HUMAN PATIENT SIMULATORS AS A FORM OF EXPERIENTIAL LEARNING FOR BACCALAUREATE NURSING STUDENTS

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ABSTRACT

RESEARCH SUBJECT: Human Patient Simulators as a Form of Experiential Learning for Baccalaureate Nursing Students

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Although traditional classroom lecture provides the theoretical basis for baccalaureate clinical practice, experiential learning encounters are also critical. However, clinical settings cannot always provide comprehensive learning experiences for every student. To address theses gaps in clinical education other types of interactive teaching approaches need to be considered. One such approach uses Dewey and Kolb's theory of experiential learning. Brannan, White, and Bezanson's 2008 study will be replicated to test these approaches. The purpose of this study will be to compare the effectiveness of traditional classroom lecture with the use of a Human Patient Simulator (HPS) in teaching specific nursing content to baccalaureate nursing students with regard to cognitive skills and confidence levels. All baccalaureate nursing students enrolled over two semesters in an adult health nursing course at a Midwestern university will be included in the sample. Each student will be randomly assigned to either the lecture (control) group or the lecture with the addition of HPS (experimental) group. All students will be given information to provide informed consent for this study as well as the option to decline. The Acute Myocardial Infarction Questionnaire: Cognitive Skills Test (AMIQ) and the Confidence Level Tool (CL) will be used to collect data in pre- and post-tests for both groups. The

findings from this study will support the use of the HPS as a valuable and constructive teaching tool.

Chapter I

Introduction to Topic

Today's "traditional" nursing student is very different from previous generations (Pardue & Morgan, 2008). These students are highly technologically advanced and master multi-taskers (Pardue & Morgan). Because of this, nursing schools must adapt and tailor curricula to meet these new and demanding needs. There is also a need to train student nurses the meet the demands of an ever evolving health care delivery system and nursing faculty must have an efficient and quality way in which to do this (Elfrink, Kirkpatrick, Nininger, & Schubert, 2010). With dwindling clinical sites and nurse faculty shortages, students can be left with inadequate experiences (Jeffries, 2005). In order to be competitive and meet the needs of the student, schools of nursing across the nation are exploring the options that exist for full scale, realistic human patient simulation. There are several companies devoted to the creation of these computerized, sophisticated mannequins that are fully capable of behaving in a realistic manner. Given this realism, many educators have found that these simulators are especially useful for providing simulation of high risk patients and critically ill patients.

The term simulator refers to "a physical object or representation of the full or part task to be replicated" (Cooper & Taqueti, 2004, p. 11). This would include both completely immersive technologies that fully replicate the targeted environment as well as those that replicate only a portion of the process or system for which it is being used. In conjunction with this definition, the term simulation refers to "the application of simulators for education or training" (Cooper & Taqueti, p. 11). This type of learning would include role playing and computerized virtual patient scenarios.

Student evaluations have revealed that many baccalaureate nursing students feel unprepared and anxious with regard to the treatment of an acute myocardial infarction (AMI) patient (Brannan, White, & Bezanson, 2008). Because of this, faculty are searching for new and innovative ways of presenting AMI information. The use of a human patient simulator (HPS) is one way in which to offer the information so that students feel more prepared to care for a patient experiecing AMI.

Background and Significance

Throughout history man has documented the use of some form of simulation for training purposes (Columbus State Community College, 2009). For instance, ancient Romans used a 6-foot tall wooden post dressed with a shield and a sword to simulate the enemy when training their men for battle (Columbus State Community College). The turn of the 20th century saw the creation of simulators to train individuals in a non-medical capacity on things such as aircraft, automobiles and ships. By the 1960s, the use of simulators for training purposes had branched into the realm of medicine (Rosen, 2008).

Documented use of two and three dimensional anatomical models used for training nurses can be found as early as 1874 (Nehring & Lashley, 2009). These models included jointed skeletons and anatomical models of arms and legs for bandage training (Nehring & Lashley). In 1910, Mrs. Chase was introduced as a full-bodied, static mannequin that could be used to practice injections and procedures involving the rectum, vagina and urethra (Nehring & Lashley). Simulation started to become more mainstream in the 1960's when many medical schools began hiring "actors" that would play the role of a "standardized patient" and with the invention of Resusci Annie which was used for cardiopulmonary resuscitation training purposes (Rosen, 2008).

During the 197's and 80s task trainers were a popular choice for training both nurses and physicians. In particular, intubation models were used for anesthesia practice (Nehring & Lashley, 2009; Rosen, 2008). By the 1990s software based simulation began to make an appearance (Rosen). These devices were low-fidelity simulators that were limited in their realism; however, they did offer the student a more realistic look at the care of the human body. With the coming of the millennium, the 21st century saw tremendous advances in the world of simulation. Several companies including Laerdahl and Meti, now offer very advanced computerized and life-like mannequins that are fully programmable to the specifications of the educator (Rosen).

The development of advanced simulators may help resolve challenges facing nursing programs in the early 21st century. First, contemporary college students have incorporated digital technology into their daily lives and expect to be technologically challenged (Pardue & Morgan, 2008). This generation of learners appears to be able to effortlessly and seamlessly instant message, work on homework, monitor an ebay auction, listen to the iPod, and answer their cell phone all at the same time (Pardue & Morgan). A second challenge is that there are a large variety of nursing programs from which this generation has to choose (Kline & Hodges, 2006). As a result, there is intense competition among schools for the best clinical sites available and those clinical sites are becoming fewer (Kline & Hodges). Because of this, not every student will get every possible experience. In order to provide for these “missing” experiences, universities are looking for alternate ways in which to provide them. The lack of clinical encounters has moved human patient simulators to the forefront of nursing education strategies.

Statement of Problem

Traditional classroom lecture does not often provide for experiential learning experiences for baccalaureate nursing students. The clinical setting is the primary place where experiential learning is used. However, due to the nature of clinical practice, there are many experiences that are not always possible to obtain in the clinical setting. Given this, there are other types of interactive teaching approaches which can realistically bridge these gaps in clinical practice. One such approach, clinical simulation, uses Kolb’s (1884) theory of experiential learning

Purpose of Study

The purpose of this study is to compare the effectiveness of a traditional lecture method of instruction and the use of human patient simulators (HPS) in teaching acute myocardial infarction nursing content to baccalaureate nursing students with regard to cognitive skills and confidence levels.

