A COMPARISON OF EDUCATIONAL STRATEGIES FOR THE ACQUISITION OF MEDICAL-SURGICAL NURSING KNOWLEDGE AND CRITICAL THINKING SKILLS: HUMAN PATIENT SIMULATOR VS. THE INTERACTIVE CASE STUDY APPROACH

by

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A COMPARISON OF EDUCATIONAL STRATEGIES FOR THE ACQUISITION OF MEDICAL-SURGICAL NURSING KNOWLEDGE AND CRITICAL THINKING SKILLS: HUMAN PATIENT SIMULATOR VS. THE INTERACTIVE CASE STUDY APPROACH

This study determined whether the use of the human patient simulator (HPS) as an educational intervention with nursing students was more effective than the use of interactive case studies (ICS) with respect to knowledge gain and critical thinking abilities and assessed the learner's perspective related to the experiences. Kolb's Experiential Learning Theory provided the framework. A multi-site, quantitative quasi-experimental two group pre-test and post-test design was utilized with a sample of 49 nursing students from two different nursing programs at a simulation center. After permission was obtained, the diploma and baccalaureate nursing students were pre-tested using a custom-designed Health Education Systems Incorporated (HESI) exam based upon ICS and HPS content, randomly assigned to either the ICS or HPS group, received the educational intervention, then were post-tested using another HESI exam based upon the same test blueprint. The HESI Scores were used to measure knowledge gain and critical thinking ability. Students also completed a researcher developed ICS / HPS evaluation form to assess their perspective of the teaching strategies.

Analysis of covariance (ANCOVA) revealed a significant difference with respect to knowledge gain using the HESI Conversion Score ($p=.018$) and HESI Scores ($p=.037$), and a significant difference with respect to critical thinking ability using the Critical Thinking subscore ($p=.051$), with the HPS group scoring significantly higher on the posttest. Descriptive statistics revealed that the student's perspective of the HPS experience was significantly more positive

when compared to the case study group with respect to the stimulation of critical thinking abilities (p=.070), perceived value (p=.001), the ability to transfer learning to the clinical setting (p=.059), need for inclusion in undergraduate education (p=.010), understanding of concepts (p=.010), invoking nervousness (p=.001), decreasing anxiety in the clinical setting (p=.074), and substitution for clinical experiences (p=.027). The results supported the use of simulation technology in undergraduate nursing education, demonstrated the effectiveness of the use of simulation as an innovative teaching strategy, validated the nursing students' positive experience with respect to simulation, and confirmed the cost-benefit ratio with respect to the resources needed to integrate simulation into an undergraduate nursing curriculum.

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PREFACE

"Some people come into our lives and quickly go. Some stay for awhile and leave footprints on our hearts. And we are never, ever the same." --Anonymous

I wish to express my sincere appreciation to those who have come into my life and forever made a difference during this challenge time. First, to my advisor and dissertation chair, Dr. Nelson: Thank you for guiding me down the path toward my doctoral degree. You knew when to let me wander, but, also, when to redirect me toward reaching my goal. To my dissertation committee, Carl Ross, Tom Zullo, and Ann Mitchell: I truly appreciate your scholarly input and expert feedback throughout my dissertation process. Because of you, I have conducted a quality research study and created a document that gives me great pride. To Lynda Davidson, Lynn George, Susan Lucot, Kathi Perozzi, and the administration, students, and faculty, *my colleagues*, at Robert Morris University: Without your support and understanding during this process, I could not have succeeded. To my friends Kathy Dobbin and Nadine Englert: Thanks for helping me to maintain my focus on completing my degree. (And, for providing some great comic relief throughout the process!) To the HESI gang, Ainslie and Mary: I am honored to have worked with such great scholars. Thanks for all of your expert advice. To my friend Susie and the "YaYa's": Thanks for the good coffee, great conversation, and for keeping me grounded. You were a breath of fresh air. To my parents, John and Sylvia Bender, and sister, Kim: Thank you for laying the foundation for high academic achievement and providing excellent role modeling throughout my life. It was this foundation that served as a springboard for success. To my children, Kayla, Sarah, Joshua, and Maura: You are my most profound achievement to date! I am so proud of all of you! And, finally, to my husband, Matthew: I could not have done this without your love and support. I understand what a challenge this was for us and I am forever grateful.

"Because I knew you, I have been changed…*for good*!" -Schwartz

1.0 INTRODUCTION: THE PROBLEM

Baccalaureate nurse educators face the challenge of finding optimal opportunities for students to learn the critical thinking skills necessary to care for patients with increased acuity, typical in today's health care system, without jeopardizing patient safety (Koh, 2002; Ravert, 2002; Weis & Guyton-Simmons, 1998). The current nursing shortage and increased acuity of patients amplify this problem(Roberts, 2000; Weis & Guyton-Simmons, 1998) resulting in the need for higher level critical thinking skills. Baccalaureate schools of nursing are rising to meet these challenges by incorporating innovative teaching approaches, exemplified by this project, increasing enrollment and adding Accelerated BSN curricular options to their programs (AACN, 2003, 2004; Bareford, 2001; Effken & Doyle, 2001; Ravert, 2004; Ribbons, 1998; Roberts, 2000; Weis & Guyton-Simmons, 1998). The newly developed Accelerated programs are offered to students who hold bachelor's degrees in fields other than nursing and require, on average, three semesters of concentrated instruction to earn a BSN.

