatric Advanced Life Support

American Heart Association Certification: Basic Life Support

PROFESSIONAL AFFILIATIONS

American Association for Respiratory Care

Indiana Society for Respiratory Care

Association for the Study of Higher Education

National Network of Health Career Programs in Two Year Colleges

City of Lawrence-Pioneering Healthy Communities Advisory Board

Indiana University Health-Allied Health Education Advisory Board

Metropolitan Indianapolis Central Indiana Area Health Education Committee-Advisory Board Chair

McKenzie Career Center for Health Occupations-Advisory Board

HIGH-FIDELITY MANIKIN-BASED SIMULATION: A STUDY OF IMPLICATIONS FOR INTERPROFESSIONAL HEALTHCARE PRACTITIONER EDUCATION AT THE ASSOCIATE DEGREE LEVEL OF STUDY

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Luster Fowler

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COMMITTEE MEMBERS

Committee Chair: Will Barratt, Ph.D.

Professor: Educational Leadership

Indiana State University

Committee Member: Joshua Powers, Ph.D.

Professor: Educational Leadership

Indiana State University

Committee Member: Betsy Frank, RN, Ph.D., ANEF

Professor Emeritus: College of Nursing, Health, and Human Services

Indiana State University

ABSTRACT

Healthcare practitioner training programs, specifically at the associate degree level of study, have historically focused practitioner training efforts on discipline-specific programming and curricula. However, these institutions have now begun to examine the utility and efficacy of incorporating interprofessional experiences into their programs. One of the current pedagogical approaches being investigated is the use of high-fidelity manikin-based simulation in the training of their healthcare students. This study examined the use of interprofessional high-fidelity versus low-fidelity simulation within associate degree-granting institutions and examined potential differences in self-efficacy and learning outcomes of participants incorporating a pre- and post-assessment.

A convenience sample of 75 students participated in this study, which included associate degree-seeking nursing students (n = 36) and associate degree-seeking respiratory care students (n = 39). Participants were divided into two groups: a high-fidelity group (n = 52) and a low-fidelity group (n = 23). Each group was composed of both nursing and respiratory care students. A subsequent assessment of pre-intervention and post-intervention self-efficacy and learning outcomes was also performed that examined students by course of study, identified as either nursing students or respiratory care students.

Differences in self-efficacy between the high-and low-fidelity groups were not significant on pre-assessment or post-assessment, p = .529 and p = .246. Additionally, differences between

nursing and respiratory care students were not significant on pre-assessment or post- assessment, $p = .079$ and $p = .779$ respectively.

Differences in perceived learning outcomes between the high-and low-fidelity groups were not significant on pre-assessment or post-assessment, $p = .747$ and $p = .219$. Additionally, differences between nursing and respiratory care students were not significant on pre or post-assessment, $p = .408$ and $p = .611$ respectively.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

The use of technology has always been viewed as a positive innovation and widely accepted as a requirement for institutions providing healthcare as well as for institutions providing healthcare education. From the development of the polio vaccine by Dr. Jonas Salk, with initial testing in 1952, to the use of interactive high-fidelity manikin-based patient simulators in the educational setting, the profession of healthcare considers the practice of maintaining currency on technological changes in the practice of healthcare paramount to the provision of the best patient care possible. The use of high-fidelity manikin-based patient simulation in the higher education setting has been embraced by physicians and nursing in the healthcare educational setting. However, the need for additional study is warranted in order to determine the benefits of high-fidelity simulator use in interprofessional education from a broader perspective that considers other allied health professions within two-year institutions at the associate degree level of study.

History of Manikin-Based Patient Simulators

The healthcare providers in hospital settings have experienced an evolution in technology over the course of recent history. As this technology continues to evolve in the hospital setting, institutions of higher education must also stay abreast of such changes in order to provide appropriate and timely education for students engaged in active pursuit of future healthcare careers. One of the many modern technologies utilized by many higher education institutions is

the high-fidelity manikin-based human patient simulator. However, the incorporation of high-fidelity simulation in healthcare education and its potential effects on the education of healthcare practitioners is a fairly recent phenomenon.

Simulation, as a practitioner-based educational tool in health care, is derived from the field of aviation. In 1929 Edwin Link developed the first aircraft simulator to assist student pilots with training and subsequently added analog computer feedback mechanisms in order to provide student pilots with additional useful information related to aircraft operation (Rodgers, 2007). An added benefit acquired over the evolution of simulation in the aviation industry has been the provision of an alternative avenue for student and certified pilots to practice hands-on skills and critical thinking via realistic flight simulators in a controlled environment, without the potential danger of a crash. Healthcare is now catching up to the use of high-fidelity simulation techniques and recognizing that medical errors in either educational or healthcare environments are unacceptable, just as aviation realized that plane crashes were unacceptable many years ago (Holtschneider, 2007).

The use of manikin-based simulation began its journey from low-fidelity to high-fidelity in the early 1960s with Peter Safar, an Austrian physician, and Asmund Laerdal, a toy manufacturer. Safar and Laerdal developed Resusci®-Anne, which was the first manikin used for the training of students in cardiopulmonary resuscitation (CPR); (Fritz, Gray, & Flanagan, 2008). Laerdal was encouraged to assist with the design by Dr. Bjorn Lind and other Norwegian anesthesiologists, following Dr. Safar's revelations regarding the discovery of increased efficiencies regarding the methodologies used to perform mouth-to-mouth resuscitation (Safar, 1958; Safar, Escarraga & Elam, 1958). These discovered efficiencies provided an avenue to potentially increase patient outcomes related to the performance of CPR by preventing the

airway from becoming obstructed by hyperextending the neck during CPR as well as providing an opportunity to simulate the performance of cardiac compressions performed during CPR by the insertion of an internal spring to the chest wall of the Resusci®-Anne manikin (Cooper & Taqueti, 2004). Previous to the introduction of Resusci®-Anne, a void existed for healthcare institutions and emergency personnel to have an avenue available to practice and become more effective practitioners of CPR, other than during actual patient emergencies.

Additional developments along the evolutionary path of manikin use in healthcare education occurred in the year 1967 with the conception and development of the SIM ONE manikin by Dr. Stephen Abrahamson, an engineer, and Dr. Judson Densen, a physician, at the University of Southern California (Cooper & Taqueti, 2004; Fritz et al., 2008). This very basic *low-fidelity* patient simulator, which provides the foundational tools for experiential-based learning for the student without the components of actual interaction and feedback provided by *high-fidelity* manikin-based patient simulators, was the first hands-on simulator created and was also used for the development of skills proficiency for anesthesiologists in a competency called endotracheal intubation, as well as for the fields of radiology, surgery, and emergency and intensive care medicine (Tsai, Harasym, Nijssen-Jordan, Jennett & Powell, 2003). Dr. Abrahamson and Dr. Densen purported that the SIM ONE manikin provided several noteworthy advantages to traditional clinical instruction methods, including (a) planned and gradual increases in the problems to be solved instead of performing new tasks as the necessity arises in the clinical care setting, (b) unlimited repetition, (c) immediate feedback, and (d) the provision of the option for learners to proceed at their own pace during the instructional process (Good, 2003).

The high-fidelity simulator was a remarkable lifelike mannequin that was controlled by a hybrid digital and analogue computer with 4096 words of memory. It had many high-fidelity features: the chest was anatomically shaped and moved with breathing, the eyes blinked, the pupils dilated and constricted, and the jaw opened and closed. To a limited extent, it was used for training and to continue some primitive experiments about efficacy. Although not rigorously justified by the methods, Dr. Abrahamson and Dr. Denson claimed that the simulator had a twofold advantage in training anesthesia residents in the skill of endotracheal intubation while "posing significantly less threat to patient safety" (Cooper & Taqueti, 2004, p. i12).

The SIM ONE manikin served as a point of inception for the development of a computer-controlled manikin whole patient simulator. Unfortunately, during this time SIM ONE failed to gain widespread acceptance as the computer technology was too expensive for commercialization of the product (Fritz et al., 2008). Additional concerns related to the commercialization of the product included the lack of vision pertaining to the market for training healthcare professionals in the product's use as the SIM ONE manikin was too far ahead of its time in terms of technology and any prospective market demand for its use in an instructional setting (Cooper & Taqueti, 2004).

In 1987, Gaba and DeAnda developed the *Comprehensive Anesthesia Simulation Environment 1.2* (CASE 1.2) manikin at the Stanford Medical School (Cooper & Taqueti, 2004). The CASE 1.2 manikin was developed as the first prototype simulator specifically developed for the purpose of investigating human performance in anesthesia. The CASE 1.2 model incorporated a commercially available waveform generator and virtual instrumentation with the manikin to simulate a patient whose vital signs could be manipulated to simulate critical events. This model served as the inception point of a high-realism simulation environment (Cooper &

Taqueti, 2004). Subsequent versions of the CASE manikin simulator were developed and utilized for the purposes of enhancing the educational realism of simulation at the Stanford Medical School and ultimately resulted in the development and implementation of a curriculum entitled Anesthesia Crisis Resource Management (Good, 2003), which was based on a relatively new aviation model of crew resource management (Cooper & Taqueti, 2004). In later years, the company licensed the CASE 1.2 and subsequent CASE 2.0 simulation products to a company called CAE-Link and eventually the company was acquired by a company called Med Sim Ltd, which eventually halted production of the product, primarily due to an unsuccessful marketing strategy (Fritz et al., 2008).

During the approximate period of manufacturing of the Med Sim manikin, another simulator was being developed at the University of Florida called the *Gainesville Anesthesia Simulator* (GAS), (Good & Gravenstein, 1989). Interest in the development of this particular simulator arose from a clinical need to train anesthesiology resident physicians in basic clinical skills, which were perceived to be in need of supplementation at the time. A secondary purpose for the development of the GAS simulator was to provide a secondary mechanism for senior anesthesia resident physicians to practice detecting and correcting rare and complex failures within the anesthesia gas delivery equipment (Good & Gravenstein, 1989). The multidisciplinary team developing the GAS simulator was led by Good and mentored by Gravenstein and began with the development of a single capability of diagnosing faults in anesthesia machines in which controllable failure modes were embedded and subsequently developed into a complete manikin which could mimic the uptake and distribution of gases used in anesthesia (Cooper & Taqueti, 2004). Later versions of the GAS simulator incorporated a mechanism for automatically recognizing as it was injected as well as providing the capability to

enact simulated physiological changes occurring in humans as both predefined sequences or in response to actions initiated by the trainer and trainee on the simulator (Cooper & Taqueti, 2004).

The development of the GAS simulator continued to progress when two very small studies conducted by Good, Gravenstein, and Mahala (1992) tested the efficacy of the GAS simulator. Researchers in this study randomized two cohorts of anesthesia residents who were stratified by whether or not simulation instruction was received and was followed by clinical evaluations of the residents' performances. The clinical evaluators were blinded as to the test participants' cohort status in order to provide objectivity. The results of this very small study (n = 16) indicated a more rapid learning curve for the participants in the cohort receiving simulation instruction prior to clinical evaluation. However, this study was ended after a three-month period in order to satisfy the increased demand for additional simulation training for all resident physicians (Good et al., 1992). In later years the GAS simulator was licensed to Loral Data Systems, which was later acquired by Medical Education Technologies Inc., which developed the product for commercial use and dubbed their new flagship product the Medical Education Technologies, Inc. (METI) *Human Patient Simulator* (HPS).

The HPS represented an evolution of development from its predecessor, the GAS. Subsequent models after the development of the HPS model included a pediatric manikin called *Pedisim* and a much simpler model called the *ECS,* which were both introduced in the late 1990s and early 2000s respectively (Cooper & Taqueti, 2004). The current adult HPS model incorporates physiological and pharmacological modeling as the operating platform, which give the simulator the ability to react like a live human by imitation of the appropriate human response (Durham & Alden, 2008). The response to input stimuli is provided by integrated

functions programmed into the HPS and displayed in a multi-layered, real time in a multi-layered, real-time ways which are vital to a true-to-life medical learning experience (METI., 2004). Additional features of the company's current product include the ability to provide respiratory gas exchange, anesthesia delivery, and patient monitoring with real physiological clinical monitors (METI., 2010).

Subsequent to the development of the Resusci®-Anne CPR simulator in the early 1960s, as well as the SIM ONE, CASE, and GAS simulator manikins, an interactive high-fidelity simulator was developed by Laerdal and Safar in 2000 with the introduction of their Sim Man and Sim Baby high-fidelity manikins. The features and benefits of Sim Man and Sim Baby include ability to simulate basic and advanced life support; ability to observe and respond to simulated patient physiological changes and anatomically accurate physiological structures, e.g. airways, lungs, veins, and arteries, and ability to provide realistic simulation of needle and tube insertions as appropriate for medical necessity (Laerdal Medical Products, 2010b). Additional technological features beneficial to instruction include ability to provide immediate feedback to programmed intervention scenarios, pre-programmed scenarios providing instructors with the ability to design and save their own patient cases, patient monitor with touch-screen technology including the possibility to configure desired layout and content to match the desired simulation environment, and software that generates an automatic debriefing post-simulation experience for the student and the instructor. The debriefing process is based on the event log, which is synchronized with video pictures that provide immediate and detailed feedback on performance to learners and an integrated video debriefing system combining the simulation event log with synchronized recordings of patient monitor and in-room video (Laerdal Medical Products, 2010b).

The respective cost and fidelity of the various simulation products available is primarily based on the technology and available features purchased. For the two primary vendors of high-fidelity simulators on the market costs can range from $36,000 to $70,000 for the Laerdal Sim Man or Sim Man 3G with associated monitoring and software to over $200,000 for the Medical TI HPS model (Durham & Alden, 2008). Both models offer optional equipment, which increases the purchase price of each simulator. In addition to the actual costs of the simulator, additional investment costs must be considered. Examples of such costs include the required support systems required for operation, possible construction costs for a designated simulation laboratory area, the costs associated with the development of training scenarios to be incorporated into the simulated learning experience, and the identification of the costs associated with the integration process of simulation into the institutional curriculum (Durham & Alden, 2008; Harlow & Sportsman, 2007).

Statement of the Problem

Healthcare practitioner training programs that have chosen to embrace this viable training supplement have focused the majority of their efforts on the education of nurses and physicians. However, as other professions that are integral to the interprofessional hospital environment continue to seek improvements in technology, training methodology, and approaches to efficient and cost effective patient care, an increased necessity for more interprofessional use of high-fidelity manikin-based patient simulators would serve to address this growing need.

Currently a void exists related to the specific use of interprofessional high-fidelity simulation experiences in training programs for nurses as well as for allied health professionals such as respiratory therapists and medical assistants at the associate degree level of study. Conversely, the use of interprofessional high-fidelity simulation appears to be more prevalent at

the baccalaureate level of training for nursing as well as at the graduate level of study for both nursing and for the training of physicians. Implementation of simulation use in the aforementioned programs, such as nursing and allied health programs at the associate degree level, could heighten the clinical preparedness and the self-efficacy of students for the actual interprofessional clinical experiences gained in the hospital setting as well as for mock clinical experiences in the laboratory setting and for mandated professional licensing examinations. Rodgers (2007) explored the use of high-fidelity simulation as a supplemental tool used for courses in advanced cardiac life support, which serves to prepare healthcare practitioners to serve in vital roles during patient resuscitation efforts, but also found significant research lacking related to the utilization of high-fidelity manikin-based simulation in an interdisciplinary environment. Christen (2009) explored the perceptions of community college educators specifically related to the potential benefits, barriers, and sustainability associated with the acquisition and implementation of high-fidelity simulation-based instruction within a paramedic training program. However, the findings of this study appeared to be somewhat inconsistent as the institutions surveyed utilized varying methods for both implementation of simulation within the curricula as well as subsequent measures of effectiveness and efficiency within their respective institutions.

Purpose of the Study

Students enrolled in professional programs in healthcare practitioner education face many challenges today when contrasted with years past. One major challenge is the proliferation of healthcare degree programs such as nursing, respiratory care, and other practitioner-based programs across the country (Fowler, 2009). The proliferation of these programs has created a response to the perceived nationwide shortage of health care professionals by both two- and four-

year institutions of higher education. As healthcare practitioner preparation programs continue to confer degrees to completing students, a secondary benefit of addressing the practitioner shortage would seemingly accompany these graduates and provide benefit to hospitals and other healthcare institutions in need of qualified practitioners.

However, interventions by institutions of higher education slated to address the need for increased practitioner capacity have also indirectly created a distinct challenge related to student access. The precipitous effect on hospitals and other healthcare facilities associated with increases in enrollments for schools providing nursing and other allied health career instruction combined with decreases in the lack of access for students in pursuit of healthcare professions has resulted in a decrease in the number of clinical experience sites for students and has also generated increased concern from regulatory bodies of clinical agencies related to any potential adverse effects on the adequacy and quality of instruction provided to students, due to an increase in capacity (Hovancsek et al., 2009; Jeffries, 2009). The traditional healthcare practitioner educational environment has historically focused on individual knowledge, education, and training as a methodology for transitioning students from the didactic and clinical components inherent to their chosen course of study to successfully licensed health practitioners; however, this traditional method is often inconsistent with variances related to the quantity and type of experiences seen by the student during training (Cannon-Diehl, 2009). Conversely, high-fidelity simulation experiences provide predictable, consistent experiences to the student–learner in the form of active teaching–learning and formative assessment where participants may reflect on strengths and limitations and summative evaluations, thereby providing an avenue for more definitive decision making from the student and a more effective assessment tool for the faculty member when evaluating student performance (Jeffries, 2005).