Research Questions

1. Do students who receive HPS instruction achieve significantly higher scores on the Acute Myocardial Infarction Questionnaire (AMIQ) post-test than students who receive only traditional lecture teaching?

2. Are the confidence levels of students who receive HPS instruction higher than confidence levels of students who received only traditional lecture teaching?

Summary

Since today's nursing student is technologically advanced, individual schools of nursing must be able to offer immersive experiences that appeal to millennial students. Throughout history, people have used some form of simulation for the purposes of training. Fully programmable computerized, life-like mannequins have made their way into the mainstream of nursing education and are increasingly being used. Because of this, it becomes necessary to study the usefulness of this technology. This study will compare the effectiveness of the traditional lecture method of instruction and the use of a Human Patient Simulators (HPS) in teaching specific acute myocardial infarction content to baccalaureate nursing students with regard to cognitive skills and confidence levels.

Chapter II

Literature Review

This literature review covers selected studies associated with the use of human patient simulators as a teaching and learning tool for the nursing student. Quantitative studies were used to develop an understanding of the use of simulation as it relates to the nursing student. Qualitative studies were reviewed to gain insight into nursing student and faculty experiences with simulation. Upon reviewing this supportive literature, four categories were identified:

1. Theoretical framework: Experiential learning
2. Clinical judgment and confidence
3. Clinical skills and competence
4. Student and faculty perceptions of simulation

Theoretical Framework: Experiential Learning

Experiential learning places an emphasis on the subjective understanding of the participants. This is facilitated by the educator who directs the experiences of a particular phenomenon in order to provide the student with a genuine and meaningful learning encounter. This theory is built on six specific propositions (Kolb & Kolb, 2005). The first is that experiential learning theory (ELT) is seen as a process and should not be viewed in terms of outcomes. Next is that all learning is considered to be *re*learning by drawing out the students' beliefs and ideas. Thirdly, learning requires that conflicts between opposing modes of worldly adaptation be systematically weighed in order to come to a resolution. The fourth proposition finds that learning is a holistic process involving the total person, including thinking, feeling, perceiving and behaving. The next proposition finds that there is a synergetic enterprise between person and environment. Lastly, the sixth proposition of ELT states that learning is the development of personal knowledge.

ELT has two modes for grasping experience: concrete experience (CE) and abstract conceptualization (AC). There are also two modes for transforming experience: reflective observation (RO) and active experimentations (AE). These four learning modes create a responsive learning cycle in which the learner assimilates abstract concepts that allow new implications to be drawn. Kolb postulates that human development is defined by learning and that personal development is shaped by individual learning (Kolb, 1984). Further research by Kolb has shown that a person's learning style can be influenced by personality type, educational specialization, career choice, and current job role and tasks (Kolb & Kolb). "Development is conceived as multilinear, based on an individual's particular learning style and life path—development of CE increases affective complexity, of RO increases perceptual complexity, of AC increases symbolic complexity, and of AE increases behavioral complexity" (Kolb & Kolb, 2005, p. 195).

Clinical Judgment and Confidence

Little research has been done on the effectiveness of high fidelity simulation in a nursing program, yet nursing programs across the country are spending large amounts of money on this technology. Lasater's (2007) qualitative study used Tanner's clinical judgment model to examine the effect of high-fidelity simulation on the clinical judgment of nursing students. This was a smaller qualitative study embedded within a larger quantitative study.

Lasater's (2007) study took place at the Oregon Health and Science University (OHSU) School of Nursing. Students in the Nursing Care of the Acutely Ill Adult course were given the opportunity to replace one clinical day per week with the use of high-fidelity simulation. Students were divided into groups of 12 and then subsequently divided into four teams of 3 students. Each student had the opportunity to serve as primary nurse every third week and each session was divided into two phases. In the first phase, the team of three students participated in the actual simulation while the others observed. In the second phase both the participating students as well as the observing students were debriefed in a group setting. Based on the demographics of the class, Lasater planned for two focus groups: white female students aged less than 24 years with no previous degree and other students including males, students older than age 25, and those with a previous degree or ethnic minorities. Of the 39 students observed only 8 nontraditional students were able to meet and form the final focus group.

Lasater (2007) videotaped a 90-minute session in which participants were allowed to speak freely with little involvement from the author. On occasion, the author used open-ended questions to help clarify the meaning of certain student comments. The author used retrospective data analysis to organize the data gathered from the videos and notes into categories and then finally, 13 themes. These themes were further reduced into the following five major codes. The codes were then tested against the transcript and found to fit approximately 95% of the student population. The final five codes included:

1. The strengths and limitations of high-fidelity simulation
2. The paradoxical nature of simulation, that is, the provocation of anxious and stupid feelings, yet increased learning and awareness
3. An intense desire for more direct feedback about their performances
4. The value of students' connection with others
5. Some general recommendations for better facilitation and learning (Lasater, p.272).

The first code recognized that students felt they were able to apply what they had learned from class and reading as well as skills lab and clinical settings to high-fidelity simulation experiences. Students found that they could experience patient scenarios and disease processes they had not been exposed to during the actual clinical practicum. Despite some of the extreme situations contained within the scenarios, students felt that they had the opportunity to anticipate possibilities and use sound clinical judgment.

Within the second code, the group of students discussed the initial anxiety elicited by the use of the simulator. It was noted by Lasater (2007) that many of the students did not always feel confident during some of the simulations, especially when serving as primary nurse. However, even with these feelings of anxiety, students verbalized that they did learn from the simulation exercise. The author also reports that one student in particular stated that during the simulations where she messed up the most she also learned the most.

The third code discussed by Lasater (2007) was that of an intense desire for more direct feedback. This finding was unexpected. During the focus group, almost all students stated that, although the facilitators were supportive, they desired more candid, forthright feedback that included the severity of the patient outcomes if the judgments they exercised had been followed in reality.

Within the fourth code, three main themes were recognized. The first, learning from others' simulation experiences, created a realm of flexibility in thinking that many students reported never having. The second, learning in teams, found that students developed a rhythm with the members of their group. Within the third theme of narrative learning, it was discovered that students enjoyed being able to hear the stories of both the facilitator as well as other students with regard to practice and care.