In addition to the nursing shortage, there is a nursing faculty shortage(AACN, 2003). Current trends indicate that due to lack of faculty, many applicants to baccalaureate nursing programs have been denied admission (AACN, 2003). Nursing education is unique in that it demands a smaller instructor to student ratio during clinical rotations, when students actually apply their knowledge obtained through lectures and implement the nursing process in actual practice with human patients. Unfortunately, this nursing faculty shortage translates to an

increased instructor-to-student ratio on the clinical units. This allows little time for students to develop critical thinking skills and practice clinical decision-making with appropriate faculty guidance. Experiential learning theory (Kolb, 1984) has been used in health professions education to emphasize the importance of clinical practice in the educational process. It is during this clinical practice that the student has the opportunity to apply abstract concepts learned in the classroom in order to enhance learning and understanding of concepts. With today's changing health care environment, there is no guarantee that the clinical unit will provide the learning opportunities necessary to expose the student to low incidence but highly critical events (Haskvitz & Koop, 2004). The nursing shortage, nursing faculty shortage, and increased ratio of student nurses to clinical faculty on clinical units may jeopardize patient safety.

The Nursing Essentials of Baccalaureate Education, developed by the American Association of Colleges of Nursing, describes critical thinking as an integral component of nursing education and practice(AACN, 1998). Characteristics of critical thinking include the ability to reason, deduce, and induce based upon current research and practice findings(Conger & Mezza, 1996). In essence, the process involves using assessment skills in identifying patient problems, analyzing these problems in terms of their implications for the underlying disease process, psychosocial needs, and recovery, and taking actions to optimize the situation. In nursing, critical thinking is an integral part of clinical practice (Bareford, 2001; Roberts, 2000). It is through the application of critical thinking skills that student nurses can begin to make competent clinical decisions based upon patient situations and previous experiences.

Computer simulation has been used with success in nursing education to re-create real-world situations and facilitate the development of critical thinking skills (Boyce & Winne, 2000; Issenberg, Gordon, Stewart, & Felner, 2000; Ribbons, 1998; Weis & Guyton-Simmons, 1998).

Until recently, computerized mannequins could not realistically re-create the health care setting or offer “real-world” scenarios (Holcomb et al., 2002; Weis & Guyton-Simmons, 1998). Recent advances in technology have greatly enhanced the capability of human patient simulators (HPS) to duplicate the types of scenarios that students are likely to encounter in clinical practice. Further, they can provide them with the opportunity to safely practice decision-making skills in a controlled environment. HPS can recreate patient care situations and allow students to practice the application of the nursing process and critical thinking skills to guide their clinical decision-making (Bond, Kostenbader, & McCarthy, 2001; Fletcher, 1995; Holcomb et al., 2002; O'Donnell, Fletcher, Dixon, & Palmer, 1998; Reznek, 2000; Schwid et al., 2002).

During the HPS process, nursing students experience a real-life patient problem and follow the nursing process by actually interacting with the HPS. The nursing student collects data on the HPS through the assessment process, analyzes this data, and intervenes based upon the patient situation. The HPS is programmed to respond appropriately to the student’s intervention, whether it is correct or incorrect. Therefore, the HPS can either recover from the problem or suffer demise by the lack of intervention or as a result of an inappropriate intervention by the student. Following the simulated patient scenario, debriefing is performed by the faculty member to give the student immediate feedback regarding his or her performance (Bruce, Bridges, & Holcomb, 2003; Hravnak, Tuite, & Baldisseri, 2005). During the debriefing process, the faculty member and student discuss performance during the simulated patient scenario, explore alternative actions, and allow the student an opportunity to ventilate feelings and reflect upon performance; this process is integral to the learning process (Alinier, 2003; Haskvitz & Koop, 2004; Seropian, Brown, Gavilanes, & Driggers, 2004b; Thiagarajan, 1998). It is during this process that students have been observed to have intense emotional responses,

especially when a patient suffered a negative outcome (Laerdal, 2005). The debriefing process, while usually constructive, can invoke psychological trauma for some, and therefore should be led by someone trained in this skill (Seropian et al., 2004b).

Although the use of HPS has increased in frequency, minimal research has been conducted with baccalaureate nursing students. More research is needed to validate the actual student outcomes of enhanced critical thinking abilities, improved clinical decision making, and increased clinical competence (Cioffi, 2001). In a study evaluating student and faculty perceptions regarding the use of HPS, researchers found that while 100% of the faculty agreed that the skills learned during the simulation would be transferable to a real clinical setting, *only half* of the students agreed (Feingold, Calaluce, & Kallen, 2004). Others recommend increased research regarding the issues surrounding pedagogy and the integration of new technologies in nursing education, and their impact upon students(Mallow & Gilje, 1999). While more research is needed, randomized clinical trials in education may not be the best approach in that the choice of educational method is removed from the participants, and quality and utility are not examined (Long, 2005). In addition, measuring educational outcomes of simulation through the use of appropriate evaluation tools must become established practice (Long, 2005).

Administratively, the use of HPS in nursing education is associated with extreme costs related to the purchasing and maintenance of equipment (Nelson, 2003), the planning of an appropriate instructional space, and the training and practice of faculty members regarding the use of the simulation technology (Nehring, Lashley, & Ellis, 2002; Seropian, Brown, Gavilanes, & Driggers, 2004a; Ziv, Small, & Wolpe, 2000). Faculty need the appropriate training to learn the software and understand how to implement this technology into the curriculum with the students (Nehring et al., 2002). Administration should develop an appropriate vision and

business plan outlining the costs and use for simulation prior to purchasing the equipment (Long, 2005; Seropian et al., 2004a). Additional research must be conducted to examine the cost benefit ratio with respect to the integration of simulation into the nursing curriculum (Ravert, 2002). In summary, there is a lack of research in the literature related to the use of simulation as an effective teaching strategy in nursing education. Minimal studies examined nursing students' experiences with respect to simulation, and very few examined the cost-benefit ratio with respect to the integration of simulation into a nursing curriculum.

1.1 PURPOSE

Minimal studies have been conducted to examine the effects of high fidelity human simulation upon knowledge gain and critical thinking abilities with undergraduate students in medical-surgical nursing. In addition, minimal studies have been conducted to examine the undergraduate student's experience utilizing the educational intervention of high fidelity human simulation. Therefore, the purpose of this study is to determine whether the use of the human patient simulator (HPS) as an educational intervention with nursing students is more effective than the use of written case studies with respect to knowledge gain and critical thinking abilities in an effort to inform nurse educators regarding effective pedagogical strategies. In addition, this study will also assess the learner's perspective related to the HPS experience. The problem under investigation can be further expressed by the following research questions.