As multiple nursing and other allied health programs have continued to offer both didactic and clinical practicum experiences as integral components of their respective programs, the required clinical practicum, which is paramount in terms of the student assimilation process of applying classroom theory to clinical practice, has also created logistical challenges to hospitals attempting to provide such opportunities to students in a real-life patient care setting (Fowler, 2009). As the process of proliferation of medical professional preparation schools and programs continues, colleges and universities offering health programs have begun to assess the possibility of offering increased experiences through manikin-based high-fidelity simulation in addition to the traditional didactic and clinical components of their programs. Concurrently, patients are now experiencing shorter hospital stays and more complex disease processes while in the hospital, causing hospitals and other healthcare providers to look for increased institutional efficiencies to serve a changing patient population.

The purpose of this study was to (a) identify the attributes and benefits associated with the use of high-fidelity simulation in interprofessional healthcare student education for the foundational skill required by all professions of basic patient assessment and (b) assess the effects on student self-efficacy and learning outcomes from the utilization of high-fidelity and low-fidelity simulation experiences in an interprofessional healthcare education environment. The use of interprofessional high-fidelity simulation within an institution of higher education at the associate degree level of study is of particular relevance as no such studies have been previously published.

Research Questions

This study examined the efficacy of the use of high-fidelity manikin-based healthcare simulators in interprofessional education and addressed the following research questions:

1. Were there differences in student self-efficacy in a high-fidelity versus low-fidelity interprofessional associate degree-level healthcare practitioner manikin-based simulation learning environment for nursing and respiratory care students?
2. Were there differences in student learning outcomes in a high-fidelity versus low-fidelity interprofessional associate degree-level healthcare practitioner manikin-based simulation learning environment for nursing and respiratory care students?

Significance of the Study

The current high cost of high-fidelity simulators, as compared to other low-fidelity skills trainers used in the healthcare education setting, must be justified in order to provide institutions with the ability to make sound fiscal and pedagogical decisions regarding internal educational process involving the potential or continued incorporation of high-fidelity manikin-based simulation. The investment cost versus institutional benefit is a decision that must be made on the institutional level, and each institution must weigh this option carefully prior to the implementation of a simulation laboratory.

Many institutions of higher education have incorporated the use of high-fidelity simulation within specific professional disciplines in order to provide additional realism and a mechanism for critical thinking without the fear of harming an actual patient. The associated latitude, in terms of ability to provide additional patient scenarios which may or may not be seen by the student in the healthcare setting, provides a more broad-based exposure to many diverse patient populations. In terms of specific professional disciplines, a majority of simulation research has occurred with regard to specific professions, for example nursing and physician education, with the majority of the incorporation of disciplines in an interprofessional simulation experience occurring during the training of practitioners for more advanced emergency care

procedures and practices such as advanced cardiac life support. However, a void of interprofessional high-fidelity simulation practice exists at the associate degree level of study specifically related to the foundational didactic level of practitioner training. Such training is an integral component of the educational processes which provides students with the training needed for the most basic tenets of patient assessment and individual self-efficacy within the context of an interprofessional patient care environment. These foundational practices, which are incorporated at the point of care, are designed to provide students with the ability to appropriately assess patients in the healthcare setting for signs and symptoms of current or potential abnormalities and begin the process of effectively assessing concerns related to patients under their care in terms of potential interventions that could be enacted prior to arrival to other members of the healthcare team. Such benefit could be provided through the individual enhancement of self-efficacy with regard to interventions which would be instituted by other members of the healthcare team such as respiratory therapists. A subsequent substantial benefit to enhanced patient assessment and critical thinking skills is the ability to recognize and communicate medically pertinent patient information to other members of the healthcare team in order to ultimately provide timely and effective intervention to the patient. Practitioner interprofessional training, at this foundational level of patient assessment, is not as common as training occurring at more advanced practitioner levels, as is the case with emergency care.

This study provides information that is useful to simulation laboratories within institutions of higher education offering healthcare practitioner training. Additionally, the results of this study will assist curriculum developers, deans, and program directors with the utilization of fiscal and pedagogical resources related to high-fidelity simulation manikins and laboratories. Lastly, this study provides insight into the need for enhanced interprofessional simulation

training at the foundational level of training, which is simple patient assessment. Such an enhancement would provide increased institutional efficiency in terms of fiscal resources and provide students with enhanced patient assessment skills and the ability to incorporate additional members of the health care team earlier in the intervention process, which would ultimately serve patients and the health care system more effectively.

Definition of Terms

High-Fidelity Simulation

An enhanced level of realism in medical education that closely resembles interactions with actual human patients.

Interprofessional Education

Education-based training that incorporates multiple healthcare practitioner disciplines in a common environment.

Low-Fidelity Simulation

A more basic level of realism in medical education that resembles interactions with actual human patients but is limited in its ability to mimic more complex patient care situations.

Self-Efficacy

Reference to a person's beliefs of individual capability or confidence.

CHAPTER 2

REVIEW OF THE LITERATURE

Simulation has been defined as "the technique of imitating the behavior of some situation or process (whether economic, military, mechanical, etc.) by means of a suitable analogous situation or apparatus, especially for the purpose of study or personal training" ("Simulation," 2012). Medical simulation is also considered a training and feedback technique in which learners practice tasks and processes under realistic settings and circumstances using tools and models, such as virtual reality, and utilizing feedback from observers, such as professors, peers, actor–patients, and video cameras (Center for Telehealth & e-Health Law, 2005).

Simulation is an educational technique that allows interactive and, at times, immersive activity by recreating all or part of a clinical experience without exposing patients to the associated risks (Fritz et al., 2008). Gaba (2004) defined simulation as a technique, not a technology, to replace or amplify real-world experiences, often immersive in nature, that evoke or replace substantial aspects of the real world in a fully interactive fashion. Also, a simulator is a device that mimics a real patient or part of the human body and that is capable of interaction with the learner. "In broad, simple terms, a simulation is a person, device, or set of conditions which attempts to present education and evaluation problems authentically" (Issenberg, McGaghie, Petrusa, Gordon, & Scalese, 2005, p. 11). The student or trainee is required to respond to the problems as he or she would under normal circumstances.

The use of human manikin-based simulation in educating health professionals enables learners to practice necessary skills in an environment that allows for errors and professional growth without risking patient safety (Galloway, 2009). Additional benefits offered by medical simulation-based experiences provides students with the ability to make critical healthcare decisions in real time, see the effects of those decisions, consider their actions, receive immediate feedback about those actions and decisions, understand the decisions made, benefit from those decisions, and engage in a new experience or relive the previous experience without harming the patient (Center for Telehealth & e-Health Law, 2005). These simulated patient care experiences offered within an educational environment provide a medium for exchange of effective clinical-based learning between the instructor and the student that is designed to increase skill proficiency as well as provide an outcome-based avenue for institutional pedagogy in terms of training future healthcare professionals.

In medical education, various techniques of simulation are being used in colleges and universities as well as in healthcare institutions intended to enhance or supplement other didactic and clinical educational avenues used in the educational processes for students. Traditional education relies heavily on language, intelligence, and rote memorization. In contrast a well-designed simulation curriculum draws upon multiple intelligences and is learner centered (Galloway, 2009). In terms of simulation used in healthcare education, the typology consists to two primary classifications, low-fidelity and high-fidelity simulation-based approaches, which may be used individually or in parallel in order to enhance the learning experience of the student.

Low-Fidelity Manikin-Based Simulation

When classifying the levels of simulation in health care education and/or hospital training, fidelity refers to the level of realism of the simulation as compared to actual interaction

with human patient populations (Reeves, 2008). Equipment utilized in healthcare education which is classified as low-fidelity includes partial task trainers, role playing, and the conceptual practice of standardized patients (Galloway, 2009). Within the majority of institutions providing healthcare practitioner education, a common practice is to utilize a combination of low-fidelity and high-fidelity simulation devices and/or experiences in order to provide a broad exposure of teaching methods and simulated laboratory experiences for students.

The Center for Telehealth & e-Health Law (2005) defined a partial task-trainer device as a simulated subset of functionality, e.g., chest tube insertion, ultrasound, and bronchoscopy, or training for rare life-threatening events such as anaphylaxis and hyperthermia. Partial task trainers are instruments widely utilized in health practitioner training programs for the majority of professional disciplines. Such disciplines include certified nursing assistants, medical assistants, radiologic technologists, respiratory therapists, physical therapists, as well as nursing and medical student education.

Advantages related to these simulation devices (Beaubien & Baker, 2004) include product sustainability, portability, standardization, and skill specificity. Disadvantages include a lower level of ability to suspend disbelief in a simulation scenario due to the single task purpose of the trainer. Additionally, low-fidelity simulators, frequently referred to as skills trainers, are considered useful for introducing and practicing psychomotor skills but lack the realism to ensure that students will be able to transfer skills to real life (Touriniemi & Schott-Baer, 2008).

Maran and Glavin (2003) stated that a partial task trainer is designed to replicate only part of the environment, and these devices resemble anatomical portions of the body, and are specific to certain training tasks. Additionally, task trainers, in most healthcare educational environments, are used for the distinct purposes of acquisition and validation of student

psychomotor assessment and individual diagnostic skills ability by subdividing the complex skills associated with certain procedural tasks into segments (Decker, Sportsman, Puetz, & Billings, 2008), as well as serving as learning opportunities for patient conditions rarely encountered in a clinical setting (Weaver, 2011). Examples of partial task trainers include intubation mannequins; IV arms: and machines involved in processes such as surgery, resuscitation, or emergency scenarios (Beaubein & Baker, 2004). Additional items, which could be classified as partial task trainers could include an item as simple as an orange that is used to teach injection techniques to a model arm for teaching venipuncture or a manikin for teaching cardiopulmonary resuscitation (Durham & Alden, 2008). Partial task trainer models are inexpensive and therefore are readily available in healthcare training centers as well as institutions of higher education engaged in curricular instruction for health programs.

A second type of low-fidelity simulation, as defined by Aldrich (2005), describes *role playing* as providing reality and practical application principles to a mock clinical situation. Within the role play, environment learners are asked to act out a clinically related situation or event and apply components of previous clinical and didactic experiences to provide direction and the tools for deducing a real-life solution to a mock clinical event or problem. The objective associated with role play scenarios is to provide fidelity to a real clinical situation that assists students with assimilation of knowledge and subsequent practical application of its tenets to real-world experiences in an actual health care environment.

The Center for Telehealth and E-Health Law (2005) defined *standardized patients* as a method of simulation implemented to allow students to interact with actors specifically trained to present their medical histories, simulate physical symptoms, and portray actual emotions as specified by each case. Several distinct advantages are associated with the standardized patients'

methodology, which include the student's ability to listen to actual heart and lung sounds when examining and assessing a patient's condition, assessing actual heart rates and blood pressures, checking reflexes and range of motion, and being able to look into ears, eyes, nose, and throats of actual people. A final important advantage to this method of assessment is the availability of immediate feedback to the student regarding the effectiveness of his or her assessment ability, which is paramount for honing this essential skill for healthcare practitioners.

Shemanko and Jones (2008) defined the low-fidelity simulation concept of standardized patients in healthcare education as simulated patients or actors, which could be utilized to teach students to conduct a patient physical assessment, take a patient history for the purpose of screening new patients, communicate bad news, or even perform prostate exams. This method has been found to assist students with gaining self-confidence, increasing self-awareness of clinical strengths and weaknesses, and with applying theory to practice. A standardized patient who is equipped with a good script and is well trained can be a very effective instrument for suspending disbelief in a given scenario and creating a significant learning opportunity for students. The primary disadvantage associated with the utilization of standardized patients as a method of low-fidelity simulation is the recurring cost associated with the hiring and scheduling of actors (Durham & Alden, 2008).

High-Fidelity Manikin-Based Simulation

The achievement of learning objectives through high-fidelity simulation includes multiple modalities, which are classified as high-fidelity. As such, high-fidelity simulators are the most utilized methods of simulation; techniques categorized as high-fidelity are complex task trainers, full mission simulation, and integrated simulators or high-fidelity interactive manikins (Galloway, 2009).

Decker et al. (2008) described complex task trainers as devices that allow a learner to perceive tactile and other stimuli to the senses through a complex computer-generated environment. These virtual-reality and hepatic systems provide additional realism to patient care scenarios and offer an opportunity for the learner to practice skills, including bronchoscopy, as well as intravenous and central line catheterization via computer-based training. Complex task trainers may incorporate hepatic systems, which provide additional feedback to the student by sensing the amount of pressure being applied to a body part. The incorporation of this type of feedback mechanism also provides benefit to the instructional process by providing affirmation of the students' ability to properly assess patients in the clinical setting (Durham & Alden, 2008). These sophisticated systems, sometimes housed in a partial task trainer, lend greater fidelity to the partial task trainer educational experience. When used within a partial task trainer, by incorporating the placement of sensors, critical information such as pressure and presence during educational activities such as pelvic exams and surgical procedures may be detected, thereby enhancing the educational experience for the student (Durham & Alden, 2008).

An additional type of simulation utilized in the education processes of healthcare practitioner training is through the use of full mission simulation. Within the context of full mission simulation, the learner is engaged in a complex situation or task that usually involves a team of practitioners in order to complete successfully (Galloway, 2009). Educational experiences classified as full mission simulation may range from a replicated emergency response in a simulated emergency room to a more complex experience that would require the use of a full operating theatre team of healthcare practitioners incorporating high-fidelity complex task trainers and/or human patient manikin-based simulators (Galloway, 2009).

Integrated simulators, or high-fidelity manikin-based simulators, are whole-body manikins that are capable of responding to certain medications, chest compressions, needle decompression, chest tube placement, and other physiologic interventions and subsequent responses implemented by the instructors or students to treat various maladies experienced by the interactive manikin during the simulation experience (Galloway, 2009). The integrated simulator manikin is supplemented by sophisticated computer controls, which can be manipulated to adjust and simulate various physiological human parameters, such as heart rate, blood pressure, and respiratory rate, as well as electrical parameters of the heart displayed as readouts on a patient monitor. As such, the various aforementioned physiological and electrical parameters are controlled by the interaction of the manikin and the integrated software. Any interventions of the student and/or instructor intended to treat the simulated patient disorder will be reflected in the response of the integrated manikin. Such responses follow an algorithm programmed into the software that is in congruence with the manner by which actual human patients react physiologically to prescribed treatment modalities, which may be either negative or positive in nature (Bradley, 2006). If a reaction is negative, then additional reactions are required on the part of the student; if a reaction is positive, then continued monitoring and/or prophylactic interventions would be necessary in order to assure patient improvement.

Simulation Use in Physician Education

Girzadas, Clay, Caris, Rzechula, and Harwood (2007) conducted a comparative trial study to assess resident physician performance in the competency domain of patient care. Their study included 44 emergency room resident physicians in various stages of training ranging from newly oriented to possessing nine, 21, and 33 months of training. The study included one case of simulated anaphylactic shock, utilizing the Sim Man high-fidelity simulator. The remaining

seven cases presented to the resident physicians were additional components of an administered oral examination. The results of their study, using an objective measure of time to action, differentiated novice residents from experienced residents and added validation to the growing body of evidence suggesting that the use of high-fidelity simulation could be a valid method of assessing patient care competency in resident physicians.

Fitch (2007) conducted a feasibility study with the purpose of assessing the ability of resident physicians in training to combine elements of high-fidelity manikin-based simulation with elements of didactic education in a basic science course. The program was designed for a population of 202 first- and second-year medical students enrolled in a basic science course and included the incorporation of four 90-minute sessions of a high-fidelity simulation experience. The goal of this pilot program study was to determine feasibility for combining elements of simulation that are currently not in wide-spread use: (a) simulation in the preclinical basic science course curriculum and (b) live interactive simulation for large numbers of participants. This experience was videotaped for post-simulation feedback and for the purpose of debriefing the medical students on the simulation experience and the medical interventions performed or suggested by the physicians in training after the experience had been completed. Four groups of participants, ranging from 50 to 51 students per simulation, were involved in the study.

The Fitch study utilized a Laerdal Sim Man high-fidelity manikin was transported to the medical school lecture hall at Wake Forest University after a mock announcement was made to the medical students that designated the impending arrival of a patient in distress and in need of emergency physician, nursing, and emergency medical services trauma team interventional care. Staff physicians, nurses, and other hospital personnel involved in the study portrayed emergency personnel, nurses, and family members during the 90-minute simulation exercise. This exercise

consisted of guided discussions and interactions with the medical students involving emergency assessment of the simulated patient's medical concerns, the generation of a differential diagnosis for the patient post-physical examination and assessment, and the discussion of potential pharmacological interventions that could be implemented in order to appropriately assist and treat the simulated patient.

The results of the study were gathered utilizing a Likert-scale instrument designed to measure the effectiveness of the simulation experience and potential correlation to components of basic science course concepts by rating the following components as *poor*, *fair*, *good*, *very good*, or *outstanding*: (a) simulation use to enhance the presentation of the clinical scenario, (b) the effectiveness of the facilitator in the presentation of the clinical scenario, (c) actors' participation in the event to enhance the clinical scenario, (d) the correlation of the clinical scenario to basic science concepts and relevance to patient care, (e) the value of the clinical approach to emergency patient evaluation, and (f) the effectiveness of the overall presentation. Out of the 202 participants in this study, 98% rated the correlation to basic science course concepts as *very good* or *outstanding*, and 99% rated the same for overall presentation.