Lastly, the fifth code proposed general recommendations for better facilitation and learning. One suggestion was to include a debriefing *immediately* following each session. This would include, as a group, watching the videos that were made during the simulation. Another suggestion included actively engaging the students who were observing the sessions.

Through the use of Tanner's clinical judgment model, Lasater (2007) was able to identify that nursing programs should use more focus groups with more faculty feedback to analyze students' reactions and clinical judgment. It was also found that more debriefing is needed after simulation exercises and that perhaps, additional faculty training is necessary.

Despite high student and faculty satisfaction, there is little support in the literature for the hypothesis that simulation improves confidence more than traditional teaching methods. Gordon and Buckley (2009) explored the ability and confidence of medical-surgical graduate nursing students to manage clinical emergencies through the use of high-fidelity simulation. All 50 students who were enrolled in an Australian graduate course volunteered to participate in this study. Prior to the immersive high-fidelity simulation experience, students participated in two 3-hour workshops in which they were able to practice assessment skills and management of an acutely ill patient. Additionally, participants engaged in a 60-minute team building exercise.

After familiarizing participants with the simulation laboratory and the SimMan capabilities, simulation workshops were then undertaken. Students participated in three 45-minute experiences. The 45 minutes included time for both the immersive simulation as well as debriefing. Randomly assigned teams of four to six individuals were created and each participant had the chance to be engaged in varying roles including team leader or airway management. Scenarios were video taped and played back to the participants before the debriefing exercise. A questionnaire consisting of 14 Likert scale questions was administered prior to the immersive high fidelity simulation. These questions addressed prioritization, airway management, breathing, circulation, defibrillation, leadership, and communication skills. This questionnaire was again administered following the simulation experience. The Cronbach alpha correlation coefficient was .94 for the pre-test and .91 for the post-test indicating acceptable reliability.

Results from this study showed that graduate student confidence in recognizing an unstable patient and identifying priorities significantly improved ($p = .02$ and $p < .001$ respectively) following simulation. Confidence also increased with regard to airway obstruction correction, breathing difficulties, altered circulation, identification as leader, performing handover, keeping others informed, voicing concerns, listening, and using resources ($p < .001$). Gordon and Buckley (2009) concluded that the use of high fidelity simulation increases confidence levels in graduate-level nursing students.

Because human patient simulators (HPS) are being used at an ever increasing rate within nursing education, more research needs to be done to validate their usefulness. Radhakrishnan, Roche, and Cunningham (2007) sought to identify clinical practice parameters and measure clinical performance improvements following simulation practice with two groups of nursing students. The authors chose a quasiexperimental, post-test design for this study.

Of the 35 nursing students enrolled in a senior year BSN capstone course a sample of 12 voluntary students was accepted. Students were randomly assigned to either the intervention group (*n* = 6) or the control group (*n* = 6). In addition to usual clinical requirements, the intervention group participated in a complex two-patient assignment simulation scenario; the control group had no simulation practice during that time frame. Both groups then, at the end of the semester, participated in a simulation scenario which was standard for this school. The following objectives were measured: safety, basic assessment, prioritization, problem-focused assessment, ensuing interventions, delegation and communication. The researchers chose to use a faculty-developed Clinical Simulation Evaluation Tool (CSET) to assess students. To eliminate bias, faculty members who were experienced with the use of the CSET but unfamiliar with the study subjects evaluated students at the end of the semester. Scores for each of the above listed objectives were calculated and the two groups were compared using a chi-square test. Reliability and validitiy of the CSET were not reported.

The intervention group's scenarios, developed through the use of software provided by the simulator manufacturer, consisted of two simulated patients with complex diagnoses. One of the simulated patients developed a medical emergency. Each subject was given a detailed report including medications, health history, current problem, and current order set. Participants were then instructed to assess both patients and prioritize their care. Each session was videotaped for future review and students were debriefed following the simulation. The control group had no simulation practice and both groups participated in all other teaching and clinical experiences. At the end of the semester, students from both groups participated in a simulation experience similar to the simulation scenario used for the intervention. This simulation experience was a mandatory part of the course and the CSET was used to evaluate students from both groups.

Radhakrishnan et al. (2007) found that the intervention group scored significantly higher in two of the seven categories being evaluated. The intervention group scored higher in safety (p = .001) and basic assessment skills (p = .009) than did the control group. Although the control group scored higher than the intervention group in focused assessment and intervention, these differences were not significant. There were no significant differences between the groups in relation to delegation and communication.

Radhakrishnan et al. (2007) found that students' initial basic assessment skills are enhanced by the use of simulation. Researchers also found that nursing instructors are able to use this technology to reinforce students' safety habits and prevent errors. Researchers concluded that this type of learning environment is safe for the students and affords them the opportunity to learn high-risk procedures and patient conditions. However, given the small sample size, these results should be used with caution. This study should be seen as a pilot study. Further research is needed to possibly relate these results to improvements in clinical judgment.

Clinical Skills and Competence

Currently, there is little evidence to support the use of human patient simulators (HPS) over traditional educational strategies. Alinier, Hunt, Gordon, and Harwood (2006) sought to test whether nursing students who participated in scenario-based simulation education had better clinical skills and competence than those students who did not participate in simulation education. The authors used an experimental pre-test/post-test, control group design within the framework of experiential learning. A 15-station Objective Structured Clinical Examination (OSCE) was developed for both the pre- and post-test. This type of exam was originally designed to test the competence of trainee doctors. It has been adapted and is now a valuable and valid evaluation tool used to assess the skills of many different types of students in healthcare.

Students in their second year of a diploma nursing program in Great Britain were invited to participate in the study. Of the 344 invited students, 133 volunteered to take the first OSCE and 99 of those students completed the second OSCE. The sample remained representative of the population. Students were given 5 minutes at each station with 1 minute to rotate between stations, making the actual exam last 90 minutes. An additional 30 minutes were utilized for student sign-in, anonymity number distribution, and OSCE organization instructions. A pilot study of the OSCE was given to a mixture of nursing and paramedic students to test the validity and objectivity of this exam. All OSCE assessors were trained by the principal investigator for particular examination stations.