1.2 RESEARCH QUESTIONS

1. How does the effect of an educational intervention using the HPS on nursing students' knowledge compare to the effect of an educational intervention using an interactive case study (ICS)?
2. How does the effect of an educational intervention using the HPS on nursing students' critical thinking abilities compare to the effect of an educational intervention using an interactive case study (ICS)?
3. What is the nursing student's perspective of the HPS and ICS activities?

1.3 SIGNIFICANCE OF THE STUDY

This study may inform nurse educators and educational administrators of the effectiveness of the use of HPS with undergraduate nursing students. It is important to determine whether the use of the HPS with undergraduate nursing students is superior to the use of other educational strategies, as the use of HPS is associated with extreme costs related to purchasing of equipment and faculty training and development. This study will attempt to determine if the use of HPS as an educational intervention with nursing students can actually increase knowledge and critical thinking abilities. If it is determined that the use of HPS can enhance knowledge and critical thinking abilities with undergraduate nursing students, then the costs can be justified. Ultimately, if the use of the HPS as an educational intervention is shown to be superior, then the outcome will result in better prepared students in the clinical area, thus improving patient safety.

In addition, as education becomes more "learner centered", it is important to assess the student's perspective of the simulation experience in an effort to improve the overall educational experience. This study will help instructors understand how students react to the HPS experience, thus providing them with opportunities for improving their teaching methods.

1.4 DEFINITIONS OF TERMS

For the purpose of this study, the following operational definitions will be utilized:

Critical Thinking Abilities: the ability to reason, deduce, and induce based upon current research and practice findings (Conger & Mezza, 1996); the foundation for sound clinical decision-making in nursing

Educational Intervention: an innovative instructional strategy used to enhance learning and critical thinking abilities in nursing students; for the purpose of this study, the two educational interventions are the use of an HPS scenario and an ICS

Human Patient Simulator (HPS): a high-fidelity, lifelike computerized mannequin that can be programmed to respond to real-world inputs in an effort to mimic the reality of a clinical environment.

Learner's Perception: the thoughts and feelings the learner has in response to an educational intervention

Nursing Knowledge: knowledge regarding the appropriate care to deliver to a patient based upon the nursing process.

Nursing Student: a person enrolled in a pre-licensure nursing program, who, upon successful completion of the program, is eligible to take the NCLEX-RN licensure exam and work in the role of the professional registered nurse. For this study, the sample consists of both diploma (those in a 16 month hospital-based program) and baccalaureate (those in a four-year university-based program) nursing students.

Scenario: the description of the environment and events that are programmed to occur during an interactive educational session with the human patient simulator, including a pre-learning activity, the scenario interaction, and a debriefing session.

Simulation: activities meant to mimic the reality of a clinical situation (Jeffries, 2005a)

Interactive case study (ICS): an educational strategy used to promote critical thinking; a "real life" clinical problem is presented on paper and critical thinking questions are posed; nursing students are expected to answer these questions after discussion with one another, but without instructor guidance

1.5 ASSUMPTIONS

For the purposes of this study, the following researcher assumptions are expressed:

- Active learning strategies can enhance nursing student learning.
- Practical opportunities for nursing students to apply knowledge learned in the classroom can enhance student learning.
- Although actual clinical experiences provide the best learning opportunities for student nurses, an educational intervention with the HPS can be a reasonable substitute.
- All students have the opportunity to learn through the use of the HPS.

- Practical experiences with the HPS are NOT meant to replace clinical experiences in the hospital.
- The HPS scenarios for an educational intervention must be carefully developed and tested by nurse educators.
- Incorporating the use of the HPS technology in nursing education is not only challenging for nursing faculty, but also expensive.
- Critical thinking abilities in nursing students are context dependent.
- Traditional methods of measuring critical thinking abilities in nursing students have not proven to be successful.
- The Health Education Systems Incorporated (HESI) developed exams can provide a reliable measure of critical thinking abilities in medical-surgical nursing based upon the methods used to develop the questions.
- For an educational strategy to be deemed successful, the teacher must not only evaluate learning outcomes, but also the student perspective of the experience.
- More research must be conducted to evaluate learning outcomes and student perspective associated with the use of the HPS as a learning strategy.

1.6 LIMITATIONS

This study was conducted with a convenience sample from two schools of nursing: one baccalaureate school and one diploma school with differing ages of students. In addition, the sample size was small due to availability of subjects thereby limiting the generalizability of the results. Although the researcher attempted to control for extraneous variables affecting the

outcome, due to the quasi-experimental nature of this design, true causality cannot be inferred. In educational research, due to curricular constraints, controlling for extraneous variables is difficult. For example, the students who were enrolled later in the study had more clinical experience than the ones enrolled earlier based upon the chronological nature of the semester. Although there were clear guidelines for the case studies, the case studies were led by both clinical instructors and a graduate student, thus limiting the control over the instructional technique, whereas the simulations were led by the researcher.

Instrumentation was also viewed as a limitation of the study. The Health Education Systems Incorporated (HESI) exam used to evaluate the knowledge gain and critical thinking abilities may have invoked feelings of anxiety in the students, based upon the general testing situation and the use of the computer to administer the exam. The Simulation and Case Study Evaluation Survey was a researcher developed tool with unknown psychometrics, although it was reviewed by expert nurse educators and pilot tested with this group. Also, one group of students in the study had experience with the HESI exam, while another group of students had experience with an exam provided by another vendor.