Simulation Use in Nursing Education

The use of high-fidelity simulation in nursing education has continued to be widely discussed among nursing educators and healthcare institutions with subsequent questions being asked related to perceived limits and opportunities associated with integration within the nursing curricula. Additional evaluative discussions regarding high-fidelity simulation have focused on the ability of this technology to satisfy the experiential and situated learning components of the nursing curriculum (Benner, Sutphen, Leonard, Day, & Shulman, 2010). Experiential learning opportunities provide a range of actual patient experiences for the student in multiple

environments, thereby providing learning through the experience garnered through the process of caring for actual patients; situated learning opportunities are provided through student exposure to particular situations of specific patients, which is one of the hallmarks of nursing education (Benner et. al., 2010).

Smith and Roehrs (2009) conducted a correlational study to examine the effects of a simulation experience on two outcomes: student satisfaction and self-confidence. The study included junior nursing students in a traditional baccalaureate nursing program. This 56-hour didactic course, which included skills laboratory competencies, also included exposure to a high-fidelity simulator. The high-fidelity simulation experience included the need to assist with the diagnosis and treatment of a patient with a respiratory disorder. The study analyzed its data based on five research questions that were based on the aforementioned design characteristics of student satisfaction and confidence associated with the high-fidelity simulation experience. The findings of the study indicated increased satisfaction and self-confidence with the high-fidelity simulation experience as opposed to traditional methods of instruction. However, the results of the study also indicated that the design of the simulation experience is also a crucial component to an effective and engaging pedagogy.

Lasater (2007) conducted a qualitative exploratory study, which was embedded within a larger study, to examine the effects of high-fidelity manikin-based simulation on the development of clinical judgment in nursing students. The larger study incorporated the additional dimensions of students' self-reporting of confidence in their clinical judgment skills, the assessment of the aptitude of students for critical thinking, and qualitative observations of students' clinical judgment skill during the high-fidelity simulation process.

Clinical judgment refers to the ways in which nurses come to understand the problems,

issues, or concerns of clients/patients, to attend to salient information, and to respond in concerned and involved ways; included in our understanding of the term is both the deliberate, conscious decision-making characteristic of component performance and the holistic discrimination and intuitive response typical of proficient and expert performance (Benner, Tanner, & Chelsa, 1996).

The Lasater study included a total of 48 junior-level non-traditional and traditional nursing student participants (47 female, 1 male), who were enrolled in a nursing course that incorporated high-fidelity simulation experiences on a weekly basis. Out of the total number of 48 students, 39 of the students had been observed during simulation and were subsequently chosen as candidates for a focus group designed to assess the students' experiences. However, out of the 39 student participants invited to participate in focus groups, only eight participants, who were all non-traditional students ranging in age from 24 to 50 years old, formed the final focus group. The final group consisted of one student of a racial and ethnic minority holding a previously acquired baccalaureate degree with four others holding baccalaureate degrees. The remaining three participants held no previously acquired degree from any institution.

The results of this study revealed a set of consistent themes which were echoed among the participants. These themes included (a) the identification of simulation as an integrator of learning, prompting the student to combine psychomotor skills and bases of theory in order to initiate critical thinking, (b) acquisition of experiences that might not be seen in the actual clinical setting, and (c) the atmosphere of collaboration acquired by learning in teams, thereby observing and participating in the experiences of other students in varying simulation roles.

A descriptive study designed to evaluate the level of nurse–physician collaboration during life-threatening pediatric simulations was conducted by Messmer (2008) utilizing a METI

HPS manikin. The participants (n = 105) included 55 pediatric resident physicians and 50 nurses comprising a total of 18 teams. Out of the 18 teams, 68% were women and 32% were men, with varying amounts of healthcare experience ranging from two or fewer years (60%), three to seven years (30%), to eight years or more (10%).

The Messmer study consisted of three scripted pediatric mock codes with life-threatening scenarios: (a) apnea-bradycardia and respiratory symptoms with physiological deterioration, (b) near drowning, and (c) head injury and increased intracranial pressure. The video recording of the mock codes was reviewed by three independent observers and subsequently scored on the Kramer and Schmalenberg Nurse-Physician Scale (KSNPS). The competency associated with the METI HPS simulator was scored by the clinical educator associated with the study. After the completion of the mock code scenarios, the participants were asked to complete a demographic survey and two National Association of Children's Hospitals and Related Institutions (NACHRI) instruments, the Collaboration & Satisfaction with Patient Care Decisions (CSPCD) and the Clinical Practice Group Cohesion.

The results of the study provided evidence of gradual increases in interdisciplinary collegiality as practitioners engaged in multiple scenarios, as measured by the KSNPS, as well as high levels of group cohesion and satisfaction with patient care decisions for physicians and nurses as measured by the NACHRI instrument.

Simulation Use in Respiratory Therapy Education

A paucity of research exists on the use of high-fidelity simulation in the education of respiratory therapists. Historically, the only high-fidelity simulation training with any connection to respiratory therapy education has been associated with emergency response systems or rapid response teams. A rapid response team consists of a group of practitioners in

the healthcare environment of a hospital who are specifically trained to respond to emergent situations and deliver emergent care to a deteriorating patient quickly (Carrigan, Jaracz, LeDonne, & Nehmer, 2007). As such, rapid response teams are of significant benefit to healthcare institutions but are not designed to provide training specifically related to the discipline-specific profession of respiratory therapists.

In contrast, a significant amount of study has been performed related to the respiratory therapy profession specifically, with the majority of previous studies associated with specific procedural methodology for improvement of the performance of patient care or related to specific desired technical outcomes related to instruction within institutions of higher education. The scope of previously performed studies engaging some type of simulation range from very simple tasks to more complex tasks, which require critical thinking and the implementation of theory to practice-based performances in the healthcare setting. Examples of this range of tasks could include initiating the use of oxygen for a patient to more complex tasks such as the measurement of lung volumes of patients in the critical care setting.

Cahoun, Columb, Mahajan, and Hardman (2008) conducted a comparative study utilizing 10 patients to determine the applicability of the Nottingham physiological model on patient outcomes associated with acute respiratory distress syndrome (ARDS). Within this study the Nottingham Physiology Simulator was calibrated to duplicate the physiologic changes in the human lung caused by ARDS. This condition is associated with increased resistance of the lung to expand, thus increasing the difficulty associated with breathing.

The measurement of the effectiveness of breathing of patients with increased respiratory distress and gas exchange in the lung is determined, evaluated, and often treated by the use of serial measurements of arterial gas tensions, or arterial blood gas measurement obtained from

drawing blood from the patient and treating the patient accordingly, (Cahoun et al., 2008). In order to effectively simulate the parameters associated with ARDS, the study incorporated a calibration of physiological parameters obtained from two randomly selected patients diagnosed with the disease to appropriately represent the disease processes parameters when calibrating the Nottingham Physiology Simulator. Subsequently, the data sets from these two patients were excluded from the validation investigation of the remaining eight patients used for comparison.

Results of this study indicated that the use of the Nottingham Physiology Simulator model and adjusting parameters within the model improved patient gas exchange in the lung of this simulated patient model more effectively than by the traditional clinical methodology of utilizing arterial gas tension of serial arterial blood gas measurements to treat patients with acute respiratory distress syndrome (Cahoun et al., 2008).

Cullen, VanScoder, Podgorski, and Elmerick (2003) conducted a study that examined the correlation and reliability between the respiratory therapist written registry and clinical simulation examinations on the prediction of successful completion of a required national practitioner examination for the profession. The two examination components that must be successfully completed in order for respiratory therapy practitioners to be awarded the registered respiratory therapist (RRT) credential are the two aforementioned examinations. These two examinations are offered to institutions of higher education teaching these programs as either practice instruments for student assessment or for use in individual evaluation. The written registry examination, for potential respiratory therapy practitioners, consists of multiple choice questions, and the clinical simulation examination is a branch-logic patient management examination. In order to receive the RRT credential required to practice as a therapist, a graduate must pass both components of the exam, which is central to the profession of

respiratory care as no other nursing or allied health profession requires the successful completion of two separate examinations in order to receive one credential.

The study utilized a sample of advanced-level respiratory therapy students (n = 60) enrolled in the final semester of study. Of these 60 students, 43 were enrolled at the associate degree level of study and the remaining 17 were enrolled at the baccalaureate degree level of study. Prior to this study none of the 60 students had ever taken a Web-based student assessment examination (Cullen et al., 2003). Students were administered a Web-based practice instrument designed to simulate both the written registry and clinical simulation components of the actual examination. These practice student assessment examinations are purported to estimate performance on the actual examinations with an accuracy of 93.5 to 95.5 percent (Applied Management Professionals, 1999).

The resultant data was divided into sub-components for both the written registry and clinical simulation examinations. The written registry was divided into three categories: (a) clinical data, (b) equipment, and (c) therapeutic procedures. For the clinical simulation component of the examination, the sub-categories were (a) information gathering, and (b) decision making. The results of the study excluded two students who did not complete the written registry examination and four students who did not complete the clinical simulation examination (Cullen et al., 2003).

The average score of students on the written registry examinations was 60.52%, and the average score of student on the clinical simulation examination for the information gathering section was 76.30%. The resultant α coefficient for the written registry results was 0.79 and the α coefficient calculated for the clinical simulation results was 0.76. A correlation of 0.86 was calculated between the written registry and clinical simulation self-assessment examinations.

The results of this study indicated that the lower reliability of the clinical simulation component of the RRT examination may call the consistency of the examinations into question, given that the clinical simulation content on the self-assessment examination is representative of the actual content on the national RRT examination (Cullen et al., 2003).

Simulation in Collaborative Interprofessional Education (Low- and High-Fidelity)

Interprofessional education is defined as occurring when two or more professions learn with, from, or about each other to improve collaboration and the quality of care (Center for the Advancement of Interprofessional Education, 2011). As collaborative learning occurs in a simulated healthcare environment, the process of the transformation of individuals from functioning independently to working together as a group evolves, with the ultimate desired outcome for the collaborative process being the acquisition of increased knowledge and skills to improve patient outcomes (Jeffries, 2007). Traditional pedagogies of healthcare practitioner instruction, which primarily focus on the cognitive domain, include lectures, laboratory courses, and videos that serve as learning tools that foster efficient and rapid delivery of essential information or development of specialized skills or techniques. However, without students applying acquired knowledge, skills, and technique to the content of work being done by professionals in chosen fields, acquired knowledge may be lost. Students who are involved in problem-solving and decision-making situations similar to those faced by healthcare professionals will need to integrate acquired information, language, and skills into action and dialogue (Jeffries, 2007).

Many institutions of higher education as well as healthcare facilities utilize high-fidelity simulation as a method of training teams of practitioners to respond quickly to emergent situations that may occur in an actual healthcare setting, such as in a hospital. This practice

aligns well with the Institute of Medicine's core competency standard, which charges healthcare practitioners to work as members of an interprofessional team within their specific scope of practice (Hickey, Forbes, & Greenfield, 2010). The name given to a group of practitioners representing various healthcare professions in simulated emergency care situations is the rapid response team and is designed for the purpose of developing teams of practitioners who are charged with the completion of a set of tasks in rapid succession to save the lives of patients (Laerdal Medical Products, 2010a).

Carrigan et al. (2009) conducted a study at the University of Illinois Medical Center to evaluate internal efficiencies related to institutional ability to respond to acute changes in patient conditions quickly and with appropriately trained medical personnel. The purpose of this internal study was to assess the institution's ability to meet the standard of care set by the Joint Commission for the Accreditation of Hospitals regarding patient safety.

The study utilized, for the purposes of assessment, a Laerdal Sim Man high-fidelity manikin-based simulator and utilized multiple simulated emergent care situations that occur with real patients. The three professions participating in the rapid response team simulation study were nurses, respiratory therapists, and physicians. All practitioners were required to attend an interprofessional training session to acclimate them to the proposed mock emergencies as well as to the high-fidelity simulator prior to the implementation of the study. The training sessions consisted of multiple scenarios and included four to six practitioners from various professional disciplines in all high-fidelity simulations. The goals slated to be achieved during the simulations included the enhancement of clinical assessment and decision making, team communication, responsibilities for the practitioner in charge of the patient's care, and the dynamics of interdisciplinary education in the clinical setting (Carrigan et al., 2009).

The results from this study support the desired benefits as increased familiarity of the team members with each other and their respective roles occurred as additional simulations took place, leading to increased accuracy of treatment, better communication among professional disciplines, which ultimately leads to more expedient assessment and treatment of deteriorating patients in the healthcare setting (Carrigan et al., 2009).

A research study conducted by Dillon, Noble, and Kaplan (2009) examined high-fidelity simulation as an instrument to foster collaborative interdisciplinary education. The study utilized a pretest/posttest design in order to identify perceptions of simulation as a collaborative educational instrument. This study included 82 participants, consisting of fourth-year baccalaureate nursing students (n = 68) and third-year medical students (n = 14) at a large urban university who completed the pretest and 40 participants, consisting of nursing students (n = 31) and medical students (n = 9), who completed the posttest.

Qualitative and quantitative data were collected from the study in addition to the collection of demographic data to describe the sample. A 15-item, four-point Likert-type scale instrument called the Jefferson Scale of Attitudes Toward Physician-Nurse Collaboration (Hojat et al, 1999) was used to measure student perceptions of collaboration from a qualitative perspective. Additionally, qualitative data were collected through the use of the participants being asked four open-ended questions regarding their perceptions of nurse–physician collaboration before and after the interdisciplinary high-fidelity simulation experience.

A mock-code learning exercise was implemented utilizing a Laerdal high-fidelity simulation manikin incorporating 10 nursing and medical students initially, followed by subsequent simulation experiences that incorporated an additional 10 participants. All mock-code experiences were videotaped for subsequent debriefing during the simulation review

process. The subsequent debriefing process for all interdisciplinary mock-code experiences focused on assessed components related to clinical skills assessment and decision-making processes but also incorporated an opportunity to discuss the feelings of the participants regarding the cumulative mock-code experience (Hojat et al., 1999).

The results of this study support the value of collaborative interprofessional simulation incorporating nursing and medical students. This study also incorporated quantitative and quantitative assessments measures as tools that were utilized to provide additional measures of understanding of the various roles of the nurse and physician in the healthcare setting. For nursing students, pretest scores were higher than the pretest scores of the medical student participants, representing a more objective view toward collaboration. However, following the mock-code simulation experience, the posttest scores of the medical student participants increased significantly for two specific factors (collaboration, $p = 0.013$; nurses' autonomy, $p = 0.025$), indicating a more objective view of collaboration and an increased understanding of the autonomous role of the nurse.

A study conducted by Whelan, Spencer, and Rooney (2008) evaluated the use of both low- and high-fidelity simulation experiences within an interprofessional healthcare practitioner educational environment. This study utilized a pre- and post-test quasi-experimental design, incorporated experiential learning, and mandated that participants work collaboratively in order to respond to a series of rural emergency healthcare scenarios.

This study incorporated a multi-station circuit consisting of three interprofessional learning stations for engagement with the participants. One of the stations utilized a high-fidelity simulation manikin and others incorporated low-fidelity simulation and role playing; however, all participants were required to rotate through all learning stations and incorporate the necessary

expertise and skills that were inherent to the students' particular course of study while engaged in the simulation experience. The results of this study indicated that participants placed an overarching greater value on interprofessional teamwork and collaboration as well as an increased awareness of professional roles and responsibilities, independent of participant engagement in a particular type of simulation, such as either low- or high-fidelity.

Benefits of Interprofessional High-Fidelity Simulation

One of the primary benefits of high-fidelity simulation is its congruence to the Institute of Medicine's five core competencies, adopted in 2003, and designed to guide the overarching practice of healthcare education. The five core competencies are (a) to provide patient-centered care, (b) to work in interdisciplinary teams, (c) to employ evidence-based practice, (d) to apply quality improvement, and (e) to utilize informatics (Greiner & Knebel, 2003). These competencies, endorsed by consensus across professional healthcare disciplines, provide common language that educators could utilize to redesign and implement healthcare educational methodologies and approaches in order to provide a more consistent pedagogical approach within institutions providing instruction (Hickey et al., 2010). The process of exposing students to effective interprofessional education programs has been shown to provide a number of positive outcomes; these outcomes include an increase in mutual understanding of the roles and values of other health professionals, raised awareness of the importance of collaborative and team working skills, enhanced communication, and improved patient care and outcomes (Whelan et al., 2008).

High-fidelity simulation can be used to help learners acquire new knowledge and to better understand conceptual relations and dynamics. At the present time physiological simulations allow students to watch simple and complex medical procedures and interventions

unfold over time and respond to interventions, in essence making textbooks, diagrams, and graphs come alive. The subsequent step for the student is the acquisition of skills to accompany knowledge (Gaba, 2004). Teaching and learning using simulation, especially high-fidelity simulation, can provide consistent, predictable experiences with more complex roles, moving the learner beyond passive educational experiences as well as provide a medium for an interprofessional practice for both healthcare practitioners and the patients who are ultimately served (Cannon-Diehl, 2009; Laerdal Medical Products, 2010b).

The practice of critical thinking skills by students in either real-life or simulated real-life situations increases the probability that those skills will be used post-graduation. In addition, these students should have multiple opportunities for practice. Because of the competition for clinical practice sites and short inpatient stays, traditional nursing practice opportunities are increasingly limited. Furthermore, the actual clinical practice setting is high-stakes, in that the wellbeing of real patients is involved and students are naturally nervous as they are gaining proficiency in a psychomotor skill (Lasater, 2007).