All of the volunteer students participated in the first OSCE. Students were then randomly assigned to either the control group (n = 50) who participated in the traditional course curriculum and associated clinical practice or the experimental group (n = 49) who participated in the same education as the control group but with the addition of a simulation experience. After a 5 to 6 month time frame all students were given a questionnaire that assessed confidence level and stress with regard to a technological environment. Students then volunteered to participate in the second OSCE.

Alinier et al. (2006) noted improvement in both groups with the experimental group demonstrating significantly higher scores on the second OSCE. The scores for the first OSCE were 48.82 % for the control group and 47.54% for the experimental group. The scores for the control group improved by 7.18% on the second OSCE while the experimental group's scores improved by 14.18%. This difference of 7.0 % is statistically significant ($p < .001$). Questionaire results demonstrated that the control group's measurement of stress (1 = *not stressful* and 5 = *very stressful*) and confidence (1 = *very confident* and 5 = *not confident*) were 2.9 and 3.5 respectively on a 5-point Likert scale while the experimental group scored 3.0 and 3.4 respectively. However these differences where not statistically significant (stress, $p = .562$ and confidence, $p = .819$). Lastly, the authors found that students who lacked confidence also stated they were stressed by exposure to a technological working environment ($p = .002$).

Alinier et al. (2006) concluded that the use of intermediate-fidelity simulation is of benefit to nursing students if used appropriately. Both students and faculty must have adequate training in order to be prepared to use simulation as a teaching tool.

Nursing students' ability to use appropriate clinical skills during nursing care was also explored by Bruce et al. (2009). Faculty at the University of Buffalo's School of Nursing constructed a mock cardiac arrest scenario using a computer-assisted simulator in a joint effort for graduate and undergraduate nurses. The sample included 9 adult nurse practitioner (ANP) students, 2 acute care nurse practitioner (ACNP) students enrolled in one of two clinical practicum courses and 107 BSN students enrolled in a second semester senior nursing clinical course.

Bruce et al. (2009) sought to determine the effectiveness of a simulation scenario using SimMan on the knowledge, confidence, clinical competence and crisis management of graduate nursing students as well as to determine the usefulness of SimMan with undergraduate students learning to manage cardiac arrest. A demographic sheet was used to gather informational data about the graduate students. Additional tools used for the graduate students included a 10-item multiple choice knowledge test consisting of questions from the current American Heart Association (AHA) protocol for cardiac arrest, a 16-item confidence scale based on Bandura's self-efficacy theory, a researcher developed 26-item competency scale based on an AHA algorithm and an evaluation instrument of which the origin was not reported. To assess the undergraduate students, a researcher developed combined demographic and evaluation sheet was created of which the origin was not reported as well as a 10-question pre- and post- multiple choice test based on the AHA algorithm. The post-test was administered immediately following the scenario and again four to eight weeks later. Reliability and validity were not reported on any of the instruments.

Prior to the simulation experience all students were instructed on the American Heart Association's cardiac arrest guidelines and oriented to the simulation center and the SimMan. Additionally, undergraduates reviewed the use of oxygen masks, ambu bags, reading EKG strips and using the defibrillator. Faculty then administered a cardiac arrest case scenario that started with a patient experiencing chest pain and the undergraduate responding appropriately. Eventually this evolved into a full blown cardiac arrest requiring the presence of the ANP student. CPR, medications and defibrillation had to be administered under the direction of the NP student. Prior to administering this scenario to the students, it was practiced by the faculty to ensure it was operational.

After participating in the scenario students were immediately debriefed. Additionally, one on one debriefing that focused on strengths and areas of improvement occurred with the graduate students. Because of the small number of graduate students and the large number of undergraduate students, the NP students were given several chances to participate in the management of the cardiac arrest while the undergraduates were able to participate only once.

Bruce et al. (2009) found that knowledge scores for the graduate students significantly improved (p = .000) between pre- and post-test except for question 4 (pulse checks). Graduate student confidence scores increased on all items; however, no statistical difference (p = .177) between pre- and post- simulation was found except for item 2 (shockable rhythm, p = .041), item 5 (defibrillator use, p = .026), and item 8 (vasopressin, p = .005). Lastly, competency scale scores did improve but were not statistically significant (p = .621) and evaluation scores were positive with a mean of 4.2 (1 = *not at all* and 5 = *very much so*). Undergraduate results showed positive evaluation scores with a mean of 4.4 (1 = *strongly disagree* and 5 = *strongly agree*). Score differences between the pre-test and first post-test (immediately following simulation) were significant (p = .01) and the score difference between the first and second post-test (four to six weeks later) were significant (p = .000). However, scores between the pre-test and second post-test were not significant (p = .218). Overall, human patient simulators

(HPS) can afford the student an opportunity to approach crisis situations in a contained and controlled environment. The use of HPS can also serve to help partner nurses of different education levels.

Given the very nature of clinical practice, students are not always able to obtain some learning opportunities in the clinical setting. Using Kolb's theory of experiential learning, Brannan et al. (2008), created a prospective, quasi-experimental comparison design to test the effectiveness of the traditional method of instruction and the use of a human patient simulators (HPS) in teaching specific nursing content to baccalaureate nursing students with regard to cognitive skills and confidence levels.

Brannan et al. (2008) included all the baccalaureate nursing students who were enrolled in a junior level adult health course in both the fall and spring terms for their sample. Each student was randomly assigned to either the lecture (control) group or the lecture and HPS (experimental) group. The Acute Myocardial Infarction Questionnaire: Cognitive Skills Test (AMIQ) and the Madorin and Iwasiw Confidence Level Tool (CL) were used to collect data in pre and post-tests for both groups. Parallel agreement of split halves of the AMIQ was evaluated. The instrument was found to be internally reliable ($r = .59$, $p = .02$) and had a Spearman-Brown reliability coefficient of .74. Additionally, the CL, which used a Likert scale format, had a reported reliability coefficient of .89.

The control group, in a 2-hour lecture, received instruction based on the four major content domains of an acute myocardial infarction (AMI). During this lecture, students had the opportunity to ask questions and participate in discussion with the educators. The experimental group received no lecture and rotated through five stations during a 2-hour time frame. The first four stations consisted of an evolving AMI vignette that eventually led to the fifth station which used a preprogrammed HPS that simulated the distinct physiological changes that occur with an AMI.