Finally, adequate control over extraneous variables, such as the impact of previous clinical experiences, was difficult to achieve in this study. The notion of multiple causation may have affected this research study. Therefore, it is difficult to link any anticipated or observed change in HESI performance to the educational intervention alone, especially with the limited number of participants.

2.0 THE LITERATURE REVIEW

This literature review focuses on the challenges of nursing education, a review of critical thinking literature, and a history and review of the use of simulation in the education of health science students. Kolb's Theory of Experiential Learning is summarized along with a description of Selye's stress response. Finally, gaps in the literature are identified.

2.1 THE CHALLENGE OF BACCALAUREATE NURSING EDUCATION

Baccalaureate nurse educators face the challenge of finding optimal opportunities for students to learn the critical thinking skills necessary to care for patients with increased acuity, typical in today's health care system, without jeopardizing patient safety (2002; Ravert, 2002; Weis & Guyton-Simmons, 1998). The current nursing shortage and increased acuity of patients amplify this problem(Roberts, 2000; Weis & Guyton-Simmons, 1998) resulting in the need for higher level critical thinking skills. Baccalaureate schools of nursing with the support of the American Association of Colleges of Nursing (AACN) are meeting these challenges by incorporating innovative teaching approaches, increasing enrollment, and adding Accelerated BSN curricular options to their programs (AACN, 2003, 2004; Bareford, 2001; Effken & Doyle, 2001; Ravert, 2004; Ribbons, 1998; Roberts, 2000; Weis & Guyton-Simmons, 1998). The newly developed accelerated programs are offered to students who hold bachelor's degrees in fields

other than nursing and require, on average, three semesters of concentrated instruction to earn a BSN. The addition of these non-traditional programs has changed the composition of the nursing student in higher education. Historically, the age of the "traditional" nursing student was 18 years of age. Yet since 1995, the average age of the nursing student enrolled in all types of programs has increased to 30 years of age (Spratley, Johnson, Sochalski, Fritz, & Spencer, 2000). This changing student composition has direct implications for nursing faculty regarding appropriate pedagogical techniques (AACN, 2003). These mature students often have multiple commitments to family and jobs in addition to their educational obligations. Characteristics of adult learners include: independence and self-motivation, an eagerness to learn that is related to their daily social and professional roles, a need for immediate application of knowledge gained, and the importance of experience laying the foundation for their continued life-long learning (Knowles, 1984). Therefore, they require a focused curriculum that is relevant and "no-nonsense", which is immediately applicable to their lives (AACN, 2003). Being able to accommodate teaching strategies for multiple groups of students is a challenge to today's nursing faculty members.

In addition to the nursing shortage, there is a nursing *faculty* shortage(AACN, 2003). Current trends indicate that due to lack of faculty, many applicants to baccalaureate nursing programs have been denied admission (AACN, 2003). The Bureau of Labor Statistics projects one million vacant positions for registered nurses by the year 2010, caused, in part, by the increasing demand for nursing care and the aging workforce (AACN, 2003). Yet, a 2002 survey conducted by the AACN determined that over 5,000 qualified applicants to schools of nursing were denied admission citing faculty shortages 41% of the time (Berlin, Stennett, & Bednash, 2003). Other factors cited included an aging nursing faculty and limited numbers of doctorally

prepared nurses choosing careers in higher education. Nursing education is unique in that it demands a smaller instructor to student ratio during clinical rotations, when students actually apply their knowledge obtained through lectures and implement the nursing process in actual practice with human patients. Unfortunately, this nursing faculty shortage translates to an increased instructor-to-student ratio on the clinical units, yet the AACN does not recommend changing this practice due to issues of patient safety (AACN, 2003). This allows little time for students to develop critical thinking skills and practice clinical decision-making with appropriate faculty guidance. In addition, there is no guarantee that the clinical unit will provide the learning opportunities necessary to expose the student to low incidence but highly critical events(Haskvitz & Koop, 2004). Based upon the aforementioned reasons, nursing faculty must begin to explore alternative methods of instruction including the implementation of innovative technologies to maximize the baccalaureate educational process for nurses(AACN, 2003; Jeffries, 2005b).

2.2 CRITICAL THINKING IN THE NURSING CURRICULUM

The Nursing Essentials of Baccalaureate Education, developed by the American Association of Colleges of Nursing, describes critical thinking as an integral component of nursing education and practice(AACN, 1998). In addition, the National League for Nursing (NLN) requires that accredited programs demonstrate that their students are developing the skills of analysis, reasoning, decision making, and independent judgment which are necessary components of the critical thinking process (1989). Although critical thinking has been studied in the nursing literature for several years, experts have not come to consensus with respect to a definition or a way to evaluate and measure the concept (Ali, Bantz, & Siktberg, 2005; Billings

& Halstead, 2005; Brunt, 2005a; Duchscher, 1999; Kataoka-Yahiro & Saylor, 1994; Rane-Szostak & Robertson, 1996; White & Gomez, 2002). One expert suggests that the cognitive process of critical thinking is characterized by a process of analyzing, synthesizing, and evaluating information that is collected through observation, reflection, experience, or communication which may lead to a particular belief or action (Paul, 1993). Kataoka-Yahiro & Saylor (1994) define critical thinking in nursing as "reflective and reasonable thinking about nursing problems without a single solution and is focused on deciding what to believe and do" (p. 352). They also define five components of critical thinking: specific knowledge base, experience, competencies, attitudes, and standards.

To develop skill performance in nursing practice, the student must be encouraged to apply reflective, critical thought and be given the opportunity to use sound principles of reasoning to decision-making (Paul & Heaslip, 1995). Another expert defines critical thinking as a reasoning and reflective process that includes decision-making and problem-solving regarding how to believe or act (Ennis, 1985). Characteristics of critical thinking include the ability to reason, deduce, and induce based upon current research and practice findings (Conger & Mezza, 1996). In essence, the process involves using assessment skills in identifying patient problems, analyzing those problems in terms of their implications for the underlying disease process, psychosocial needs, and recovery, and taking action to optimize the situation.