Within the context of medical education, simulation may be an effective tool of inclusion for the delivery of potentially effective and lasting skills acquisition and psychomotor development (McDonald, 1987). Simulation provides an opportunity for the enhancement of knowledge as basic acquired skills are integrated into actual clinical techniques, a process for which simulation may have considerable power, especially as it can readily provide experience with even uncommon anatomical or clinical presentations (Gaba, 2004).

One of the potential benefits of high-fidelity simulation in an interprofessional educational setting was studied by Paige et al. (2009) to assess the effectiveness of high-fidelity simulation team training on participants' beliefs in their ability to confidently carry out

teamwork related competencies. This study utilized a mock operating room complete with a high-fidelity human patient simulator, a complex task cholecystectomy model, and the required surgical equipment. The sample for this study included 38 professionals from various surgical sub- disciplines who took part in at least one training session. The hypothesis of the researchers, who stated that simulated operating room team training could increase self-efficacy related to team work, was supported by data collected from the Likert-scale instrument utilized in this study, which reported statistical significance from four of the 15 items utilized that measured confidence.

Enhancement of the Ability to Assess Student Competency and Self-Efficacy

High-fidelity simulation incorporated within the curriculum of practitioner training programs may provide an additional measure of assessment of student-acquired skill prior to engagement of actual practice in a clinical setting. Simulation provides opportunities for healthcare professionals to make mistakes and learn from them in a safe and educational environment (Messmer, 2008). Participants in simulation consistently indicate that they value these opportunities (DaVita, Schaefer, Lutz, Wang & Dongilli, 2004; Ostergaard, Ostergaard, & Lippert, 2004). Surgeons who received simulator training showed significantly greater improvement in performance in the operating room than those in a control group not receiving such training (Grantcharov et al., 2004).

The preparation and education of competent healthcare practitioners requires that educators receive both formative and summative evaluations, which could be facilitated with the use of high-fidelity human patient simulators. For example, during learning, faculty can take advantage of teachable moments as learners provide care in scenarios drawn from real life.

Scenarios for a summative evaluation are designed to include all of the salient critical elements that must exist to validate competency (Decker et al., 2008).

The traditional processes closely associated with education of healthcare practitioners is no longer dependent on the types of patients available; simulation provides the opportunity to duplicate many rare and emergent conditions as often as is needed. Overall, simulation increases learning and retention, improves overall performance and communication skills, and enhances teamwork among healthcare practitioners while reducing the actual safety risk to patients (Messmer, 2008).

Self-Efficacy

Within the healthcare environment, individual self-efficacy provides benefit to the bedside practitioner. Enhanced self-efficacy increases confidence in the practitioner's ability to appropriately address and resolve patient-related concerns in the healthcare setting. Bandura (1993), states that among the mechanisms of personal agency none is more central or pervasive than people's beliefs about their capabilities to exercise control over their own level of functioning and over events that affect their lives. These beliefs include cognitive, motivational, affective, and selection processes that provide great influence over how people feel, think, motivate, and behave (Bandura, 1993).

The human cognitive processes of forethought, individual motivation, and personal goal setting all may have effects on individual self-efficacy. These factors, either alone or in combination, could assist students with the process of transforming theory into effective practice, while potentially enhancing individual self-efficacy. At the core of social cognitive theory is the importance of self-efficacy beliefs, defined as "people's judgments of their capabilities to

organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p. 391).

Forethought serves as a precursor to a student's chosen course of action and influences participatory scenarios constructed and rehearsed by the student directly affecting motivation, goal setting, and subsequent follow through associated with a required task culminating with either an enhancement or lessening of self-efficacy (Bandura, 1993, 1997). Motivation and goal setting, required to complete an assigned task, are indirectly proportional to the student's sense of self-efficacy, as those who possess enhanced self-efficacy visualize success and commit themselves to explicit standards and goals, often intensifying efforts when their performances fall short of the desired goal. Conversely, students with a low sense of self-efficacy may become easily discouraged by failure and may tend to be easily influenced by the perceptions of others related to personal self-efficacy (Bandura, 1993; Bandura & Cervone, 1983).

In a study conducted by Pike and O'Donnell (2010), the impact of clinical simulation on pre-registration nursing student education was evaluated. This study utilized a quasi-experimental pre- and post-test research design and included an experimental group of participants utilizing high-fidelity simulation and a control group of participants utilizing low-fidelity simulation. This study incorporated participants and previous questionnaire responses from a larger preliminary study conducted by Pike (2008) and included the formation of a focus group to examine the experiences of the participants. Two principle themes arose from the study: (a) the resultant low level of student self-efficacy associated with communication within the control group and (b) enhanced motivation and perceived self-efficacy through simulation for participants within the experimental group.

Enhancement of Student Learning Outcomes

Learning outcomes, as defined by Bloom's Taxonomy of Educational Objectives for Cognitive Domain, are designed to focus on cognitive levels of learning outcomes ranging from knowledge, which is the most basic level, to evaluation, which is the highest level (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956; Schumacher, 2004). Additional study of Bloom's work was performed by Anderson et al. (2001), who developed more fully the emphasis of utilizing taxonomy in curriculum, added terminological changes to correlate with the development of learning objectives, and added enhancements designed to clarify the hierarchical structure.

The use of high-fidelity simulation provides multiple benefits to the educational experience leading to effective learning, including providing feedback, allowing repetitive practice, provision of a controlled environment for learning, and ensuring defined outcomes are achievable (Issenberg, McGaghie, Petrusa, Gordon, & Scalese, 2005).

Through the use of human patient simulations, students are offered a sequence and set of instructional practices that create the conditions in a mock work world. Students then receive feedback through debriefing about their practice. The experience offers multiple opportunities for corrective practice and critical reflection. In human patient simulation, educators have the responsibility of making sure that the most relevant cue sets are apparent and that the script for the scenario is followed to ensure the intended learning transfer (Elfrink, Kirkpatrick, Nininger, & Schubert, 2010, p. 98).

Schumacher (2004) examined and measured learning outcomes of undergraduate nursing students by utilizing a customized Health Education Systems examination. This study found statistically significant differences between participant critical thinking ability ($p \leq 0.002$) and

learning outcomes ($p \leq 0.001$) when simulation or a combination of simulation and classroom engagement was utilized during learning activities. Similar improvements were found by Hoffman, O`Donnell, and Kim (2007) in a study which utilized the Basic Knowledge Assessment Tool-6 to measure improvement of knowledge of senior nursing students, after seven weeks of engagement in traditional clinical experiences and seven weeks of engagement in high-fidelity patient simulations. Significant improvements were found in six of eight subscales, with the two subscales not demonstrating knowledge enhancement not included in the high-fidelity patient simulation component of the study.

A randomized controlled trial was conducted by Liaw, Scherpbier, Rethans, and Yobas, (2012), which assessed simulation learning outcomes between a control group and experimental group of baccalaureate nursing students ($n = 31$). The study utilized a pre- and post-assessment of knowledge, self-reported confidence, and clinical performance in order to evaluate the use of simulation as an intervention. The results of this study found no significant differences between the two groups on pre-assessment of knowledge, self-reported confidence, and clinical performance; however, mean scores of knowledge and clinical performance were higher for the intervention group on post-assessment.

Enhancement of Student Ability to Apply Theory to Practice

Medical student education shares common objectives with many other professions regarding devising strategies and methodologies to be implemented for the purpose of providing an avenue for students to bridge the gap between theoretical knowledge and practical application of medical theory. Historically, the medical curriculum has been designed to provide students with a foundational base of medical science-based theory followed by clinical externships designed to provide practical application concepts to the previously acquired medical science

theory (Morgan, Cleave-Hogg, DeSousa, & Lam-McCullough, 2006). In the case of high-fidelity manikin-based simulation, the learner is provided with the opportunity to receive a hands-on practitioner-based educational experience, without the inherent risk associated with attempting to apply medical theory to practice on actual human patients (Morgan et al., 2006).

The ultimate goal of the high-fidelity simulation experience is to provide a medium for students to transfer their learning from the simulation laboratory to the clinical setting as they care for human patients, which is ultimately beneficial to both the student and to the patients served (Lasater, 2007). High-fidelity simulation, when used appropriately, provides the ultimate training environment in which participants can practice critical assessment and communication skills before engaging in practice, thereby assuring that the practitioner possesses the knowledge and confidence necessary to provide safe and effective care (Broussard, Myers, & Lemoine, 2009).

One distinct additional benefit for students engaged in high-fidelity simulation experiences is that such experiences could also serve as reinforcements for traditional classroom learning as well as adjunct strategies to supplement traditional laboratory sessions (Weaver, 2011). The desired outcome of the culmination of the goals and benefits of high-fidelity simulation as either an adjunct to or reinforcement of the traditional instructional methodology is a student who is better prepared to meet the challenges associated with the ever-increasing complexity of the clinical practice setting from both didactic and clinical perspectives (Leonard, Shuhaibar, & Chen, 2010).

Enhancement of Patient Safety

The emphasis on simulation should be viewed as an integral part of the training methodologies utilized by clinical personnel and teams for the training of future healthcare

personnel. Future development of simulation training should require continual revision, rehearsal, performance assessment, and refinement as a required portion of healthcare practice, and include methods to improve overall quality and risk management in the clinical setting (Gaba, 2004).

Effective healthcare risk management is a crucial component to the overall operation of any hospital or healthcare institution. All institutions that provide healthcare to patient populations institute and maintain policies for the specific purpose of increasing overall awareness related to risk management. One of the foci of institutional risk management programs is the lessening or elimination of medical errors, which occur within healthcare facilities in the United Sates on an annual basis. Medical errors often cause injury to patients but may also result in more catastrophic outcomes, such as patient death. Such was the case of Josie King, an 11-month-old child who was a patient at Johns Hopkins Medical Center, who died as a result of medical errors precipitating her death (Quality and Safety Education for Nurses, 2001). Simulation provides a unique modality for experiential learning and evaluation. The simulated setting also provides a risk-free environment where learners can integrate theory and practice without the fear of harming actual patients, thereby lessening the inherent risk associated with hands-on clinical education (Decker et al., 2008). Due to the rise in morbidity and mortality among hospitalized patients throughout the United States, heightened concerns associated with the professional competency of healthcare practitioners have been placed in the forefront of issues or concerns in these professions. As a result of this increased emphasis, nursing and other healthcare professionals are under increased scrutiny from constituencies both internal and external to institutions providing care to patients (Durham & Alden, 2008). Concurrently, healthcare organizations are seeking more effective institutional tools and strategies for the sole

purpose of enhancing safety and quality in an ever-changing health care environment. High-fidelity simulation training, within an organizational learning environment, may serve to assist institutions to increase the awareness of its potential benefits while also providing a method for meeting the increased demand for greater health care institutional value and expectations for predictable safety (Chenot & Daniel, 2010).

In the Kohr, Corrigan, and Donaldson (2003) report *To Err is Human: Building a Safer Health Care System* simulation training is recommended as one strategy that can be used to prevent errors in the clinical setting. The authors wrote that "health care organizations and teaching institutions should participate in the development of simulation for training novice practitioners, problem solving, and crisis management, especially when new and potentially hazardous procedures and equipment are introduced" (Kohn, Corrigan, & Donaldson, 2000, p. 179).

Enhancement of the Interprofessional Educational Experience

According to Greiner and Knebel (2003), one innovative use of high-fidelity simulation in the healthcare or educational setting is that of teamwork training. The promotion of ultimate patient safety is one of the five healthcare practitioner education competencies identified by the Institute of Medicine. A second of the Institute of Medicine's core competencies addresses work in interprofessional teams by stating, "Cooperate, collaborate, communicate, and integrate care in teams to ensure that care is continuous and reliable" (Greiner & Knebel, 2003, p. 45). One of the basic tenets of a successful interprofessional team is communication among its members. Additionally, a member who is often overlooked in the treatment of patients is the family of the patient. Miscommunication, or lack thereof, could result in an environment which leaves family members uninformed and removed from engagement in the very processes designed to result in

patient improvement and subsequent discharge from the hospital (Quality and Safety Education for Nurses, 2009). The ultimate desired outcomes of team training, according to Beaubien and Baker (2004) are reflections of displayed participant orientation to healthcare challenges, situational applications of leadership in healthcare, mutual respect for professional disciplines that vary from their own, and goal accomplishment for individual members and for the entire team.

Greiner and Knebel, (2003) strongly encouraged the use of simulation as a method of practitioner training that should be incorporated into healthcare practitioner educational programs. However many healthcare practitioner educational programs have not implemented such practices due to either the lack of funding to purchase high-fidelity simulation manikins or due to the lack of collaborative efforts instituted by both institutions of higher education as well as by healthcare institutions. Additional implementation of high-fidelity simulation may supplement the actual clinical experiences obtained by the student in healthcare facilities during the clinical externship components of the training curriculum.

Summary

Upon review of the literature associated with this topic, generalizations can be made regarding the use of high-fidelity simulation, from historical and discipline-specific perspectives. Additional perspective garnered from a review of the literature provides perspective on the use of low- or high-fidelity simulation for discipline-specific and interprofessional applications, as well as information regarding the potential benefits of its use in higher education.

High-fidelity manikin-based and low-fidelity simulation share many common benefits to the student learning experience. These benefits include standardization of psychomotor assessment and evaluation of skill specificity. However, high-fidelity manikin-based simulators

provide additional realism to the educational experience, which has been received somewhat positively by learners who have reported increases in critical thinking ability, increased self-efficacy, increased learning outcomes, and enhanced teamwork when placed in situations requiring interprofessional collaboration.

Discussions regarding the most effective use of high-fidelity manikin-based simulations have become increasingly popular in the medical education arena. Varying opinions abound regarding the best use of high-fidelity simulation within the curriculum, which include its use as only a supplement to the traditional didactic classroom to serving as an adjunct strategy to the laboratory component of the curriculum. Additionally, conversations are now taking place in associate degree, baccalaureate degree, and graduate degree institutions regarding the most effective use of high-fidelity simulation from an interprofessional perspective.

One notable research contribution regarding the use of high-fidelity manikin-based interprofessional simulation is missing from this literature review, which is its effect on the community college student population. Additional study is required in order to determine the effect of high-fidelity manikin-based simulation on the self-efficacy and learning outcomes of students at the associate degree level of study.

CHAPTER 3

METHODOLOGY

The purpose of this study was to determine if the use of high-fidelity manikin-based patient simulation improved the self-efficacy of students and improved learning outcomes within an interprofessional learning environment as compared to the traditional discipline specific environment of healthcare practitioner education. A quasi-experimental design was selected due to the inability to randomize the participants in this study. Conversely, a true experimental research design provides a medium by which cause and effect relationships between interventions and outcomes could be evaluated; however, any relationship between cause and effect must be inferred within a quasi-experimental research design methodology (Campbell & Stanley, 1963).

Research Questions

Two research questions guided this study. The first was, Were there differences in student self-efficacy in a high-fidelity versus low-fidelity interprofessional associate degree level healthcare practitioner manikin-based simulation learning environment for nursing and respiratory care students?

A second question also provided additional direction for this study which asked, Were there differences in student learning outcomes in a high-fidelity versus low-fidelity interprofessional associate degree level healthcare practitioner manikin-based simulation learning environment for nursing and respiratory care students?

Design of Study

This study employed a quasi-experimental, non-equivalent groups, between-groups construction design in order to evaluate the relationship between the self-efficacy of students enrolled in nursing and respiratory care programs at two institutional regions of a Midwestern associate degree-level granting institution and the effect engagement in interprofessional high-fidelity and low-fidelity simulation experiences had on student self-efficacy and perceived learning outcomes. This study included an experimental group of participants engaged in high-fidelity simulation experiences and a control group of participants who engaged in low-fidelity simulation experiences. This design was selected due to the inability to randomize the selection process of participants, but I wanted to incorporate the structural framework of a pretest-posttest randomized experimental design. An additional consideration given to the utilization of this research design was access to the necessary study participants over the course of a semester, which would have been required if this design required the assessment and evaluation processes of student self-efficacy be incorporated within a specific college course held over an entire semester. The study design is depicted in Figure 1.