Students within the experimental HPS group scored significantly higher (p = .05) on AMIQ scores than the control lecture group. However, confidence levels between the two groups did not differ significantly (p = .09). These findings support the use of the HPS as a valuable and constructive teaching tool. HPS is positive, effective, and efficient. It can improve nursing students' understanding of nursing practice and create a learner-centered approach to teaching complex course content.

Despite these positives, there are still many areas to be studied regarding the use of HPS. One such area compares the use of high fidelity simulation versus low fidelity simulation in an advanced cardiac life support (ACLS) course. Hoadley's (2009) study sought to ascertain whether students in an ACLS course were more satisfied and scored higher on post-testing, both cognitively and behaviorally, after participating in a course using high-fidelity simulation than those who participated in the standard low-fidelity course. Using the theoretical framework of experiential learning, researchers compared results from these two different ACLS courses.

This study took place in an AHA training center affiliated with a level-one trauma center. The population of the study included all healthcare providers (physicians, nurses, respiratory therapists and medics) requiring ACLS certification. The sample included 53 healthcare providers enrolled in an ACLS course who were randomly assigned to either the control group (n = 24) or the experimental group (n = 29). Researchers hypothesized that ACLS participants experiencing the high fidelity simulation would have significantly higher post-test scores than those who experienced low fidelity simulation.

Several instruments, beginning with a simple demographic survey that helped researchers to determine participants' expertise, abilities, and experiences with ACLS, were used. The AHA Mega Code Performance Score Sheet was used to measure the cognitive knowledge of ACLS participants. This instrument was tested for content validity and inter-rater reliability. Next, a 20-item, two-part Simulation Design Scale (SDS) developed by the National League for Nursing (NLN) was used. Cronbach's alphas of .92 and .96 were previously reported for each part. Lastly, the NLN's Student Satisfaction and Self-Confidence in Learning Scale was used to measure students' satisfaction and confidence. Acceptable reliability has been reported with a Cronbach's alpha of .94 for the satisfaction sub scale and .87 for the self-confidence subscale.

Hoadley (2009) found that students did not score higher on post-testing after the use of high-fidelity simulation when compared with low-fidelity simulation ($p = .26$). Scores for the Mega-Code Performance Score Sheet after the use of high-fidelity simulation were also not found to be statistically significant ($p = .12$). Additionally, researchers found that mean scores of the SDS were not statistically significant. No statistically significant differences on student satisfaction and self-confidence were found between the groups. Although these results did not demonstrate increased skills scores, learner satisfaction or learner confidence, these findings are not consistent with other literature supporting the use of high-fidelity simulation as a useful educational tool. Hoadley suggested that the size of the sample, instructor- and manikin-to-participant ratios, and debriefing sessions may have contributed to these less than positive results.

Student and Faculty Perceptions of Simulation

Simulators have been used in many professions since the 1960s and have now entered the realm of nursing education (Cooper & Taqueti, 2004). Henrichs, Rule, Grady, and Ellis (2002) examined the use of human patient simulators (HPS) within the context of experiential learning. The primary goal of the authors was to obtain the perceptions of nurse anesthesia students (NAS) with regard to anesthesia patient simulation. Additionally, the authors sought to understand the behavioral responses and anxiety levels of students in relation to simulation, student perceptions specifically related to anesthesia education, and students' most and least favorite aspects of simulation. The use of simulation for certification and recertification was also explored.

A convenience sample of 12 first-year nurse anesthetist students with a lack of previous simulation experience was chosen. Three investigational strategies were used in this study: observations of four simulation sessions by the primary investigator, journal entries by the students, and focus group interviews. All data obtained were triangulated in order to increase the reliability of the results. A modified version of Stevick-Colaizzi-Keen method of analysis of phenomenological data was combined with Creswell's data analysis procedures to evaluate data acquired from observations, journals, and interviews.

Students were asked to rank order the perceived advantages and disadvantages of simulation identified from the data. The top three perceived advantages included (a) improved critical thinking and decision-making skills, (b) ability to learn crisis management skills, and (c) ability to learn how to administer anesthesia without causing harm. Of the 11 perceived advantages, improved leadership skills ranked last. Four perceived disadvantages of simulation were identified. Lack of knowledge of appropriate action was ranked first, followed by fixation on errors, anxiety, and a noted lack of reality at times.

All students experienced some level of anxiety as a behavioral response to the simulation. Anxiety was described as “feelings of apprehension, uneasiness, or fear” (Henrichs et al., 2002, p. 223). Anxiety diminished for some students as their familiarity with the simulation grew, but increased for others who thought that a better performance was expected after each session. Overall, students’ perceptions of simulator utilization for anesthesia education were very positive. All students felt that more time should be dedicated to simulator use. Also, most students felt that simulation should be used after graduation as part of their continuing education. There were several aspects of simulation that students seemed to like the best. The first was the ability to learn in a controlled environment. Scenarios could be stopped for discussion and then resumed afterward. This supervised atmosphere gave students learning encounters without posing any harm. Having a “hands-on” experience afforded students the ability to improve their psychomotor skills. Lastly, students enjoyed having the opportunity to “treat” rare events or unusual complications to which they might not otherwise be exposed.

Students also identified their least favorite aspects of simulation. This included aggravation with equipment that would occasionally malfunction. The authors noted that this did not occur routinely but, when it did, it seemed to distract the student from the situation at hand. Students also complained that the lack of reality, at times, hindered their learning. Additionally, they often felt like “sitting ducks” as they knew that a crisis event was going to occur at some point in the simulation experience. Lastly, students expressed an anxiety when taking over a case from a Certified Registered Nurse

Anesthetist as they felt the report received was not detailed enough and left them scrambling to orient themselves to the situation.

Despite identifying that simulation should be used in continuing education, most students felt this was not appropriate for certification or recertification. The reasoning for this includes the lack of reality, differences in instructor grading, and possibly differing scenarios between participants. One student commented that nurses are taught to trust what is seen in the patient and not just is seen on the machines. Despite this, there were a few students who felt that simulation should be used for recertification citing the need to test psychomotor skills.

Henrichs et al. (2002) concluded that qualitative studies are important in obtaining information with regard to the student experiences of simulation. Simulation is key to the NAS's experience of rare anesthesia complications. Lastly, the hands-on nature of simulation allows the student to be involved in a crisis without harming a patient.