The critical thinking process defined by experts, Watson and Glaser, in 1964 generally mirrors the nursing process as stated in a Critical Thinking Text published by Brooks, et al. (Duchscher, 1999). The critical thinking process as compared to the nursing process is: delineating a problem (assessment), selecting pertinent information for solving the problem (planning), recognizing stated and unstated assumptions (planning), formulating or selecting

relevant hypotheses (nursing diagnosis), and identifying valid conclusions and validity judgment of inferences (evaluation) (Duchscher, 1999). Although many nurse educators see critical thinking as reflecting the nursing process, many feel that this omits other important parts of critical thinking, including the behavioral and/or affective components (Ali et al., 2005).

In nursing, critical thinking is an integral part of sound clinical judgment (Alfaro-LeFevre, 1995; Bareford, 2001; Daly, 1998; Kataoka-Yahiro & Saylor, 1994; Oermann, 1997; Roberts, 2000). It is through the application of critical thinking skills that student nurses can begin to make competent clinical decisions (Martin, 2002) based upon patient situations and previous experiences. In addition, the development of critical thinking skills, and, therefore, competent clinical decision-making is not achieved through one method alone, but through the implementation of multiple teaching-learning strategies such as clinical practice, simulation strategies, Socratic questioning methods, and written assignments (Oermann, 1997), and the use of open-ended, context-based questions to evaluate students rather than the use of multiple choice tests (Oermann, Truesdell, & Ziolkowski, 2000). Making competent clinical decisions is also dependent upon one's confidence in his or her ability to apply these critical thinking skills correctly, yet few studies that examine nursing students' confidence levels have been conducted (Seldomridge, 1997).

Nursing education facilitates competence through a process that requires students to examine knowledge that is relevant to practice (Milligan, 1998). Competence is defined by the context in which a critical situation arises (Daly, 1998; Epstein & Hundert, 2002; Milligan, 1998), so that competence in medical-surgical nursing practice may differ from competence in another specialty of nursing practice. Also, the context of a situation is an important part of clinical reasoning and it's impact upon competent and patient-specific delivery of care (Daly,

1998). Because of this, one authority suggests that we move away from trying to test general "critical thinking", and move toward measuring nursing specific clinical thinking and health care specific critical thinking (Tanner, 2005).

Some experts suggest that nursing education must shift from competency based education to problem based learning in order to facilitate critical thinking skills (Bechtel, Davidhizar, & Bradshaw, 1999). Problem based learning is built upon the utilization of critical thinking skills to make decisions in the clinical setting (Garrett & Callear, 2001) and often requires more faculty time to develop than competency based education. Examples of the use of problem based learning in the curricula would be for nursing faculty to provide initial data regarding a patient condition either through a case study or simulation, and allow the student time to collect data, analyze the data set, and arrive at the appropriate conclusions. Competency based education remains more traditional in the emphasis upon the validation of the achievement of objectives, rather than the actual learning process of the student. These experts suggest that the incorporation of problem based learning in addition to utilizing competency based education for evaluating the student in the nursing curriculum is paramount in assisting with the critical thinking and clinical judgment skills of new graduates (Bechtel et al., 1999).

Although no clear definition of critical thinking exists, critical thinking measurement inventories have been developed. Two of the most widely used commercial instruments used to measure critical thinking are the Watson-Glaser Critical Thinking Appraisal (WGCTA) (Watson & Glaser, 1964) and the California Critical Thinking Skills Test (CCTST) (Facione & Facione, 1992) and the companion California Critical Thinking Disposition Inventory (CCTDI) (Billings & Halstead, 2005; White & Gomez, 2002). The three subscores of the CCTDI: analysis, evaluation, and inference, are major core skills identified in the Delphi Report for the theory of

critical thinking, published in 1990, that defined the "ideal critical thinker" as being "habitually inquisitive, well informed, trustful of reason, open minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit" (Facione, 1990)(p. 3). Although these two instruments have been used and tested with nursing students, the results have been inconsistent, with few authors reporting an increase in critical thinking abilities as students progress through the curriculum, and others showing no significant increase as a result of student progression (Adams, Stover, & Whitlow, 1999; Billings & Halstead, 2005; Brunt, 2005a; Maynard, 1996; Profetto-McGrath, 2003; Tanner, 2005; White & Gomez, 2002). One study did, however, find a statistically significant increase in critical thinking abilities as measured by the WGCTA when *practicing nurses* were tested (Maynard, 1996) suggesting that practice and experience can enhance critical thinking. Measuring critical thinking is challenging, and the use of commercial instruments, to some extent, have been favored, although when reliability and validity are not established, alternative measures of performance, such as portfolios and performance evaluation, are recommended (Rane-Szostak & Robertson, 1996).

One group of educators used the CCTST to measure the effects of using videotaped vignettes to enhance critical thinking skills in nursing students. In addition, the students' nursing knowledge was assessed using an instructor developed exam that focused on the topics in the vignettes. A pretest/posttest design with a sample of 83 nursing students was used, and, while data analysis revealed an increase in nursing knowledge after experiencing the vignettes, there was no increase in core critical thinking skills after the vignettes, suggesting that the use of the

CCTST, a general test to measure critical thinking, may not be the best measure with nursing students. In addition to the quantitative measures, student and faculty interviews were conducted to identify their perceptions regarding the usefulness of the method of instruction. In general, both students and faculty members were satisfied with the learning experience.

White & Gomez (2002) used the CCTST and CCTDI to measure the critical thinking abilities of 29 students enrolled in an RN to BSN completion program at the beginning and end of their year-long study. Although the scores of both exams increased, results were not found to be significant, perhaps due to the small sample size. No correlations were found between age, ethnicity, sex, or years of work experience and their scores on the critical thinking inventories. Similarly, another group of educators performed a similar study using 228 students and identical measures, with no statistically significant results (Profetto-McGrath, 2003).