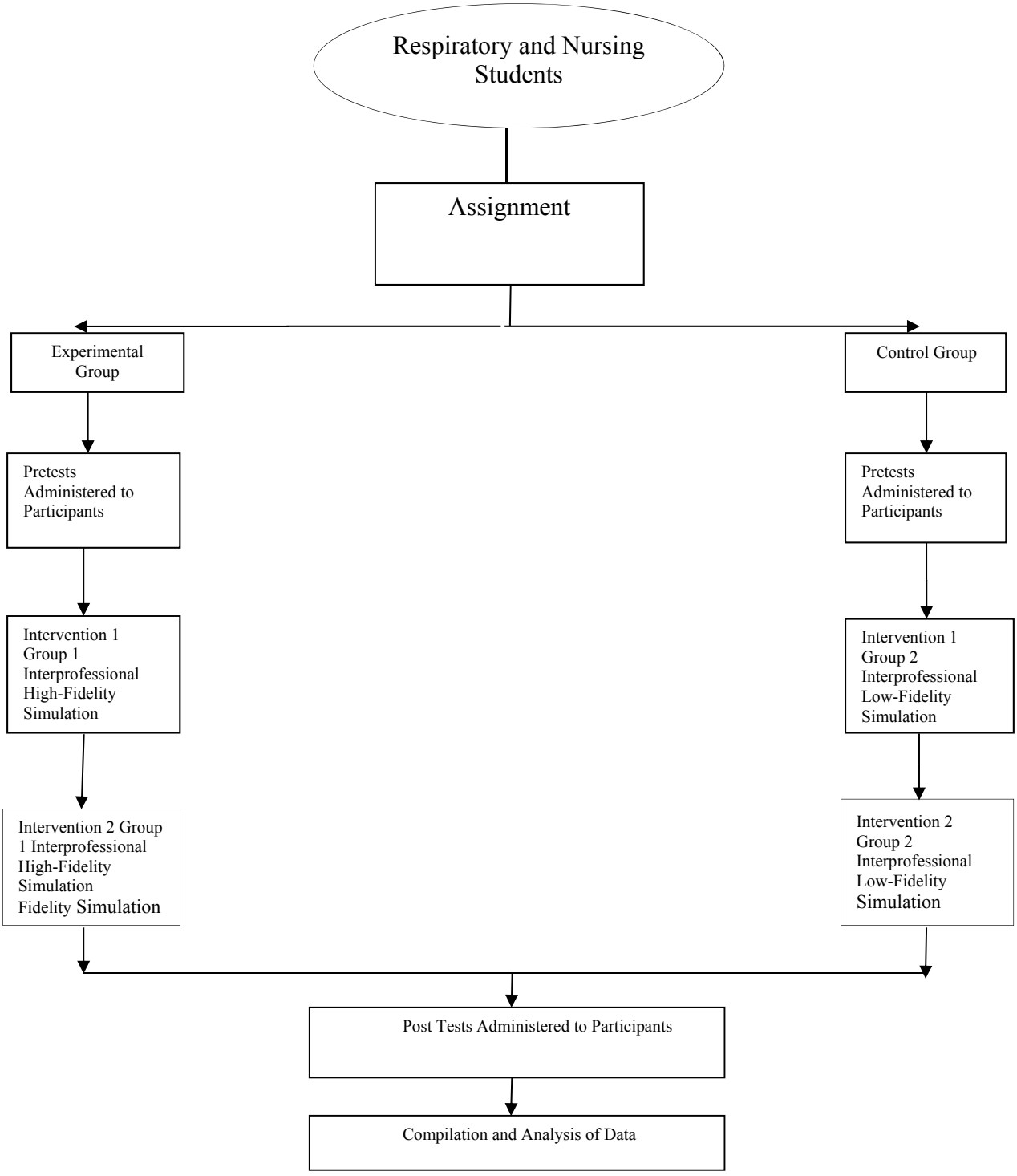

Figure 1. A representation of the study design designating groups, interventions, and measures.

The Web Center for Social Research Methods (2006) described a nonequivalent groups research design as the ability to use intact groups of participants that are thought to be similar as

the treatment and control groups of participants in order to compare the treated group fairly with the comparison group by the measurement of both groups pre- and post-treatment.

The associate degree-granting institution utilized for this study comprised a central administration with oversight of all curricular offerings of the college and 14 regional campuses offering various associate degree programs across the state. The nursing program offered by this institution held a single institutional accreditation for all campuses offering the nursing program; however, the campuses offering the respiratory care program, were all individually accredited. All regions of this institution offering nursing and respiratory care program shared a common curriculum for those programs, regardless of the region offering the program.

This study included students enrolled in nursing and respiratory care programs at a regional campus of an associate degree-level granting institution that utilized high-fidelity simulator manikins exclusively for the education of nurses as the experimental group. Students enrolled in similar nursing and respiratory care programs at a different regional campus of the same associate degree-granting institution, which utilized low-fidelity simulator manikin training within the curriculum, were designated as the control group.

Experimental Group Setting

Interprofessional simulation experiences for all experimental group participants in this study were high-fidelity patient simulations and were conducted at regional campus of a Midwestern community college associate degree-granting institution. Within the 250,000 square foot facility, two high-fidelity simulation laboratories previously utilized for nursing education, occupy approximately 800 square feet of educational space. An additional room designed for debriefing, which is the process of providing active feedback to students after the completion of a simulation experience, was also located in the nursing program instructional space. The two

simulation laboratories within the facility housed two Laerdal manikin-based adult simulators, one Laerdal pediatric simulator, and one Laerdal baby simulator. Additional equipment housed in the laboratory included four desktop computers, two wireless laptop computers, cameras for recording student simulation experience for subsequent review, if needed, and various additional patient monitoring equipment needed for continuous assessment of patient condition.

Previous activities encompassing high-fidelity simulation educational initiatives within this associate degree-granting institution had been limited to nursing students only who were enrolled in either the practical nursing or associate degree registered nursing programs. Respiratory care students of this regional campus, prior to participation in this study, had no previous interprofessional experiences in the nursing simulation laboratory. For the purposes of this study all experimental group interprofessional simulation experiences were conducted within this setting in one of two simulation laboratories operated and maintained by the nursing program faculty and central administration of the region and consisted of associate degree seeking nursing and respiratory care students only.

Control Group Setting

Interprofessional simulation experiences for all control group participants in this study were low-fidelity patient simulations and were conducted at an alternative campus of a Midwestern community college associate degree-granting institution. These low-fidelity simulation experiences were conducted in a health professions competency laboratory located in the nursing program area. Within the health professions competency laboratory, a 550 square foot facility included multiple low-fidelity manikins, partial and complex task trainers, four desktop computers, as well as other variable patient monitoring and assessment equipment. For

the purposes of this study, all control group interprofessional simulations were conducted in this setting and consisted of associate degree seeking nursing and respiratory care students only.

Population and Sample

The population for this study was second semester of instruction or beyond, community college students enrolled in associate degree nursing and respiratory care healthcare practitioner training programs at two campuses. The nursing and respiratory care programs offered by this institution were designed to provide students with the didactic and clinical preparation necessary to function as healthcare practitioners in their chosen field of study.

The entire curriculum of the nursing program within this institution could be completed in six semesters and incorporated four semesters of total program-level instruction but required that two semesters of specific prerequisite courses be successfully completed in previous semesters prior to formal application to the program through a competitive application process. Once students were formally accepted to the nursing program, the final four semesters of instruction combined the foundational components of professional discipline-specific theory with practical applications of theory in competency-based laboratory and in actual clinical environments. Participants engaged in this study from the nursing program had successfully completed three semesters of previous coursework and were in their fourth semester of instruction within the program. After successful completion of all didactic and clinical program requirements specific to each program, students receive an associate of science degree in nursing and are then eligible to take the NCLEX-RN examination.

The entire curriculum of the respiratory care program could be completed in seven semesters and incorporated five semesters of total program-level instruction but also required that two semesters of specific prerequisite courses be successfully completed in previous

semesters prior to formal application to the program through a competitive application process. Once students are formally accepted to the respiratory care program, the final five semesters of instruction combine the discipline-specific didactic theory with practical applications of theory in competency-based laboratory as well as in actual clinical environments. Participants engaged in this study from the respiratory care program had successfully completed four semesters of previous coursework and were in their fifth semester of instruction within the program. Upon successful completion of all didactic, laboratory, and clinical program requirements specific to the program, students receive an associate of science degree in respiratory care. Subsequently, students are then eligible to take the registered respiratory therapist examination.

Students from these particular disciplines were chosen due to the need to provide direct patient care in emergent and non-emergent care situations in the actual healthcare setting as members of an interprofessional team. Within the healthcare setting, the potential exists for significant benefit to patients who find themselves in need of emergent and non-emergent care if it is administered by practitioners appropriately trained in the practice of quickly and efficiently assessing patient conditions and acting quickly with the appropriate medical intervention and/or treatment.

Group Descriptions

Experimental Group

Experimental group participants engaged in this study were exposed to high-fidelity manikin-based simulation experiences. Student participants, currently enrolled in respiratory care and nursing programs, were prompted to engage in an interprofessional effort to assist the simulated patient by the institution of medically appropriate interventions designed to evaluate

interprofessional collaboration of the simulated patient from the inception of the simulation through the recovery process.

All participants in this group were administered the Interprofessional Self-Efficacy Assessment and Learning Outcomes Assessment Scale instruments as pre-treatment assessments of individual self-efficacy and perception of learning. Subsequent to participant completion of both pre-treatment assessments, students engaged in interprofessional high-fidelity simulation experiences. These experiences included exposure to interprofessional simulations with a Laerdal Sim Man manikin programmed with a patient care scenario which included the following patient conditions: (a) hypoxia, (b) tachypnea and/or apnea, (c) dyspnea, and/or respiratory distress, and (d) oxygen desaturation. Upon completion of the interprofessional experience a post-treatment administration of the Interprofessional Self-Efficacy Assessment and Learning Outcomes Assessment Scale instruments were administered, followed by a debriefing process of the entire interprofessional experience with all experimental group participants.

Control Group

Control group participants engaged in this study were exposed to low-fidelity simulation experiences. Such experiences incorporated the use of partial task trainers, role-playing, and standardized patients in order to provide an interprofessional experience to the participants. Student participants, currently enrolled in respiratory care and nursing programs, were prompted to engage in an interprofessional effort to assist the simulated patient by the institution of medically appropriate interventions designed to evaluate the interprofessional collaboration of the simulated patient from the inception of the simulation through the recovery process.

All participants in this group were also administered the Interprofessional Self-Efficacy Assessment and Learning Outcomes Assessment Scale instruments as pre-treatment assessments

of individual self-efficacy and perception of learning. Subsequent to participant completion of both pre-treatment assessments, students engaged in interprofessional low-fidelity simulation experiences. Student participants within low-fidelity simulation exposures were prompted to engage in a patient care scenario which consisted of the following conditions: (a) hypoxia, (b) tachypnea and/or apnea, (c) dyspnea and/or respiratory distress, and (d) oxygen desaturation. Subsequent to the completion of the interprofessional experience, a post-treatment administration of the Interprofessional Self-Efficacy Assessment and Learning Outcomes Assessment Scale instruments were administered, followed by a debriefing process of the entire interprofessional experience with all control group participants.

Recruitment

The initial step in the recruitment process of participants for this study began by obtaining the approval of the institutional review boards of both Indiana State University and the Midwestern community college associate degree-granting institution. After approval was obtained from both institutions, I then approached the deans of the schools of nursing and health sciences as well as the program directors of the respiratory care and nursing programs at the associate degree-granting institution to inquire regarding the participation of their students in this study.

I approached students enrolled in respiratory care and nursing programs and provided information regarding the nature of the study in overview format and inquired as to their interest in participating in the study using the Participant Introduction Script for Faculty form (Appendix A). Upon the establishment of participant interest I described this study in greater detail to each participant and asked each participant to review and complete the Consent to Participate in Research form (Appendix B) and the Demographic Survey form (Appendix C). Participant

confidentiality was assured through the process of identifying participants with a two to three digit random number. I maintained an electronic record of the identities of the participants for communication purposes during the process of data collection. The electronic record was only maintained until the data collection process was completed and was then destroyed.

Additional criteria utilized in the selection process included the following:

1. Participating students had garnered some previous exposure to the actual healthcare environment through clinical experiences acquired within their respective program curricula.
2. Participants possessed relative levels of knowledge within their respective disciplines.
3. Participants had previously engaged in experiences with other healthcare disciplines in a realistic setting and were therefore able to evaluate the interprofessional experiences through the lens of self-efficacy.
4. None of the participants had prior experience with the Interprofessional Self-Efficacy Assessment (ISEA) tool.

Instrumentation

Demographic Survey Form

This form was used to obtain demographic information about individual participants in this study. The form asked for student's age, gender, ethnicity, highest parental education level, program of study, previous healthcare experience, and previous high-fidelity simulation experience. The Demographic Survey can be found in Appendix C.

Interprofessional Self-Efficacy Assessment (ISEA)

The ISEA instrument, comprising 10 Likert-type questions and modified from Bandura's (2006) *Guide to Constructing Self-Efficacy Scales* was utilized to assess the effect of

interprofessional engagement of students in high-and low-fidelity simulations on student self-efficacy. This study utilized a pre- and post-assessment format for evaluation of self-efficacy. The ISEA instrument can be found in Appendix D.

Learning Outcomes Assessment Scale

The learning outcomes assessment scale utilized in this study was (a) modified from a study conducted by Christophel (1990); (b) developed by Richmond, Gorham, and McCrosky (1987); and (c) composed of 12 Likert-type questions. The Learning Outcomes Assessment Scale was utilized to assess interprofessional participant perceptions of cognitive learning. For the purposes of this study, I administered a pretreatment scale to assess the level of interprofessional perceptions of cognitive learning taking place in the respective program areas prior to engagement in high- or low-fidelity simulation. I subsequently administered a post-treatment scale to assess the level of interprofessional perceptions of cognitive learning that had taken place in the respective program areas after engagement in either high- or low-fidelity simulation. Reliability using this measure in previous research was reported with an alpha of .94 (Gorham, 1998). Reliability using this measure for this study was calculated, and resulted in an alpha of .90. The Learning Outcomes Assessment Scale may be found in Appendix E.

Analysis

I administered the ISEA and the Learning Outcomes Assessment Scale instruments to all participants prior to engagement in any interprofessional simulation experiences. Administration of these two instruments prior to the application of the treatment of high- or low-fidelity simulation assisted me with the establishment of baseline statistical data. Subsequent administration of the aforementioned instruments as a post-test assessment tool assisted me with

the acquisition of statistical data to be used for the comparison of pre-treatment and post-treatment differences and additional analysis.

For the purposes of this study I used participant years of experience in healthcare and previous years of high-fidelity simulation experience derived from the Demographic Survey form to serve as covariates for comparison of mean differences in pre- and post-self-efficacy and learning outcomes for the two groups. Other demographic data derived from the Demographic Survey form was utilized to describe the sample more fully. I performed a power analysis with an anticipated effect size of 0.5 for the purpose of calculating an a-priori sample size for this study. This analysis resulted in a recommended minimum total sample size of 128 participants for a two-tailed hypothesis. Additionally, I used analysis of covariance (ANCOVA) measures to evaluate the between subjects relationships of the study's participants.

Summary

This study utilized two groups of participants within its quasi-experimental design, a control group of nursing and respiratory care students from one campus of a Midwestern community college associate degree-granting institution and an experimental group of nursing and respiratory care students from another campus of a Midwestern community college associate degree-granting institution. In order to assure relative balance between the two student populations being studied, I limited the number of nursing students, as the nursing programs are larger in terms of enrollment than the other program within this study.

The participants in the study, within the experimental group, engaged in interprofessional high-fidelity simulation experiences that were recorded for subsequent viewing and debriefing. Additionally, these participants were provided with and asked to complete the ISEA and the Learning Outcomes Assessment instruments, which I used for data analysis.

Participants in this study within the control group engaged in interprofessional low-fidelity simulation experiences that were recorded for subsequent viewing and debriefing. Control group participants were provided with and asked to complete the ISEA and the Learning Outcomes Assessment instruments, which I utilized for data analysis.

Analysis of my data and any subsequent findings were utilized to evaluate the potential relationship between student self-efficacy/perception of cognitive learning outcomes and the use of high- or low-fidelity simulation within an interprofessional healthcare environment within an associate degree-granting institutional of higher education.

Chapter 4

PRESENTATION AND ANALYSIS OF THE DATA

The purpose of this study was to compare student self-efficacy and perceived learning outcomes of associate degree nursing and respiratory care students when exposed to either high-fidelity interprofessional simulation or to traditional low-fidelity interprofessional simulation. This chapter presents a description of the data collected in this study and also shows the results of statistical analysis of the data. All data were analyzed utilizing IBM (PASW) Statistical Package for Social Sciences software, Version 20.

Population and Sample

The population of this study was second semester or beyond associate degree nursing and respiratory care students in their respective degree granting programs. Additionally, these students possessed the necessary base of knowledge related to patient assessment within their respective programs of study, which was necessary for effective engagement with student practitioners outside of their chosen courses of study.

Recruitment efforts began with an extended personal invitation to associate degree-seeking nursing and respiratory care students enrolled in two regional campuses of a Midwestern community college system. The total number of invitations extended was 75 after the completion of all initial recruitment processes, which resulted in the acquisition of informed consent from 75 participants. Participants were subsequently designated into treatment groups of

nursing and respiratory care students at each campus. A group of nursing and respiratory care students from one regional campus was then designated as the high-fidelity experimental group, and the second group of nursing and respiratory care students from a different regional campus was designated as the low-fidelity control group.

The composition of the experimental group included 25 associate degree-seeking nursing students and 27 associate degree-seeking respiratory care students. All students within this group participated fully in all activities associated with this study. The final *n* for the high-fidelity simulation experimental group was 52. The composition of the control group consisted of 14 associate degree-seeking nursing students and nine associate degree-seeking respiratory care students. All students within this group participated fully in all activities associated with this study. The final *n* for the control group of associate degree-seeking nursing and respiratory care students was 23. The combined *n* for this study was 75 and included 36 respiratory care students (48%) and 39 nursing students (52%).

A pretest was administered to the low- and high-fidelity groups to assess the level of individual self-efficacy prior to engagement in the study. The pretest was the ISEA**.** The mean score for the low-fidelity control group was 69.7 (*SD* = 16.1) with scores ranging from 15 to 93. The mean score for the high-fidelity experimental group was 64.6 (*SD* = 13.8), with scores ranging from 34 to 90. The difference between the two groups was not significant ($F = .025$, $df = 1,73$, $p = .163$), two-tailed. Data obtained from this pretest were also utilized to assess the level of individual self-efficacy between the respiratory care and nursing students engaged in this study. The mean score for the respiratory care student group (high- and low-fidelity) was 71.5 (*SD* = 11.7) with scores ranging from 47 to 93. The mean score for the nursing student group

(high- and low-fidelity) was 61.3 (*SD* = 15.4) with scores ranging from 26 to 116. The difference between the two groups was significant (*F* = 3.193, *df* = 1,73, *p* = .002), two-tailed.