Little data currently exist on the effectiveness of an HPS in preparing students appropriately for the ever-changing field of healthcare, faculty attitudes regarding HPS, or the best way to train faculty on the use of HPS. King, Moseley, Hindenlang, and Kuritz (2008) sought to explore faculty attitudes and contributing factors to the use of HPS (Phase I) and to then evaluate the implementation of an educational intervention program for faculty using HPS (Phase II). The theory of planned behavior (TPB) was used as the framework for this study.

A voluntary convenience sample of 34 faculty members representing 72% of the total faculty from a large ADN program in the southeastern United States was used for Phase I. Key variables were measured with two instruments. The Faculty Attitudes and

Intent to Use Related to the Human Patient Simulator survey was a researcher developed tool adapted from two other tools in the literature. The survey was reviewed by two experts to determine content validity. Five open-ended questions were included at the end of the survey focusing on use of HPS, advantages and disadvantages of HPS, uses associated with HPS, and HPS items to include in an educational program.

In Phase I, the TPB constructs of attitudes, subjective norms, perceived behavioral control (PBC), and intent to use were applied to this study. A Likert scale of 1 (*strongly disagree*) to 5 (*strongly agree*) was used with a mean score of 4.0 or higher considered to be a positive finding. In the attitudes construct, faculty's beliefs and perception of HPS use had a mean score of 3.9 which was not considered positive.

An examination of the construct of subjective norms revealed that three groups influenced faculty use of HPS: College of Nursing administrators, peers, and students. Of these three groups, only the administrators were found to positively persuade faculty to use HPS. However, it is noted by the authors that faculty reported student opinions were also important. The composite mean for this construct was 4.0; subjective norms were considered to positively influence faculty.

The PBC construct measured experience, preparation time, ease of use, time to be proficient, instructors' guide, and training/educational program. Ninety-four percent (n = 32) of the faculty surveyed felt they could become confident and proficient at using HPS with a mean of 4.5 (positive). In contrast only 18% (n = 6) felt that the HPS was easy to use, while 82% believed HPS was not easy to use. Ninety-four percent of those surveyed replied that they would use HPS if they could attend an educational program. The total combined mean for this construct was 3.9 (not positive).

The behavioral intent to use was the next construct examined. Researchers found a positive mean of 4.1 with regard to the surveyed faculty's intent to use the HPS during the present academic year. A general intent to use HPS had a positive mean score of 4.3.

The five open-ended items at the end of the survey, the use of HPS, advantages and disadvantages of HPS, associations with HPS, and HPS items to include in an educational program were clustered according to the previously mentioned TPB constructs above. Associations with the use of HPS and the advantages of the use of HPS fell into the attitude construct. The disadvantages of time, support, and education fell into the PBC construct while the disadvantage of the number of students in a session fell into the attitude construct.

Since 62% of those faculty members who were surveyed had never had hands-on HPS training and 73% had not attended any type of HPS educational program, King et al. (2008) concluded that the absence of training on the use of HPS resulted in faculty's lack of comfort and competence. These findings reflect the gap identified in the literature review and support the need for faculty development specific to the use of HPS.

Phase II consisted of an educational program designed to change faculty members' beliefs about the use of HPS and to increase their intent to use HPS as a teaching strategy in the future. Enrollment was limited to the first 16 faculty members who applied on-line. However, only 15 individuals applied and subsequently participated in the program. The instruments used in Phase 1 were slightly modified and administered in Phase 2 as pre- and post-surveys. Open-ended questions were deleted and a rank order question measuring program participants' intent to use was added. Additionally, the post-survey asked participants if their change in attitude was due to the education program.

All 15 of the subjects were full time faculty members and 73% (n = 11) had never had hands on training with the HPS. Eighty percent (n = 12) had never participated in an educational program regarding HPS. Sixty-seven percent (n = 10) of participants had used the HPS as a teaching tool. When asked how many times participants had used HPS as a teaching tool in the last academic year, the mean response was 1.9 times and 47% (n = 7) reported using HPS zero to one time.

The theory of planned behavior constructs of attitudes, subjective norms, perceived behavioral control (PBC), and intent to use were measured again in Phase II. The educational program had a statistically significant effect ($p < .05$) on each of the overall constructs. Differences between pre- and post-scores were analyzed on an item basis for each construct. The mean score for attitudes increased from 3.9 to 4.6 with a significant effect ($p < .05$) on five of the eight scale items. A significant effect ($p < .05$) was found on four of the six subjective norms items. Two of eight perceived behavioral control items were significantly affected by the educational program ($p < .001$) and one of two behavioral intention items was significant ($p < .02$).

King et al. (2008) found that participants had very little experience and training in the use of HPS. Some faculty held negative attitudes toward HPS. Yet, despite this, the majority of faculty still felt that HPS was a valuable teaching strategy. Participants had a positive intention to use HPS; however, many felt the time for preparation and ease of use was negative. Assessment of faculty beliefs and educational needs created a strong intervention and narrowed the existing knowledge gap. Many nursing faculty have little to no experience using HPS; therefore, there is a lack of positive attitudes regarding comfort level and confidence. Despite this, faculty are still receptive to the use of HPS.

Assessing faculty learning needs prior to educating them on the HPS does positively affect beliefs.

It must also be noted that students have many different learning styles and educators must find creative ways to teach these students. Technology, such as high-fidelity simulators (HFS) is currently being used to educate nursing students. However, little data exist as to how technology relates to learning styles. Fountain and Alfred (2009) examined the relationship between student satisfaction and learning styles when an HFS is used.

A convenience sample of 104 senior nursing students in an advanced medical-surgical course from 3 campuses of one school of nursing participated in this study. Students participated in a 3-hour experiential learning activity that began with a 90-minute review of interpretation of dysrhythmias and emergency cardiac pharmacologicals and ended in a 90-minute HFS scenario. Prior to the experiential learning activity, students completed five case studies that dealt with patient cardiac problems. It should also be noted that each student had approximately eight hours of previous lab experience with HFS from prior semesters.