Using a nonexperimental, descriptive design, another group of researchers studied 143 senior level baccalaureate students to determine if there was a relationship between critical thinking abilities and clinical competence (May, Edell, Butell, Doughty, & Langford, 1999). The CCTST and CCTDI were used to measure critical thinking abilities, and clinical competence was measured by a faculty-created clinical competency test using a Likert-type scale that faculty used to measure student performance. Data analysis revealed that although students were able to think critically, there was no statistically significant correlation between their clinical competence and critical thinking total scores. These researchers suggest that critical thinking and clinical competence may not, in fact, merge until some time after the students become practicing nurses.

A longitudinal evaluation of baccalaureate nursing students' critical thinking abilities was conducted using the WGCTA as the measurement instrument (Adams et al., 1999). Using a

sample of 203 baccalaureate nursing students enrolled in one nursing program, the researchers sought to determine if the scores of the sophomore level students would differ in comparison to the senior level students. Data analysis did not reveal any increase of critical thinking abilities between the sophomore and senior years, leading the researchers to suggest that, even with the large sample size, the WGCTA is a nonviable instrument when used with nursing students

Jenkins and Turick-Gibson (1999) used role playing and a qualitative design to assess the development of critical thinking skills using the three components of mental operations (knowledge, and attitudes and dispositions) to provide evidence of critical thinking. Following a role play scenario, students used journaling to describe the experiences. Qualitative analysis revealed that the journals provided evidence of critical thinking abilities in the researcher's three predetermined components. The researchers suggested that this interactive instructional design promotes a positive learning experience and provided the opportunity for students to apply their knowledge which, in turn, developed the mental operations, knowledge, and attitudes of critical thinking.

In an integrated review of the literature surrounding critical thinking in nursing, Brunt (2005a) found that although several studies exist examining aspects of critical thinking, a clearly defined, consistent definition of critical thinking was lacking. In addition, studies have not supported a clear relationship between critical thinking and competence. She suggests a definition of critical thinking: "the process of purposeful thinking and reflective reasoning where practitioners examine ideas, assumptions, principles, conclusions, beliefs, and actions in the context of nursing practice" (p. 66). Based upon the review, she suggests that certain teaching strategies such as using context dependent questions, Socratic questioning, discussion

strategies, and scenario-based case studies can enhance the development of critical thinking skills in nurses (Brunt, 2005b).

One researcher suggests that there is a crisis in critical thinking among new graduate nurses (Del Bueno, 2005). Based upon the results of her performance based development system assessment (PBDS) tool, del Bueno reports that only 35 percent of new RN graduates, regardless of educational preparation, meet her entry level expectations for clinical judgment. This researcher feels that nursing curricula need to focus less on "teaching content", and more on the use of or application of knowledge through clinical practica. She also emphasizes the importance of a clinical coach or preceptor that continues to ask the new nurse critical thinking questions, rather than just imparting more information upon the learner. The importance of practice and questioning of the learner at the application, analysis, and synthesis level can lead to the enhancement of critical thinking skills, and, therefore, clinical judgment and competence. Based upon her four components of critical thinking (Del Bueno, 2001): problem recognition, problem management, differentiation of urgency, and rationale, Tong and Henry (2005) are in the process of developing a PBDS system for evaluating nursing students, using video scenarios and open ended questioning to qualitatively evaluate students. Testing should be done, though, to determine whether this is a valid assessment tool for use with nursing students.

One educator / researcher developed a midrange Theory of Critical Thinking of Nurses based upon the works of Benner and Paul, and tested this theory through research with 149 nursing students (Martin, 2002). Patricia Benner in her theory, From Novice to Expert, offers a framework for understanding how nurses gain experience in the clinical setting, therefore, allowing them to progress through the five stages of professional competence: novice, advanced beginner, competent, proficient, and, finally with intuition and continued experience, they

become expert practitioners of nursing (Benner, 1984) . Based upon this theory, the Theory of Critical Thinking in Nurses suggests that as a nurse moves from novice to expert level through the use of experience and knowledge acquisition, critical thinking is enhanced and, therefore, used for clinical decision making (Martin, 2002). To test this, Martin used a researcher developed instrument in consultation with critical thinking experts entitled the Elements of Thought Instrument that measures critical thinking and clinical decision making ability of nurses, with validity established by Dr. Paul. The sample consisted of ADN and BSN, students, new graduates, and experienced nurses with various certifications. Data analysis revealed that critical thinking skills were positively correlated with clinical expertise, with nursing students having the lowest scores and experienced nurses scoring highest. Decision-making scores increased with levels of experience, and no significant differences were found in critical thinking or decision-making between BSN and ADN students. The researcher states that a definite limitation to this study is the use of the new tool and the limited and non-randomized sample size.

In response to the need for a consistent definition for critical thinking, Scheffer and Rubenfeld (2000) developed a consensus statement about critical thinking in nursing based upon the results of a Delphi study. A panel of 55 experts in nursing from nine different countries determined: "Critical thinking in nursing is an essential component of professional accountability and quality nursing care. Critical thinkers in nursing exhibit these habits of the mind: confidence, contextual perspective, creativity, flexibility, inquisitiveness, intellectual integrity, intuition, open-mindedness, perseverance, and reflection." (p. 357). It is interesting, though, that since this new conceptualization has been created, publications that use this new definition to guide instrument development or further research in nursing education have not been found (Tanner, 2005).