Each group was also administered a second pretest designed to assess the level of the perception of learning occurring in their specific programs related to working on an interprofessional basis with other practitioners prior to engagement in the study. The pretest was the Learning Outcomes Assessment Scale pretest. The mean score for the low-fidelity control group was 77.6 (*SD* = 20.3), with scores ranging from 27 to 116. The mean score for the high-fidelity experimental group was 73.9 (*SD* = 18.9), with scores ranging from 26 to 106. The difference between the two groups was not significant (*F* = .054, *df* = 1,73, *p* = .448), two-tailed. These data were also utilized to assess the level of the perception of learning between the respiratory care and nursing students engaged in this study. The mean score for the respiratory care student group was 81.1 (*SD* = 18.1) with scores ranging from 27 to 106. The mean score for the nursing student group was 69.3 (*SD* = 18.8) with scores ranging from 26 to 116. The difference between the two groups was significant (*F* = .012, *df* = 1,73, *p* = .007), two-tailed.

Descriptive Data

Descriptive data were obtained from the Demographic Survey form. This survey was administered to all participants prior to the inception of the study.

Age

Representations of the entire sample group consisted of a mean age of 33.5 (*SD* = 8.17) with an age range of 21 to 55. The median age for the entire sample group was 33. The low-fidelity simulation control group consisted of 23 participants with a mean age of 34.2 (*SD* = 9.42), with an age range of 23 to 55 years. The median age for the low-fidelity group was 33 years. The high-fidelity simulation experimental group consisted of participants with a mean age

of 33.13 (*SD* = 7.63), p=.05, two-tailed with an age range of 21 to 47 years. The median age for the high-fidelity group was 34 years. Means of participant ages for both groups is presented in Table 1.

Table 1

Participant Age

	Control Group / Low-Fidelity		Treatment Group / High-Fidelity	
Age	Nursing Students	Respiratory Care Students	Nursing Students	Respiratory Care Students
Number of Participants	14	9	25	27
Age Mean	33.0	36.3	32.2	34.0
Age SD	9.9	9.9	7.9	7.3

Gender

The entire sample group comprised 50 women (66.7%) and 25 men (33.3%). The low-fidelity control group comprised of 19 women (82.6%) and 4 men (17.4%) and the high-fidelity experimental group comprised 31 women (59.6%) and 21 men (40.4%). Gender specific demographic data for both groups is presented in Table 2.

Table 2

Participant Gender

	Control Group / Low-Fidelity		Treatment Group / High-Fidelity	
Gender	Respiratory Care Students	Nursing Students	Respiratory Care Students	Nursing Students
Male	2	2	6	15
Female	12	7	19	12

Ethnicity

The entire sample group consisted of 64 European-Americans (85.3%), two African-Americans (2.7%), one East Asian (1.3%), one South Asian (1.3%), two Hispanic or Latinos (2.7%), three participants of multiracial origin (4%), and two participants who chose not to answer (2.7%). A representation of the demographic data collected, according to group assignment and ethnicity is presented in Table 3.

Table 3

Participant Ethnicity

	Control Group / Low-Fidelity		Treatment Group / High-Fidelity	
Ethnicity	Respiratory Care Students	Nursing Students	Respiratory Care Students	Nursing Students
Eastern European	13	8	21	22
African American	0	0	1	1
East-Asian American	0	0	1	0
South Asian	0	0	1	0
Hispanic or Latino American	1	0	0	1
Multi-Racial	0	0	1	2
Prefer Not to Answer	0	1	0	1

The low-fidelity simulation control group comprised 21 European-Americans (91.3%), one participant of Hispanic or Latino descent (4.3%), and one participant who chose not to answer (4.3%). The high-fidelity simulation control group comprised 43 European-Americans (82.7%), two African Americans (3.9%), one East Asian (1.9%), one South Asian (1.9%), one

Hispanic or Latino (1.9%), three participants of multiracial descent (5.7%), and one participant who chose not to answer (1.9%).

Participant GPA

The mean GPA for the entire sample group was 3.435 (*SD* = .379), with a range of 2.452 to 4.00 and a median GPA of 3.536. The mean GPA for the low-fidelity simulation group was 3.133 (*SD* = .411), with a range 2.450 to 3.810 and a median GPA of 3.119. The mean GPA for the high-fidelity simulation group was 3.568 (*SD* = .273), with a range of 2.742 to 4.000 and a median GPA of 3.614. A representation of mean GPA for both groups is presented in Table 4.

Table 4

Participant GPA

	Low-Fidelity/ Control Group	High-Fidelity/ Experimental Group
GPA		
Mean	3.13	3.57
SD	.411	.273

Parental Educational Level

The entire sample group (*n* = 75) comprised four participants whose highest level of parental education was some high school (5.3%), 17 whose parents completed high school (22.7%), 19 whose parents started but did not complete college (25.3%), nine whose parents who completed an associate degree (12%), 17 whose parents completed a baccalaureate (22.7%), and nine whose parents completed a graduate degree (12%).

The low-fidelity simulation control group comprised two participants whose highest level of parental education was some high school (8.7%), five whose parents completed high school

(21.7%), seven whose parents started but did not complete college (30.4%), four whose parents completed an associate degree (17.4%), three whose parents completed a baccalaureate degree (13%), and two whose parents completed a graduate degree (8.7%). The mean value for the highest level of parental education for the low-fidelity simulation control group was 3.30 (*SD* = 1.42).

The high-fidelity simulation experimental group comprised two participants whose highest level of parental education was some high school (3.9%), 12 whose parents completed high school (23.5%), 12 whose parents who started but did not complete college (23.5%), five whose parents completed an associate degree (9.8%), 14 whose parents completed a baccalaureate degree (27%), and seven whose parents completed a graduate degree (13.7%). The mean value for the highest level of parental education for the high-fidelity simulation experimental group was 3.73 (*SD* = 1.51). A representation of the parental education level for all participants is presented in Table 5.

Table 5

Participant Parental Education Level

	Control Group / Low-Fidelity		Treatment Group / High-Fidelity	
Parental Education Level	Nursing Students	Respiratory Care Students	Nursing Students	Respiratory Care Students
Some High School	2	0	1	1
High School	3	2	6	6
Some College	2	5	3	9
Associate Degree	4	0	2	3
Bachelor's Degree	1	2	9	5
Graduate Degree	2	0	4	3

Previous Healthcare Experience

The entire sample group consisted of 29 participants (38.7%) who possessed previous healthcare experience and 46 participants (61.3%) who did not possess any previous healthcare experience. Out of the 29 participants who possessed previous experience, 15 of these participants (51.7%) had less than one year of experience, and 14 of these participants (48.2%) had greater than three years of experience in healthcare prior to engagement in this study. For the purposes of this study, prior healthcare experience was defined as engagement in employment activities for which compensation was received.

The low-fidelity simulation control group (n = 23) consisted of 13 participants (56.5%) who possessed prior healthcare experience prior to engagement in this study. Out of the 13 participants possessing prior experience, the duration of previous experience was less than three years for seven participants (53.8%) and greater than three years for six participants (46.1%).

The previous healthcare-related positions held by these participants included medical coder, pharmacy technician, phlebotomist, patient transporter, and licensed practical nurse.

The high-fidelity simulation experimental group (n = 52) consisted of 16 participants (30.7%) who possessed prior healthcare experience prior to engagement in this study. Out of the 16 participants possessing prior experience, the duration of previous experience was less than three years for eight participants (50%) and greater than three years for eight participants (50%). The previous healthcare-related positions held by these participants included emergency department support staff, biofeedback technician, paramedic, medical lab technician, hospital employee assistance staff, certified nursing assistant, infection control staff, dialysis tech, and certified surgical technologist. A representation of previous healthcare experience for all participants, according to group assignment is presented in Table 6.

Table 6

Participant Previous Healthcare Experience

	Control Group / Low-Fidelity		Treatment Group / High-Fidelity	
Previous Healthcare Experience	Respiratory Care Students	Nursing Students	Respiratory Care Students	Nursing Students
Yes	12	1	5	11
No	2	8	20	16

Previous High-Fidelity Experience

The entire sample group consisted of 36 participants (48%) who possessed previous experience with high-fidelity manikin-based simulation and 39 participants (52%) who did not possess previous experience with high-fidelity manikin-based simulation. Out of the 36

participants possessing previous experience, 36 of these participants (100%) had less than 10 hours of experience and zero participants (0.0%) had greater than 10 hours of previous experience with a high-fidelity manikin prior to this study.

The low-fidelity control group (n = 23) consisted of eight participants (34.7%) who possessed prior high-fidelity simulation experience prior to engagement in this study. I acknowledged this finding as potential data contamination, as I had not anticipated that any participant in the low-fidelity group would have possessed any previous high-fidelity experience. Out of the eight participants possessing prior experience within this group, the duration of previous experience was less than 10 hours for eight participants (100.%) and greater than 10 hours for zero participants (0.0%), no participants possessed more than 10 hours of previous high-fidelity experience.

The high-fidelity experimental group (n = 52) consisted of 28 participants (53.8%) who possessed prior high-fidelity simulation experience prior to engagement in this study. Out of the 28 participants possessing prior experience, the duration of previous experience was less than 10 hours for 28 participants (100%) and greater than 10 hours for zero participants (0.0%), no participants possessed more than 10 hours of previous high-fidelity experience. A representation of previous healthcare experience for all participants, according to group assignment is presented in Table 7.

Table 7

Participant Previous High-Fidelity Experience

	Control Group / Low-Fidelity		Treatment Group / High-Fidelity	
Previous High-Fidelity Experience	Respiratory Care Students	Nursing Students	Respiratory Care Students	Nursing Students
Yes	7	1	24	4
No	7	8	1	23

Major Findings

Research Question 1

The first research question stated, Were there differences in student self-efficacy in a high-fidelity versus low-fidelity interprofessional associate degree-level healthcare practitioner manikin-based simulation learning environment for nursing and respiratory care students?

This research question was tested by utilizing the ISEA instrument with a pre- and post-treatment analysis. Previous healthcare experience and previous high-fidelity experience were utilized as covariates for this analysis. Prior to conducting ANCOVA measures, I tested the homogeneity of regression (slopes) assumption in order to determine the interaction between the covariates and the independent variables. Findings from this test of interaction between the covariate previous healthcare experience and the independent variable pre-treatment self-efficacy were not significant, $F(11, 25) = .585$, $p = .823$, meaning that the assumption of homogeneity of variance had been met. A second test of interaction was performed to assess the level of interaction between the covariate previous high-fidelity experience and the independent variable

pre-treatment self-efficacy. Findings from this test of interaction were not significant, $F(13, 23) = 1.498$, $p = .192$, affirming that the homogeneity of variance assumption had been met.

Analysis by Participant Type

ANCOVA measures were conducted for this study with a pre- and post- assessment. The dependent variable for this analysis was participant type and included two levels: high-fidelity and low-fidelity participants. The independent variable for the pre-treatment analysis was pre-treatment self-efficacy, and the covariates for this analysis were previous healthcare experience and previous high-fidelity experience. The ANCOVA for the pre-treatment analysis was not significant, $F(1, 36) = .976$, $p = .529$. However, only 3% ($w2 = .03$) of the total variance in pre-treatment self-efficacy was accounted for by participant type controlling for the effect of previous healthcare experience and previous high-fidelity experience. For the purposes of this study, participant type was defined as either high or low-fidelity. ANCOVA data of pre-treatment self-efficacy by participant type are presented in Table 8.

Table 8

ANCOVA Summary of Pre Treatment Self-Efficacy by Participant Type

Source	Sum of Squares	*df*	Mean Square	*F*
Previous Health Experience	.401	1	.401	1.942
Previous High-Fidelity Experience	.002	1	.002	.011
Error	7.436	36	.207	

Note: R Squared = .534, Adjusted R Squared = .042, Computed using alpha <= .05

An ANCOVA was also conducted post-treatment to assess the effect of the treatment on participant self-efficacy. The dependent variable for this analysis was participant type and included two levels: high-fidelity and low-fidelity participants. The independent variable for the

post-treatment analysis was post-treatment self-efficacy, and the covariates for this analysis were previous healthcare experience and previous high-fidelity experience. The ANCOVA for the post-treatment analysis was not significant, $F(1, 35) = 1.262$, $p = .246$. However, 54% ($w2 = .542$) of the total variance in post-treatment self-efficacy was accounted for by participant type, controlling for the effect of previous healthcare experience and previous high-fidelity experience. ANCOVA data of post-treatment self-efficacy by participant type are presented in Table 9.

Table 9

ANCOVA Summary of Post Treatment Self-Efficacy by Participant Type

Source	Sum of Squares	*df*	Mean Square	*F*
Previous Health Experience	.698	1	.698	3.878
Previous High-Fidelity Experience	.040	1	.040	.222
Error	6.295	35	.180	

Note: R Squared = .605, Adjusted R Squared = .165, Computed using alpha = .05

Analysis by Student Type

Additional ANCOVA measures were conducted with a pre- and post-treatment assessment to test the effects of the application of the treatment on nursing and respiratory care students, by course of study specifically. The dependent variable for the pre-treatment analysis was student type and included two levels: nursing and respiratory care participants. The independent variable for this analysis was pre-treatment self-efficacy, and the covariates were previous healthcare experience and previous high-fidelity experience. The ANCOVA for the pre-treatment analysis was not significant, $F(1, 36) = 1.609$, $p = .079$. However, 12% ($w2 = .119$) of the total variance in pre-treatment self-efficacy was accounted for by student type when controlling for the effects of previous healthcare experience and previous high-fidelity

experience. For the purposes of this study, student type was defined as either a respiratory care or nursing student. ANCOVA data of pre-treatment self-efficacy by student type are presented in Table 10.

Table 10

ANCOVA Summary of Pre Treatment Self-Efficacy by Student Type

Source	Sum of Squares	*df*	Mean Square	*F*
Previous Health Experience	1.010	1	1.010	9.668
Previous High-Fidelity Experience	4.045	1	4.045	38.713
Error	3.762	36	.104	

Note: R Squared = .799, Adjusted R Squared = .587, Computed using alpha = .05

Subsequently, an ANCOVA was conducted post-treatment to assess the effect of the treatment on participant self-efficacy by course of study. The dependent variable for the post-treatment analysis was student type and included two levels: nursing and respiratory care participants. The independent variable for this analysis was post-treatment self-efficacy, and the covariates were previous healthcare experience and previous high-fidelity experience. The ANCOVA for the post-treatment analysis was not significant, $F(1, 35) = .773$, $p = .779$. However, 49% ($w2 = .049$) of the total variance in post-treatment self-efficacy was accounted for by student type controlling for the effect of previous healthcare experience and previous high-fidelity experience. ANCOVA data of post-treatment self-efficacy by student type are presented in Table 11.

Table 11

ANCOVA Summary of Post Treatment Self-Efficacy by Student Type

Source	Sum of Squares	*df*	Mean Square	*F*
Previous Health Experience	.741	1	.741	4.805
Previous High-Fidelity Experience	2.377	1	2.377	15.406
Error	5.400	35	.154	

Note: R Squared = .713, Adjusted R Squared = .390, Computed using alpha = .05

Research Question 2

The second research question stated, Were there differences in student learning outcomes in a high-fidelity versus low-fidelity interprofessional associate degree-level healthcare practitioner manikin-based simulation environment for nursing and respiratory care students?

This research question was tested by utilizing the Learning Outcomes Assessment Scale Instrument in a pre- and post-treatment analysis. Previous healthcare experience and previous high-fidelity experience were utilized as covariates for this analysis. Prior to conducting ANCOVA measures, I tested the homogeneity of regression assumption in order to determine the interaction between the covariates and the independent variables. Pre and post analyses were conducted, which considered the independent variable of Learning Outcomes. Findings from this test of interaction between the covariate previous healthcare experience and the independent variable, pre-treatment learning outcomes, were not significant, $F(46, 26) = .787$, $p = .766$, meaning that the assumption of homogeneity of variance has been met. A second test of interaction was performed to assess the level of interaction between the covariate previous high-fidelity experience and the independent variable pre-treatment learning outcomes. Findings from

this test of interaction were not significant, $F(46, 26) = .832$, $p = .713$, also meaning that the homogeneity of variance assumption had been met.

Analysis by Participant Type

An ANCOVA was conducted for this study with a pre and post assessment. The dependent variable for the pretreatment analysis was participant type, and included two levels: high-fidelity and low-fidelity participants. The independent variable for this analysis was pre-treatment learning outcomes, and the covariates were previous healthcare experience and previous high-fidelity experience. The ANCOVA for the pre-treatment analysis was not significant, $F(1, 26) = .803$, p = .747. However, 52% (w 2 = .522) of the total variance in pre-treatment learning outcomes was accounted for by participant type controlling for the effect of previous healthcare experience and previous high-fidelity experience. For the purposes of this study participant type was defined as either high or low-fidelity. ANCOVA data of pre-treatment learning outcomes by participant type are presented in Table 12.