At the end of the lab activity, students were given the option to complete the Student Satisfaction and Self-Confidence in Learning scale. Completion of this instrument served as implied consent for this study. Ultimately 78 students completed and returned the form. Social learning and solitary learning were the two learning styles found to be significantly ($p = .01$ and $p = .04$ respectively) correlated to satisfaction. Satisfaction in the simulation activity was slightly higher at the larger campus when compared to the other two however, this difference was not significant ($p = .071$). Based on these results, Fountain and Alfred (2009) concluded that learning opportunities created to support specific learning styles are enhanced through the use of high-fidelity simulation.

Since many nursing schools are turning to high-fidelity simulation (HFS) to enhance these student learning styles, the outcomes related to simulation must be explored. Smith and Roehrs (2009) measured two outcomes from the Nursing Education Simulation Framework: student satisfaction and self-confidence. In addition the researchers sought to ascertain (a) how well the five simulation design characteristics described in the model were present in the simulation activity, and (b) the correlation of these characteristics as well as demographics to satisfaction and confidence.

Smith and Roehrs (2009) chose a voluntary sample of 68 traditional junior baccalaureate nursing students enrolled in their first medical/surgical course. As a part of course requirements, students completed a simulation scenario in the ninth or tenth week of the semester. They were allowed to volunteer to participate in the study. Three instruments were used to study this population. First, the researchers designed a demographic survey in order to describe the sample. Next, the Student Satisfaction and Self-Confidence in Learning Scale and the Simulation Design Scale (SDS) were used. Both of these tools were developed by the NLN. Content validity of both instruments was established by a 10 person expert review panel. Reliability was not reported

Overall, students responded positively to the simulation. They were satisfied with the simulation teaching method as indicated by a mean score of 4.5 on a 5-point Likert scale (1 = *strongly disagree* and 5 = *strongly disagree*).

Students felt confident in the care of a respiratory patient with a mean self-confidence score of 4.2 on the same Likert scale as above. Smith and Roehrs (2009) also found that students had positive feelings regarding the five design characteristics of the SDS: objectives, support, problem solving, guided reflection, fidelity. Satisfaction could be attributed to the five design characteristics of the SDS with the characteristic of objectives contributing the most. Lastly, researchers found no correlation between the demographic characteristics of the students and their satisfaction and self-confidence.

In general, Smith and Roehrs (2009) have shown that careful attention should be given to the five design characteristics of a simulation experience. In particular, the design characteristics of objectives and problem solving may require even more attention by the nurse educator. Additionally, adjusting faculty workloads may be necessary to allow for this attention.

Summary of Literature

The above review of the use of human patient simulators (HPS) to teach nursing content illustrates that there may be positive benefits associated with the use of HPS. Yet these studies also show that further research needs to be done. Since high-fidelity simulation is a new and developing technology, there must be strong and persuasive evidence as to its usefulness. This is especially true for the field of nursing.

Most studies presented in this proposal have suggested that human patient simulators (HPS) are a valuable tool for the nursing student. Clinical judgment and confidence can be impacted by the use of HPS. Lasater's (2007) study suggests that focus groups are needed to analyze students' reactions and judgments and that faculty must offer more feedback in these group settings. This may require additional faculty training. Researchers also suggest that more time for debriefing is necessary after simulation. Gordon and Buckley (2009) found that confidence levels of graduate nursing students increased through the use of HPS suggesting that it is a very practical mode of teaching many nursing aspects including clinical judgment. Radhakrishna et al. (2007) were able to demonstrate that this technology is useful in reinforcing safety habits and offers the student a safe, risk free learning environment. However, this study, due to the small sample size, should be viewed as a pilot study. Further research is needed to evaluate how the increase in safety habits may relate to clinical judgment.

Nursing students' clinical skills and competence may also be affected by the use of HPS in a school of nursing. Alinier et al. (2006) found that, if used appropriately, the students can benefit from the use of simulation. It is, however, noted by the authors that proper training in the use of simulation for both faculty and students is necessary before implementing this technique. Bruce et al. (2009) identified that the controlled environment of the simulation setting provides students the opportunity to visit crisis situations in a controlled environment. These researchers also discovered that this technology can serve to unify nurses of different education levels. Again, Brannan et al. (2008) were able to identify that the use of HPS as a teaching tool positively affected the nursing students' skill level and competence. In contrast, Hoadley (2009) reported that HPS did not create better skills scores, learner satisfaction or learner confidence. The author does note that these results must be taken with caution as there was a small sample size, poor instructor- and manikin-to-participant ratio and potentially inadequate debriefing sessions.

Student and faculty perceptions of simulation as an educational strategy have also been explored in the literature. Henrichs et al. (2002) were able to conclude that nursing anesthesia students' experiences of rare complications were ideally experienced through the use of HPS and that these experiences could be handled in a realm that did not harm a patient. Faculty perceptions and attitudes were also examined by King et al. (2008). These authors identified that despite a lack of comfort and confidence with HPS, many faculty were still receptive to the use of HPS. It was also recognized that assessing faculty beliefs and educational needs was an important step to narrow the existing knowledge gap. Another study by Fountain and Alfred (2009) found that learning styles can be enhanced through the use of HPS which improved learner satisfaction. This can play a part in the perceptions held by the student. The last study examined in this literature review was by Smith and Roehrs (2009). In looking at the five design characteristics of a simulation experience, the researchers reason that careful attention should be given to them by the nurse educator. It was also discovered that faculty workloads may need to be adjusted in order to allow for this attention.

The studies included in this review assessed students' experiences, confidence, skills, perceptions and clinical judgements. Many found that students' confidence levels, abilities, and clinical skills improved after practicing with an HPS. Since patients and scenarios are programmable, the student has the chance to experience certain situations, patients, or disease processes that may not otherwise be encountered during a typical clinical experience. Overall the use of an HPS seems to improve student outcomes and helps to affirm this strategy as a valuable teaching tool. As comfort levels increase, nursing faculty are slowly incorporating this technology into curriculums across the globe. Continued HPS research will play a necessary part in the success of this tool.

Chapter III

Methodology

Schools of nursing have an obligation to keep up with the many technological advances that have occurred in the last century. Most students in today's world are well versed in the latest technological advances. Schools of nursing must adapt and tailor curriculum to meet these new and demanding needs. Given this, traditional classroom lecture does not often provide for experiential learning experiences for baccalaureate nursing students. The clinical setting is the primary place where experiential learning is used. However, clinical settings are also limited in the type of learning opportunities available to students. Because of this, instructors must find other types of interactive teaching approaches which can realistically provide for these gaps in clinical practice. One such approach uses Kolb's (2005) theory of experiential learning. The proposed study is a replication of the Brannan et al. 2008 study. The purpose of this study is to compare how effective the traditional method of instruction and the use of a Human Patient Simulators (HPS) are in teaching specific nursing content to baccalaureate nursing students with regard to cognitive skills and confidence levels. This chapter contains a description of the methods and procedures for this study.