In summary, the review of literature on critical thinking by nursing students suggests that while critical thinking is difficult to define, it is perhaps even more difficult to measure. The Health Education Systems Incorporated (HESI) is a proprietary organization that administers standardized exams for schools of nursing to assess student competency and evaluate achievement of curricular outcomes (Morrison, Adamson, Nibert, & Hsia, 2004). Since 1999, the number of schools of nursing using the standardized exams has increased by 565%, with many incorporating their use into progression policies, due the published reliability and validity data related to the exams. The HESI corporation provides a variety of exams including a comprehensive exit exam that has demonstrated a high degree of criterion-related validity in the accuracy of predicting NCLEX success (Spurlock & Hanks, 2004) , and specialty exams for different areas of nursing, one being medical-surgical nursing (Morrison et al., 2004). These methods for exam construction and evaluation are rooted in critical thinking theory (Paul, 1990) and the cognitive taxonomy developed by Bloom (Bloom, Krathwohl, Englehart, Furst, & Hill, 1956), and are continually being re-evaluated by the HESI corporation.

When writing test items, HESI incorporates four components: including the rationale for each item, writing the test item at the application level or above according to Bloom's taxonomy (Bloom et al., 1956), requiring multi-logical thinking to answer each question, and requiring a high level of discrimination to choose among plausible alternatives (HESI, 2005; Morrison et al., 2004). The Medical-surgical Nursing Exam is one specialty exam that evaluates the student on knowledge and competencies in medical-surgical nursing. Because HESI applies this detailed model to test item development, critical thinking components such as higher level thinking and reasoning during decision making are assessed in addition to medical-surgical nursing knowledge. To calculate the scores, HESI uses a predictability model (HPM) that does not

produce a percentage score, but rather uses item difficulty level and regression analysis to produce the score. The HESI corporation assigns a total score, but also provides specific scores based upon the categories of the nursing process, NCLEX client need categories, nursing specialty areas, and the NLNAC categories of critical thinking, therapeutic communications, and therapeutic nursing interventions. Therefore, the student and instructor receive a comprehensive and detailed report of performance in many categories, providing details for formative evaluative purposes. The student not only receives a total score immediately, but also receives feedback regarding each item making this process both formative and summative for the student.

Each test returned to HESI undergoes item-analysis and measures of reliability. The Kuder Richardson Formula 20 (KR-20) and point biserial correlation coefficients are calculated for each test item. The estimated KR-20 for the medical-surgical specialty exam is reported at 0.919, with each test item being used from between 4,525 and 17,997 times between the years 1999 and 2003. Storage of data from all HESI scores is used in the projected reliability for each test administered. In addition, content validity of each exam has been established through the use of input from expert nursing educators and clinicians by evaluating the relevance of the content to entry-level nursing practice. Construct validity is evaluated through the use the NCLEX test blueprints as a foundation for the exams, and by the fact that many nursing faculty members and schools of nursing trust the data reported by the exams, giving confidence to their use for progression policies and remediation techniques (Morrison et al., 2004). Several non-published thesis studies have successfully demonstrated convergent validity by showing a positive correlation between the student's HESI scores and their course grades and cumulative grade point averages (Morrison et al., 2004). Since measures of critical thinking should be context dependent, the use of a valid and reliable medical-surgical nursing exam constructed

according to these classical methods may be the best available way to measure student's critical thinking skills with respect to medical-surgical nursing content.

2.3 THE HISTORY OF SIMULATION AND HUMAN PATIENT SIMULATION

Simulations can be defined as "activities that mimic the reality of a clinical environment" (Jeffries, 2005a) and have been used instructionally in a wide variety of professions including the aviation industry, space flight, firefighting, and combat (Gaba, 1992). The fidelity, or "realness", of simulations can vary in many ways, such as the use of simple case studies, utilization of human actors to present clinical scenarios, two dimensional computer-based simulations, and the use of high-fidelity patient simulators that respond to real-world inputs realistically (Jeffries, 2005a; Laerdal, 2005; Seropian et al., 2004b). While simulation has been used by the aviation industry with flight training for years (Rhodes & Curran, 2005; Rolfe & Staples, 1986), the use of a rudimentary human patient simulator in the health care field was first introduced in 1969 to assist anesthesia residents learn the skill of endotracheal intubation (Abrahamson, Denson, & Wolf, 1969; Gaba & DeAnda, 1988). But more realistic human patient simulators were not created until 1988 and were used primarily to train anesthesiologists. Since then, the medical community and, especially, anesthesia has used human patient simulation (HPS) to teach technical skills and crisis management in an effort to produce more skillful practitioners (O'Donnell et al., 1998). The benefit of using simulations in education is to expose the student to high risk, low occurrence "critical events", and practice in a safe-environment, incurring no harm to a "real patient" (Chopra et al., 1994; Gaba, 1992). Until recently, computerized mannequins could not realistically re-create the health care setting or offer real-world" scenarios (Holcomb et

al., 2002; Weis & Guyton-Simmons, 1998). Recent advances in technology have greatly enhanced the capability of human patient simulators (HPS) to duplicate the types of scenarios that students are likely to encounter in clinical practice. Further, they can safely practice decision-making skills in a controlled environment. HPS can recreate patient care situations and allow students to practice the application of the nursing process and critical thinking skills to guide their clinical decision-making (Billings & Halstead, 2005; Bond et al., 2001; Fletcher, 1995; Holcomb et al., 2002; O'Donnell et al., 1998; Reznek, 2000; Schwid et al., 2002).

2.4 LOW FIDELITY AND HIGH FIDELITY SIMULATION IN OTHER HEALTH CARE DISCIPLINES

Simulations have also been used as an evaluation tool in the health care setting, utilizing various levels of fidelity during the evaluations (DeVita, 2005; Holcomb et al., 2002). Simulations using human "actors", or standardized patients, have been used widely with success to evaluate performance of medical students in trauma courses (Ali et al., 1999; Ali, Cohen, Gana, & Al-Bedah, 1998). The use of a cardiology patient simulator was deemed successful in enhancing learning outcomes with respect to the ability to identify cardiac heart sounds for physician assistant training (Issenberg et al., 2000).