Table 12

ANCOVA Summary of Pre Treatment Learning Outcomes by Participant Type

Source	Sum of Squares	*df*	Mean Square	*F*
Previous Health Experience	.000	1	.000	.098
Previous High-Fidelity Experience	.095	1	.095	.319
Error	6.069	26	.233	

Note: R Squared = .619, Adjusted R Squared = .083, Computed using alpha = .05

A post-treatment ANCOVA was also conducted to assess the effect of the treatment on participant learning outcomes. The dependent variable for the post-treatment analysis was participant type, and included two levels: high-fidelity and low-fidelity participants. The

independent variable for this analysis was post-treatment learning outcomes and the covariates were previous healthcare experience and previous high-fidelity experience. The ANCOVA for the post-treatment analysis was not significant, $F(1, 31) = .1.310$, $p = .219$. However, 74% of the total variance in post-treatment learning outcomes was accounted for by participant type controlling for the effect of previous healthcare experience and previous high-fidelity experience. ANCOVA data of post-treatment learning outcomes by participant type are presented in Table 13.

Table 13

ANCOVA Summary of Post Treatment Learning Outcomes by Participant Type

Source	Sum of Squares	*df*	Mean Square	*F*
Previous Health Experience	2.123	1	2.123	12.242
Previous High-Fidelity Experience	.072	1	.072	.418
Error	5.377	31	.173	

Note: R Squared = .663, Adjusted R Squared = .195, Computed using alpha = .05

Analysis by Student Type

Additional ANCOVA measures were conducted with a pre- and post-treatment assessment to test the effects of the application of the treatment on nursing and respiratory care student learning outcomes, by course of study specifically. The dependent variable for the post-treatment analysis was student type and included two levels: nursing students and respiratory care participants. The independent variable for this analysis was pre- treatment learning outcomes and the covariates were previous healthcare experience and previous high-fidelity experience. The ANCOVA for the pre-treatment analysis was not significant, $F(1, 26) = 1.097$, $p = .408$. However, only 19% ($w2 = .193$) of the total variance in pre-treatment learning

outcomes was accounted for by student type, controlling for the effects of previous healthcare experience and previous high-fidelity experience. For the purposes of this study, student type was defined as either a respiratory care or nursing student. ANCOVA data of pre-treatment learning outcomes by student type are presented in Table 14.

Table 14

ANCOVA Summary of Pre Treatment Learning Outcomes by Student Type

Source	Sum of Squares	*df*	Mean Square	*F*
Previous Health Experience	.061	1	.061	.478
Previous High-Fidelity Experience	3.826	1	3.826	29.815
Error	3.337	26	.128	

Note: R Squared = .822, Adjusted R Squared = .493, Computed using alpha =.05

Subsequent ANCOVA measures were conducted post-treatment to assess the effect of the treatment on participant learning outcomes. The dependent variable for the post-treatment analysis was student type and included two levels: nursing and respiratory care participants. The independent variable for this analysis was post-treatment learning outcomes, and the covariates were previous healthcare experience and previous high-fidelity experience. The ANCOVA for the post-treatment analysis was not significant, $F(1, 31) = .914$, $p = .611$. However, 24% (w 2 = .237) of the total variance in post-treatment learning outcomes was accounted for by student type, controlling for the effect of previous healthcare experience and previous high-fidelity experience. ANCOVA data of post-treatment learning outcomes by student type are presented in Table 15.

Table 15

ANCOVA Summary of Post Treatment Learning Outcomes by Student Type

Source	Sum of Squares	*df*	Mean Square	*F*
Previous Health Experience	1.486	1	1.486	10.369
Previous High-Fidelity Experience	2.000	1	2.000	13.950
Error	4.444	31	.143	

Note: R Squared = .763, Adjusted R Squared = -.433, Computed using alpha = .05

Ancillary Findings

The ISEA indicated that the low-fidelity control group began with a slightly higher degree of individual self-efficacy than the high-fidelity experimental group, although not statistically significant. The mean score for the low-fidelity control group was 69.7 (*SD* = 16.1), and the mean score for the high-fidelity experimental group was 64.6 (*SD* = 13.8). The advantage in self-efficacy for the low-fidelity group continued on the post-assessment. The mean score for the low-fidelity group was 77.3 (*SD* = 16.4), and the mean score for the high-fidelity group was 73.0 (*SD* = 12.9). There were no statistically significant differences in self-efficacy between the two groups after completion of the post-assessment, $t(73) = -1.253$, $p = .214$ (two-tailed). Comparison of mean scores of pre- and post-self-efficacy by participant type are presented in Table 16.

Table 16

Comparison of Pre and Post Means of Self-Efficacy by Participant Type

Pre and Post Self-Efficacy	High or Low Fidelity	*N*	Mean	SD
	High Fidelity	52	64.615	13.762
Pre Self-Efficacy	Low Fidelity	23	69.739	16.096
Post Self-Efficacy	High Fidelity	52	72.942	12.877
	Low Fidelity	23	77.945	16.413

Analysis of Means by Participant Type

The Learning Outcomes Assessment Scale indicated that the low-fidelity control group began with a slightly higher degree of previous learning occurring in current courses than the high-fidelity experimental group, although not statistically significant. The mean score for the low-fidelity control group was 77.6 (*SD* = 20.3) and the mean score for the high-fidelity experimental group was 73.9 (*SD* = 18.9). The advantage in the learning outcomes assessment favored the low-fidelity group on the post-assessment. The mean score for the low-fidelity group was 88.1 (*SD* = 22.7), and the mean score for the high-fidelity group was 85.0 (*SD* = 18.0). There were no statistically significant difference in self-efficacy between the two groups after completion of the post-assessment, $t(73) = -.647$, $p = .519$ (two-tailed). Comparison of mean scores of pre- and post-learning outcomes by participant type are presented in Table 17.

Table 17

Comparison of Pre and Post Means of Learning Outcomes by Participant Type

Pre and Post Learning Outcomes	High Or Low Fidelity	*N*	Mean	SD
	High Fidelity	52	73.865	18.910
Pre Learning Outcomes	Low Fidelity	23	77.565	20.337
Post Learning Outcomes	High Fidelity	52	84.961	18.0
	Low Fidelity	23	88.130	22.7

Analysis of Means by Student Type

The ISEA indicated that the respiratory care students began with a slightly higher degree of individual self-efficacy than the nursing students overall. The mean score for the respiratory care student group was 71.4 (*SD* = 11.7), and the mean score for the nursing student group was 61.1 (*SD* = 13.8). The advantage in self-efficacy for the respiratory care student group continued on the post-assessment. The mean score for the respiratory care student group was 79.3 (*SD* = 11.5), and the mean score for the nursing student group was 69.7 (*SD* = 14.8). There was a significant statistical difference in self-efficacy between the two groups after completion of the post-assessment, $t(73) = 3.091$, $p = .003$ (two-tailed). Comparison of mean scores of pre- and post-self-efficacy by student type are presented in Table 18.

Table 18

Comparison of Pre and Post Means of Self-Efficacy by Student Type

Pre and Post Self-Efficacy	Nursing or Respiratory	*N*	Mean	SD
Pre Self-Efficacy	Respiratory Student	36	71.472	11.680
	Nursing Student	39	61.307	15.449
Post Self-Efficacy	Respiratory Student	36	79.250	11.532
	Nursing Student	39	69.717	14.812

The Learning Outcomes Assessment Scale indicated that the respiratory care students began with a slightly higher degree of previous learning occurring in current courses than the nursing students overall. The mean score for the respiratory care student group was 81.1 (*SD* = 18.1), and the mean score for the nursing student group was 69.3 (*SD* = 18.9). The advantage in the learning outcomes assessment also favored the respiratory care student group on the post-assessment. The mean score for the respiratory care student group was 86.9 (*SD* = 24.1), and the mean score for the nursing student group was 85.0 (*SD* = 14.1). There were no statistically significant difference in learning outcomes between the two groups after completion of the post-assessment, $t(73) = .442$, $p = .660$ (two-tailed). These findings aligned with the post-assessment ANCOVA measures performed between these groups, which were not significant ($p = .682$). Comparison of means scores of pre- and post-learning outcomes by student type are presented in Table 19.

Table 19

Comparison of Pre and Post Means of Learning Outcomes by Student Type

Pre and Post Learning Outcomes	Nursing or Respiratory	*N*	Mean	SD
Pre Learning Outcomes	Respiratory Student	36	81.138	18.095
	Nursing Student	39	69.333	18.839
Post Learning Outcomes	Respiratory Student	36	87.972	24.126
	Nursing Student	39	85.974	14.141

Summary of the Findings

This study incorporated the participation of 75 students and sought to evaluate the effects, if any, on student self-efficacy and learning outcomes when participants were subjected to the treatment of either high-fidelity or low-fidelity interprofessional simulation. All subjects were designated into two treatment groups consisting of either high-fidelity (experimental group) or low-fidelity (control group). A secondary designation of the two treatment groups was formulated by the participant's specific course of study, respiratory care or nursing. All analyses were conducted utilizing both pre- and post-assessment instruments.

The first research question contained two components. This question first examined differences in self-efficacy between high- and low-fidelity participants and found no significant differences between these two groups on pre- or post-assessment, $p = .529$ and $p = .246$ respectively. The second component of this research question sought to examine differences in student self-efficacy between respiratory care students and nursing students participating in this study, and found no significant differences between these two groups on pre- or post-assessment, $p = .079$ and $p = .779$ respectively.

The second research question also contained two components. The first question examined differences in learning outcomes between high- and low-fidelity participants, and found no significant differences between these two groups on pre or post-assessment, $p = .747$ and $p = .219$ respectively. The second component of this research question sought to examine differences in learning outcomes between respiratory care students and nursing students participating in this study and found no significant differences between these two groups on pre or post-assessment, $p = .408$ and $p = .611$ respectively.

Additional analyses were performed that contained two components and examined mean differences in pre- and post-assessment self-efficacy and pre- and post-assessment of learning outcomes between high- and low-fidelity participants and between respiratory care and nursing students.

The evaluation of mean differences of pre- and post self-efficacy for the high- and low-fidelity groups found no significant mean differences between the two groups, $p = .214$ and $p = 341$ respectively, two-tailed. However, evaluation of pre-treatment self-efficacy between respiratory care students and nursing students favored the respiratory care student group and were significant, $p = .002$, two-tailed.

Evaluation of pre and post mean differences in learning outcomes for the high and low-fidelity group were not significant, $p = .448$ and $p = .519$ respectively, two-tailed. Subsequent evaluation of mean differences in learning outcomes between respiratory care and nursing students were not significant, $p = .007$ and $p = .660$ respectively, two-tailed.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this chapter is to present a summary of the work and the my conclusions. This chapter will summarize the study's methods, limitations, implications, and provide recommendations for future research on the subject matter.

Purpose

The purpose of this study was to determine if the interprofessional use of high-fidelity manikin-based simulation had an effect on student self-efficacy and perceived learning outcomes when compared to the use of low-fidelity manikin-based simulation in an interprofessional learning environment.

Population and Sample

The intended population for this study was associate degree-seeking community college respiratory care and nursing students in at least the second semester of instruction within their specific programs of study. A convenience sample of 75 students participated in this study, which consisted of both respiratory care and nursing students enrolled at each institution. Students at each institution were subsequently placed in either a high-fidelity experimental group or a low-fidelity control group, based on institutional ability to provide either high-fidelity or low-fidelity simulation. The final *n* for the high-fidelity group was 52 and included 27

respiratory care students and 25 nursing students. The final *n* for the low-fidelity group was 23 and consisted of nine respiratory care students and 14 nursing students.

Methods

This study was a quasi-experimental, non-equivalent groups, pre-and post-assessment design. Participants were recruited from two regional campuses of a Midwestern community college system offering associate degree programs in nursing and respiratory care. The intervention utilized in this study was the type of simulation provided to the participants for interprofessional engagement of high- and low-fidelity associate degree nursing and respiratory care students.

Prior to the administration of the treatment two pretests were administered to all subjects; the first of these being the ISEA and the second being the Learning Outcomes Assessment Scale (Appendices E and F respectively). The pre-test mean scores for self-efficacy and learning outcomes were calculated for each participant and subsequently compiled to produce an overall pre-test mean score for each group. Participants then engaged in either high- or low-fidelity simulation exercises within their respective institutions.

The high-fidelity experimental group participated in interprofessional simulation exercises with the high-fidelity manikin, which required interprofessional collaboration in order to provide a medical intervention for the treatment of a distressed patient (Appendix D). Conversely, the low-fidelity control group participated in similar interprofessional simulation exercises but utilized partial task trainers, role playing, and standardized patients to provide an interprofessional medical intervention for the treatment of a distressed patient (Appendix D).

Subsequent to the completion of interprofessional high- and low-fidelity simulation exercises for both groups, two post tests were administered to all participants, the first of these

being the ISEA and the second being the Learning Outcomes Assessment Scale (Appendices G and H respectively). The post-treatment mean scores for self-efficacy and learning outcomes were calculated for each participant and subsequently compiled to produce an overall post-test mean score for each group. Data acquired from the administration and collection of the pre and post-tests of self-efficacy and learning outcomes of both groups were then utilized to assess differences between groups in terms of high- and low-fidelity groups as well as between respiratory care and nursing students.

Two research questions guided this study:

Research Question 1

Were there differences in student self-efficacy in a high-fidelity versus low-fidelity interprofessional associate degree-level healthcare practitioner manikin-based simulation learning environment for nursing and respiratory care students?

Research Question 2

Were there differences in student learning outcomes in a high-fidelity versus low-fidelity interprofessional associate degree-level healthcare practitioner manikin-based simulation environment for nursing and respiratory care students?

Results from this study indicated that no statistically significant differences were present between the low and high-fidelity groups in pre and post self-efficacy or pre-and post-learning outcomes; however, overall mean scores of pre-and post-treatment self-efficacy and learning outcomes did increase for both groups. An additional analysis performed in this study evaluated differences in pre and post self-efficacy and learning outcomes when comparing respiratory care and nursing students. Results of this analysis also indicated that no statistically significant differences were present between the respiratory care and nursing student groups in pre- and

post- assessment of self-efficacy or pre- and post learning outcomes; however, overall mean scores of pre- and post-treatment self-efficacy and learning outcomes did increase for both groups.

Limitations

Total Sample Size of Participants

For this study, the total sample size of both groups was 75 participants. This sample size could have had a potential effect on the accuracy of results. Subsequently, all analyses were performed at $p = .05$ in an attempt to address the lack of sample size. A more substantial sample of subjects within the experimental and control groups in this study would have aided in the reduction of potential inaccuracies in statistical analysis. A post-study power analysis performed, with an anticipated effect size of 0.5, affirmed the small sample size as a possible concern, given that the calculation resulted in a recommended minimum total sample size of 128 participants.

Differences in the Educational Level of Participants at the Point of Participation

There was a difference in foundational knowledge between the respiratory care and nursing students at the time of participation in this study which could have affected the results. This study included of nursing students enrolled in Semester 4 of a total of six semesters of instruction within the nursing program and respiratory care students enrolled is Semester 5 of a total of seven semesters of instruction within the respiratory care program. All subjects participating had successfully completed introductory professional courses within the curriculum of their chosen courses of study; however, the respiratory care students appeared to possess more foundational knowledge specific to the interprofessional simulation scenario posed at the time of the study, as opposed to the nursing students.

The nursing curriculum provides instruction, more specific to the simulation scenario at a later point within the nursing curriculum. Such experiences were garnered by the nursing students participating in this study within a complex medical-surgical nursing course offered in a subsequent semester of the nursing curriculum. Conversely, respiratory care students garnered exposure to similar patient care experiences within the Critical Care I-course, as well as in the Clinical Applications I-course previously taken in the respiratory care curriculum.

The nursing students participating in this study had successfully completed courses in the following areas prior to participation in this study: (a) nursing fundamentals lecture and lab, (b) medical-surgical nursing I-lecture and lab, (c) introduction to pharmacology, (d) medical-surgical nursing I-lecture and lab, (e) introduction to pharmacology, (f) medical-surgical nursing I-clinical, (g) anatomy and physiology I & II, (h) English composition, (i) introduction to psychology, (j) speech communication, (k) college mathematics, and (l) a social/behavioral sciences elective course. Additionally, the nursing students participating in this study were taking the following courses concurrently during the semester of participation in this study: (a) advanced pharmacology, (b) medical-surgical nursing II-lecture and clinical, and (c) mental health nursing-lecture and clinical. The nursing curriculum course content, which was more specific to the mock patient scenario within this study, was provided to nursing students within a medical-surgical II course being taken during the semester of participation in this study, as well is in Semester 5 of the curriculum in a subsequent complex medical-surgical nursing course.

This study also included respiratory care students enrolled in Semester 5 of a total of seven semesters of instruction within the respiratory care program. These students had successfully completed courses in the following areas prior to participation in this study: (a) introductory respiratory care, (b) cardiopulmonary physiology, (c) respiratory care

pharmacology, (d) therapeutic modalities, (e) critical care I, (f) clinical medicine I, (g) clinical applications I, (h) anatomy and physiology I & II, (i) English composition, (j) introduction to psychology or sociology, (k) speech communication, (l) college mathematics, and (m) a chemistry elective course. Additionally, the respiratory care students participating in this study were taking the following courses concurrently during the semester of participation in this study: (a) clinical applications II, (b) critical care II, and (c) emergency management.

At the conclusion of simulation experiences for both groups, 33 of the 36 participating nursing students (92%) stated that they acquired a new base of knowledge and appreciation for the scope of practice of the respiratory therapist. Additionally, I received several unsolicited comments from nursing student participants regarding the interprofessional simulation experience and their levels of individually perceived levels of knowledge acquisition as compared to the respiratory care students. The overwhelming majority of unsolicited comments received appeared to be related to the interprofessional simulation scenario itself, as many of the nursing students stated they possessed no previous experience working directly with a patient in respiratory distress or in concert with respiratory care students or respiratory therapists.