Research Questions

1. Do students who receive HPS instruction achieve significantly higher scores on the Acute Myocardial Infarction Questionnaire (AMIQ) post-test than students who receive only traditional lecture teaching?
2. Are the confidence levels of students who receive HPS instruction higher than confidence levels of students who received only traditional lecture teaching?

Population, Sample and Setting

The population for this study will include all junior level nursing students enrolled in a baccalaureate program. A sample of 100 students from a four-year university program in Muncie, Indiana will be recruited. Fifty students will be drawn from the fall semester and 50 from the spring semester. Students must have matriculated into the junior level by adhering to the admission and retention criteria set forth by the School of Nursing. All students must be enrolled in Adult Health Nursing I. Students enrolled in the fall (Group 1) will receive only traditional lecture and clinical experiences with regard to acute myocardial infarction. Students enrolled in the spring (Group 2) will receive HPS training in the care of an acute myocardial infarction instead of lecture.

Protection of Human Subjects

This study will be submitted to the institutional review board (IRB) of Ball State University for approval prior to conducting any research. This study will adhere to the ethical considerations of research and students will be given the opportunity to decline participation in the study without any effect on their grades. Prior to the start of this study, participant rights will be discussed; anonymity will be assured. Additionally, all participants will receive a full disclosure letter outlining the study. The course instructor will not be involved in recruiting students, implementing the teaching strategies, or evaluating the outcomes of the study.

Procedures

Lecture and HPS content will be created by two experienced nurse educators. This content will include diagnostic evaluation of acute myocardial infarction (AMI), pathogenesis and prevention of AMI, nursing care during the acute phase and nursing care during the recovery phase of AMI. Participants in both groups will be encouraged to read the textbook and use the study guide to prepare for the AMI class. Participants in group 1 will receive a traditional 2-hour lecture in which participants will be given the opportunity to ask questions and engage in discussion. Participants in group 2 will receive no lecture and will be divided into groups of 10. Each group of 10 will rotate through 4 evolving case study stations that will use clinical decision making questions regarding AMI content experiences and physiologic changes. The fifth station will involve the use of the HPS. Students will be given a time allotment to complete each of the first four stations. A faculty member will be available to guide and direct students through these stations.

The last station will contain a preprogrammed HPS that will replicate the physiologic changes that occur during AMI and will be reviewed during the first 4 case study stations. This preprogrammed scenario will move the “patient” from admission to the onset of angina, then to increasing angina, AMI and finally to improvement of condition. All students will have access to the same equipment such as stethoscopes, patient monitors and oxygen as well as the chart and physician orders. The AMIQ, the

Confidence Level tool (CL) and a demographic sheet will be administered to both groups prior to receiving the chosen instructional method. Upon completion of the simulation experience students will then participate with one of the faculty members in a 30-minute structured debriefing session that will encourage reflective learning among the students. The same AMIQ and CL tools will be administered as a post-test following instruction.

Research Design

This study is a prospective, quasi-experimental, pre-test/post-test comparison group design. The independent variable in this study will be the instructional method of classroom lecture versus the use of HPS. The dependent variables for this study include cognitive skill levels and confidence in the treatment of an AMI patient.

Instrumentation, Reliability and Validity

Two parallel forms (form A and form B) of the AMIQ will be developed by two raters who are experienced educators and experts in the content area of AMI. Each version will contain 20 multiple choice questions that will be cultivated from the following four major content domains of the nursing care of the AMI patient:

1. Diagnostic evaluation of patients suspected to have acute myocardial infarction and coronary artery disease.
2. Pathogenesis and prevention of acute myocardial infarction.
3. Nursing care of acutely ill acute myocardial infarction patients.
4. Nursing care of patients with acute myocardial infarction during early recovery and discharge teaching (Brannan et al. 2008, p.496).

To assess reliability and validity, both forms of the AQMI will be pilot tested with 16 nursing students. Eight students will be randomly assigned form A while the other half will be assigned form B. The total number of correct answers between forms A and B will be compared using a Pearson *r* correlation coefficient. Additionally the Spearman-Brown reliability coefficient will be used to assess the internal consistency between the parallel forms.

The Confidence Level tool (CL) will be adapted, with permission, to the purposes of this study. This tool originally measured the effects that computer-assisted learning had on baccalaureate nursing students' confidence levels of specific surgical nursing skills and has a reported reliability coefficient of .89. This tool will contain 34 questions using the four aspects of the nursing process: assessment, planning, implementation and evaluation. All questions will relate to the care of an AMI patient and will contain a Likert scale ranging from 1 (*completely lacking confidence*) to 4 (*very confident*).

Measures of Data Analysis

Statistics will be analyzed using SPSS version 17.0 for Windows with a significance level of .05. Sample characteristics will be characterized using descriptive statistics. Cronbach's alpha will be used to assess reliability of the CL tool for both groups in the pre- and post-tests. Research questions will be tested using multiple linear regression to control for pre-test scores and evaluate if the group assignments are significantly associated with post-test scores. Multiple linear regression was chosen as it will explain and model relationships between two or more explanatory variables (Yale University, 1997). It does this by associating values from the independent and dependent variables through a regression line of explanatory variables (Yale University, 1997).

Summary

This chapter describes the methods and procedures to be used in this study. Through the framework of experiential learning the variables of cognitive skills and confidence levels will be tested. A prospective, quasi-experimental, pre-test/post-test comparison group design will be used. A sample of 100 junior level nursing students will be assigned to either the control or the intervention groups. Data will be gathered using the Acute Myocardial Infarction Questionnaire and the Confidence Level tool as well as a demographic sheet. Data will then be analyzed using multiple linear regression. Significance levels will be set at an alpha level of .05. This research study is a replication of a previous study by Brannan et al (2008). Results will further establish the practical use and necessity of HPS in the education of baccalaureate nursing students.

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