Conversely, 30 of the 39 respiratory care students (77%) stated that they had acquired additional knowledge and insight into the multiple responsibilities associated with the scope of practice of the nurse. However, I received no additional unsolicited comments from the respiratory care student participants in this study.

Measure of Knowledge

This study measured only participant perceptions of learning utilizing the Learning Outcomes Assessment Scale. A previous study, conducted by Richardson and Swan (2003), examined the effect of social presence and interaction of students in relation to perceived

learning and satisfaction. The results of the Richardson and Swan study found significant correlation between social presence and perceived learning within instructional environments, and suggested that social presence and interaction were key components to the formation of the perception of learning. The Learning Outcomes Assessment Scale utilized in my study, which measured only the perception of learning, could have contributed to the post assessment evaluation of the interprofessional experiences incorporated in my study.

Implications and Recommendations

Implications

The results of this study, although not statistically significant for comparisons of self-efficacy and perceived learning outcomes for low- and high-fidelity groups, as well as for comparisons of nursing and respiratory care groups, provided valuable insight regarding the current and future use of high- and low-fidelity manikin-based simulation within academic institutions offering nursing or allied health training programs at the associate degree level of study. For example, the implementation of these collaborative adjuncts to traditional pedagogy could supplement the classroom and clinical settings, in terms of student exposure to situations that may not be normally experienced by students within the traditional classroom or clinical environment. The use of such a strategy could serve to add value to healthcare practitioner training programs by providing an avenue to transform the classroom and lab experiences of students by providing an avenue to integrate theory and lab-based hands-on skills to manikin-based simulation scenario-specific practice within the simulation laboratories of associate degree-granting institutions. However, due to the costly nature of high-fidelity simulators, many institutions of higher education have chosen to refrain from such purchases due to the current

lack of research affirming the validity of high-fidelity simulators as predictors of clinical performance (Liaw et al., 2012).

A second implication of the potential benefit of using interprofessional high-fidelity simulation in the training of healthcare students is the ability to provide collaborative exposure to students along multiple points of the curriculum. Implementation of high-fidelity simulator use in an educational setting aligns with the Institute of Medicine's core competencies for interprofessional education, which spoke to practitioner ability (a) to provide patient-centered care, (b) to work in interdisciplinary teams, (c) to employ evidence-based practice, (d) to apply quality improvements, and (e) to utilize informatics (Greiner & Knebel, 2003).

A third implication related to the use of high-fidelity interprofessional simulation is fiscal in nature, which limits the ability of institutions to purchase simulators due to significant cost, as well as additional limitations related to the logistics of course delivery within programs, the timing of clinical externship differences of programs, and challenges related to the appropriate training of faculty members providing` oversight of simulation experiences (Hovancsek et al., 2009; Jeffries, 2009). However, two-year and four-year institutions of higher education considering the purchase of high-fidelity simulators face additional fiscal and logistic challenges such as required support systems for operation, construction costs for a designated instructional area, and the challenges associated with the incorporation of simulation into specific program curricula (Durham & Alden, 2008; Harlow & Sportsman, 2007). Should both two-year and four-year institutions choose to invest in this technology, potential enhancements in curricula and instruction would need to be weighed against the current prohibitive purchase costs and lack of research validating the use of this tool as an adjunct to or as a replacement for instruction.

An additional implication related to the use of high-fidelity simulation on an interprofessional basis is related to patient safety. The use of simulation provides a medium for practitioners to acquire additional knowledge related to patient care practices, engage in critical assessment and communication skills related to patient care, enhance current skills, and potentially lessen medical errors in the healthcare setting (Decker et al., 2008; Whelan et al., 2008). The ability of institutions to provide practitioner training, while maintaining patient safety, is a benefit that should be integral to the decision-making processes related to the purchase of high-fidelity simulators for any institution.

Recommendations

The findings and implications of this study suggest the following opportunities for additional research. This section discusses the series of recommendations, based on size and scope of future study, level of interprofessional education integration, the level of complexity associated with potential future simulation, and a cost versus benefit analysis of simulation fidelity.

Size and Scope of Future Study

This study utilized a control group and experimental group of participants at two regional campuses of a Midwestern associate degree granting institution offering respiratory care and nursing programs. Future study should consider broadening the scope of this study and incorporate multiple associate degree-granting institutions in order to acquire multiple sets of data, which could be used for comparison purposes by institution. These studies could subsequently be sequenced and utilized for a future large scale or longitudinal study.

Additional opportunities for future implementation of high-fidelity simulation studies should ultimately involve academic administrators, who are charged to make pedagogically

pertinent and fiscally responsible decisions for the benefit of their institutions. A potential future method of approaching the costly nature of high-fidelity simulators could be to engage higher education administrators and faculty of two-year institutions in a focus group environment in order to evaluate research studies previously performed on this topic. This approach could assist academic administrators and faculty with the process of evaluation of the feasibility of any potential institutional purchase objectively, with an approach that would be supported by research data.

Level of Interprofessional Education Integration

This study utilized respiratory care and nursing students. Many other healthcare practitioner programs could benefit from interprofessional practice provided from high-fidelity simulation. Future study on this topic should consider the incorporation of students from additional professional disciplines specific to two-year institutions, such as medical assisting, nursing assisting, surgical technology, or phlebotomy, which could be beneficial to these practitioners in terms of the collaborative simulated clinical experience provided. At present, the level of interprofessional education integration occurring in medical education is primarily limited to nursing students, physicians, respiratory therapists, and pharmacists (Laerdal Medical Products, 2010b); however, the transitional process from individuals functioning independently to working collaboratively as a group to improve patient outcomes is applicable to all healthcare practitioners (Jeffries, 2007).

Level of Complexity of Future Simulations

This study focused specifically on interprofessional basic patient assessment and basic medical intervention. Additional study should consider the incorporation of higher levels of collaboration and critical thinking using more challenging patient care scenarios in order to

evaluate self-efficacy and learning outcomes. Future simulations, including higher levels of complexity associated with rapid response teams or critical and emergent care situations utilizing varying medical education practitioner disciplines, could present additional value to institutions conducting this research. Future study, incorporating multiple practitioner disciplines and multiple high- and low-fidelity simulation stations, could enhance communication and familiarity among professional disciplines, which could lead to increased accuracy in treatment and more expedient assessment of deteriorating patients in the healthcare setting (Carrigan et al., 2009).

Cost versus Benefit Analysis of Simulation Fidelity

This study evaluated participant self-efficacy and perceptions of cognitive learning outcomes utilizing high- and low-fidelity simulation as a treatment. Given the costly nature of high-fidelity simulator manikins, future study on this topic should consider a cost versus benefit analysis in order to evaluate the effect on self-efficacy when utilizing low-fidelity manikins versus high-fidelity manikins for specified skills. Results from this study could be beneficial to academic administrators in the decision-making process regarding institutional investments in simulation technology.

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APPENDIX A

Participant Introduction Script for Faculty

Hello, I would like to discuss a research study which is being performed at the college. I am here to ask for your permission to participate in a research study involving student healthcare practitioners and collaboration among students from multiple healthcare programs. The purpose of this study, "High-Fidelity Manikin-Based Simulation: A Study of Implications for Interprofessional Healthcare Practitioner Education at the Associate Degree Level of Study", is to determine if the self-efficacy of health program students participating in this study, along with the ability to collaborate with other student practitioners is enhanced by interprofessional experiences utilizing both high-fidelity and low-fidelity patient-based simulation.

APPENDIX B

Consent to Participate in Research Form

The purpose of this study is to determine if the use of high-fidelity manikin-based simulation enhances the self-efficacy of students as well as collaboration among healthcare professions in an interprofessional environment. An additional purpose of this study is to determine if participation among students enrolled in varying healthcare practitioner programs assists with student ability to understand more fully the expectations and responsibilities of the positions of other healthcare professions in addition to their chosen course of study.

For the purposes of this study students are being recruited from respiratory care and nursing programs by the Principal Investigator (PI) for this study. In order to participate, you must be 18-years of age or older, able to read and speak English, and be enrolled as a second semester student in one of the aforementioned programs being offered by Ivy Tech Community College.

If you elect to participate in this research study, you will be asked to complete a brief demographic survey form, which will take approximately five minutes to complete, the Interprofessional Self-Efficacy Assessment (ISEA), which will take approximately 10 minutes to complete, and the Learning Outcomes Assessment Tool, which will take approximately 10 minutes to complete.

Your performance within this study will not be discussed with others and your individual scores will not be shared with any other participants or with college faculty. By taking the Interprofessional Self-Efficacy Assessment and Learning Outcomes Assessment tool and participating in the interprofessional simulations associated with this study you may receive an educational benefit through the practice of taking these examinations, which are associated with critical thinking, self-efficacy, and learning within a collaborative simulated healthcare environment.

Participation in this study is strictly voluntary. Your grade will not be affected if you choose not to participate. You may also withdraw from this study at any time, even after initially agreeing to participate.

All participants in the study will be identified by a random number assigned to each participant and no personal information will either be collected or published. All answers and data will be kept strictly confidential and maintained in a secured file.

If you choose to participate, please complete the information below and return to the PI facilitating this research study. The PI for this study will collect these forms from you and use this information to notify you regarding the time and location of the testing. If you have any further questions, you may contact Luster Fowler, via email at lfowler11@ivytech.edu. Thank you for your time and consideration given to participating in this study.

I_____, agree to participate in the study High-Fidelity Manikin-Based Simulation: A Study of Implications for Interprofessional Healthcare Practitioner Education at the Associate Degree Level of Study. I meet the eligibility and exclusion criteria listed below. I agree to be contacted at the following email address or telephone number regarding the time and location of the testing.

Email_____

Contact phone number_____

Inclusion Criteria:

- Student Respiratory Therapist or Nurse, 18 years of age or older, able to read and speak English
- Student must not be currently licensed to practice as an CRT, RRT, or RN, and must be enrolled as at least a second semester student within their designated course of study

Exclusion Criteria:

- Enrollment as a first semester student in the academic healthcare preparation programs participating in this study

APPENDIX C

Demographic Survey Form

Age of Student at time of participation_____

Gender: Self-identified as male or female: (Check One) M _____ F _____

What is your ethnicity?

Caucasian_____

African-American_____

East Asian_____

South Asian_____

Pacific Islander_____

Hispanic / Latino_____

Native American or Alaskan_____

Multi-Racial_____

Prefer Not to Answer_____

What is the highest achieved educational level of your parents?

Some High School_____

High School_____

Some College_____

Associate Degree_____

Bachelor's Degree_____

Graduate Degree_____

Program Enrolled at College: (Check One)

Respiratory Care_____

Nursing_____

Do you have previous experience in a healthcare environment prior to enrollment in your current program: (Check One)

Yes_____

No_____

If yes, how much previous experience

Fewer than 3 years_____

Greater than 3 years_____

If yes, what was your previous position in healthcare?

Do you have previous experience in high-fidelity simulation (Check One):

Yes_____

No_____

If yes, how many hours?

Less than 10 hours_____

Greater than 10 hours_____

APPENDIX D

Narrative Description

XXXXXX is a 31 year old female who is in the hospital following an exacerbation of asthma. The patient's normal treatment regimen includes the following:

Advair Inhaler: 250/50 BID

Albuterol Inhaler: 3 to 4 puffs QID

Albuterol Nebulizer: PRN

The patient had been unable to refill her prescription for her Advair inhaler, due to a change in her financial situation. A family history of cardiac and pulmonary disease is present.

The patient is currently stable and resting comfortably with the following clinical data:

Temp 99.1

Pulse 86

Respirations 18

SpO2 (room air) 95%

EKG Normal Sinus Rhythm

Two hours later, the nurse assigned to the patient finds the patient in distress. The patient's clinical data is now:

Temp 99.6

Pulse 116

Respirations 30 & labored

Breath Sounds Bilateral expiratory wheezes

APPENDIX E

Interprofessional Self-Efficacy Assessment-Pretest

Please review the questions and rate your level of confidence with the following skills by recording a number from 0 to 10, with 10 being the greatest confidence level, using the scale below.

0 1 2 3 4 5 6 7 8 9 10

No Confidence Moderate Confidence Full Confidence

	(0-10)
I am confident in my ability to assess a patient for cardiac or respiratory distress	_____
I am confident in my ability to recognize the signs and symptoms of a hypoxic patient	_____
I am confident in my ability to recognize abnormal breath sounds by auscultation assessment	_____
I am confident in my ability to recognize abnormal cardiac rhythms on a cardiac monitor	_____
I am confident in my ability to recognize the appropriate pharmacological or medical device interventions necessary to appropriately treat a hypoxic patient	_____
I am confident in my ability to manage a patient airway, if needed	_____
I am confident in my ability to perform CPR during a resuscitation effort	_____
I am confident in my specific role as a nurse or respiratory therapist in the assessment and treatment of patients in cardiac or respiratory distress	_____
I know the specific roles that nurses and respiratory therapists play regarding the assessment and treatment of patients in cardiac or respiratory distress.	_____
I am confident in my ability to adequately assess a patient following a successful medical intervention	_____

APPENDIX F

Learning Outcomes Assessment Scale

Learning Assessment Scale-Pretest

Instructions: Please review the following questions and provide ratings of **your current level of learning** in your current or previous courses on a scale of 0 to10, with 10 being the highest, related to working with other healthcare professions in the following situations.

0 1 2 3 4 5 6 7 8 9 10

Patients in either cardiac or respiratory distress

0 1 2 3 4 5 6 7 8 9 10

The signs and symptoms of hypoxia

0 1 2 3 4 5 6 7 8 9 10

Recognition of the appropriate pharmacological or medical device interventions

necessary to treat a hypoxic patient

0 1 2 3 4 5 6 7 8 9 10

Normal and abnormal cardiac rhythms on a monitor

0 1 2 3 4 5 6 7 8 9 10

Breath sounds via auscultation assessment

0 1 2 3 4 5 6 7 8 9 10

Ability to manage a patient airway

0 1 2 3 4 5 6 7 8 9 10

The specific role played by respiratory therapists in the assessment and treatment of a patient in cardiac or respiratory distress

0 1 2 3 4 5 6 7 8 9 10

The specific role played by the nurse in the assessment and treatment of a patient in cardiac or respiratory distress

0 1 2 3 4 5 6 7 8 9 10

The role of the nurse during CPR

0 1 2 3 4 5 6 7 8 9 10

The role of the respiratory therapist during CPR

0 1 2 3 4 5 6 7 8 9 10

The role of the respiratory therapist in the assessment of a patient following a successful medical intervention for the patient in cardiac or respiratory distress

0 1 2 3 4 5 6 7 8 9 10

The role of the nurse in the assessment of a patient following a successful medical intervention for the patient in cardiac or respiratory distress

APPENDIX G

Interprofessional Self-Efficacy Assessment-Post-Test

Please review the questions and rate your level of confidence with the following skills by recording a number from 0 to 10, with 10 being the highest confidence level, using the scale below.

0	1	2	3	4	5	6	7	8	9	10
No Confidence					Moderate Confidence					Full Confidence

	(0-10)
I am confident in my ability to assess a patient for cardiac or respiratory distress	_____
I am confident in my ability to recognize the signs and symptoms of a hypoxic patient	_____
I am confident in my ability to recognize abnormal breath sounds by auscultation assessment	_____
I am confident in my ability to recognize abnormal cardiac rhythms on a cardiac monitor	_____
I am confident in my ability to recognize the appropriate pharmacological or medical device interventions necessary to appropriately treat a hypoxic patient	_____
I am confident in my ability to manage a patient airway, if needed	_____
I am confident in my ability to perform CPR during a resuscitation effort	_____
I am confident in my specific role as a nurse or respiratory therapist in the assessment and treatment of patients in cardiac or respiratory distress	_____
I know the specific roles that nurses and respiratory therapists play regarding the assessment and treatment of patients in cardiac or respiratory distress.	_____
I am confident in my ability to adequately assess a patient following a successful medical intervention	_____

APPENDIX H

Learning Outcomes Assessment Scale

Learning Assessment Scale-Post Test

Instructions: Please review the following questions and provide a rating on a scale of 0 to10, with 10 being the highest, of how **much you have learned**, related to working with other healthcare professions in the following situations.

0 1 2 3 4 5 6 7 8 9 10

Patients in either cardiac or respiratory distress

0 1 2 3 4 5 6 7 8 9 10

The signs and symptoms of hypoxia

0 1 2 3 4 5 6 7 8 9 10

Recognition of the appropriate pharmacological or medical device interventions necessary to treat a hypoxic patient

0 1 2 3 4 5 6 7 8 9 10

Normal and abnormal cardiac rhythms on a monitor

0 1 2 3 4 5 6 7 8 9 10

Breath sounds via auscultation assessment

0 1 2 3 4 5 6 7 8 9 10

Ability to manage a patient airway

0 1 2 3 4 5 6 7 8 9 10

The specific role played by respiratory therapists in the assessment and treatment of a patient in cardiac or respiratory distress

0 1 2 3 4 5 6 7 8 9 10

The specific role played by the nurse in the assessment and treatment of a patient in cardiac or respiratory distress

0 1 2 3 4 5 6 7 8 9 10

The role of the nurse during CPR

0 1 2 3 4 5 6 7 8 9 10

The role of the respiratory therapist during CPR

0 1 2 3 4 5 6 7 8 9 10

The role of the respiratory therapist in the assessment of a patient following a successful medical intervention for the patient in cardiac or respiratory distress

0 1 2 3 4 5 6 7 8 9 10

The role of the nurse in the assessment of a patient following a successful medical intervention for the patient in cardiac or respiratory distress