A group of health care educators evaluated trauma team performance using HPS for resuscitation training (Holcomb et al., 2002). The educators developed standardized trauma scenarios and an evaluation tool that was used by 10 3-person military trauma teams. This pilot study demonstrated the ability of the use of HPS to objectively evaluate team performance due to

the ability to reproduce clinical scenarios objectively. In addition, there was significant improvement in the trauma team's scores after participating in a 28-day trauma refresher course.

A group of anesthesia faculty used HPS to evaluate anesthesia residents' performance in critical situations (Schwid et al., 2002). Ninety-nine anesthesia residents consented to be videotaped and evaluated by three different anesthesia faculty members. Criterion and construct validity, internal consistency, and interrater reliability scores were calculated via statistical analysis. In conclusion, the researchers found the use of HPS to be a reliable and valid method of evaluating the performance, but the design, implementation, and evaluation tool used with the HPS needs to be enhanced before HPS is used for accreditation purposes.

The use of HPS in medical education with success has been widely reported in the literature (Gordon & Reznek, 2002; Reznek, 2000). Faculty and colleagues from the Harvard Division of Emergency Medicine along with anesthesia faculty from the Center for Medical Simulation developed a simulator-based medical education service, allowing students to practice medicine within a safe environment with the help of a physician-mentor (Gordon & Reznek, 2002). Over 90% of the students who have experienced this service over the years have recommended that the HPS exercises should be a mandatory component of their medical school education.

Many have used the HPS with professionals in the health care setting. Bruce, Bridges, & Holcomb (2003) describe the positive effects of using HPS to train United States Air Force nurses with respect to trauma and warskills. The technology allowed the trauma team members to practice their critical assessment skills and decision making abilities in a safe atmosphere, and also allowed faculty to evaluate their performance (Bruce et al., 2003).

Some have suggested that low fidelity simulations can be used in the professional setting to enhance effective teamwork and communication in providing safe care (Leonard, Graham, & Bonacum, 2004). Kaiser Permanente, a non-profit health system, utilizes the use of low fidelity simulations, such as walking through a peri-natal unit and mapping out all activities that would potentially be needed if an emergency caesarean section would need to be performed, and asking the participants to respond. In addition, higher fidelity simulations using mannequins driven from a laptop computer to enhance non-judgmental learning regarding challenging clinical situations have been used with success with their health care personnel (Leonard et al., 2004).

The use of simulation in the professional setting in the form of patient safety simulation laboratories has also been described by Nelson (2003). The author suggests using these simulation labs to evaluate evidence-based practices, design safety improvement projects, and test new emerging technologies in an effort to create a safer environment for health care workers and patients. Trossman (2005) describes the successful use of the HPS to orient new graduates in a large medical center, suggesting that the use of the HPS is helpful in recreating low occurrence high risk situations and easing the anxiety of new nurses. She also uses role playing to enhance assertiveness by assigning one other person in the scenario to be a "difficult" colleague. The use of HPS allows the new nurse to practice these anxiety-producing skills effectively within the safe environment of the simulation lab (Beyea, 2004; Trossman, 2005).

HPS technology has been used to train critical care nurses, according to Vandrey and Whitman (2001). The authors describe the use of HPS in recreating most any clinical event in a hospital-based critical care course, such as shock, myocardial infarction, pneumothorax, airway emergencies, and cardiac arrest. The students of the critical care course found the HPS

experience to be extremely helpful for learning and practicing their critical care skills in the safe environment of the HPS lab.

Bond, Kostenbader, and McCarthy (2001) questioned a diverse group of health care providers (n=78), both pre-hospital and in-hospital, to evaluate the level of acceptance of human patient simulators utilized in training methods after experiencing the HPS as a learning strategy. A 5 point Likert-type scale and open ended questions were asked. Data analysis revealed a high level of acceptance for the simulation training. The most positive comments related to the realism of the situation and the ability to see responses to treatments. Overall, this diverse group of health care providers were accepting of the use of this technology to enhance training methods (Bond et al., 2001).

Another group of nursing researchers conducted an interpretive approach to examine the effectiveness of an interdisciplinary approach to learning in helping care providers to understand their overlapping roles in the clinical management of asthma (Rodehorst, Wilhelm, & Jensen, 2005). CD's were used as the simulation medium, and students of nursing, medicine, respiratory therapy, and pharmacy were invited to participate. Themes were identified from the qualitative, interpretive analysis in an attempt to understand the students' perceptions of the usefulness of this interdisciplinary learning experience. A convenience sample of 26 health-care practitioners from four campuses of a large Midwestern university participated in focus groups with the intent of viewing a CD of asthma case study vignettes and answering a set of questions afterward. Transcribed answers were then analyzed for clusters, and then themes according to each practitioner's discipline. The themes were classified according to homophily (understanding the similarities of a discipline, yet knowing about their differences), norms, values, and cultures (addressing each profession's own attitudes and behaviors with the understanding that all must

work together as a team to promote quality care), professional orientation (the inclinations that are characteristic of a specific discipline and the social system that governs), and hierarchy (the social order of decision-making in health care). The researchers suggest that this type of interdisciplinary training utilizing CD simulations helped to clarify the roles of the different disciplines, and that the perception's of team members' roles could be better understood.

With the use of the HPS, the increasing fidelity allows the recording of objective data during a realistic event achieved, which further enhances the validity of the evaluation (Hamilton, 2005; Marsch et al., 2005). One group of researchers conducted a prospective study in a tertiary level intensive care unit to evaluate the adherence to algorithms of cardiopulmonary resuscitation of first responders in simulated cardiac arrests (Marsch et al., 2005). During the study, the researchers programmed a HPS to experience ventricular fibrillation in the presence of one nurse while the remaining two nurses were available to assist if needed. Medical residents were also members of the team. Results revealed that while the recognition and call for help occurred in an appropriate time frame, the first responders often did not build a team structure that facilitated ongoing team activity. Further research was suggested to examine ways to facilitate team building during emergency situations, and further evaluation with the use of HPS can assist in evaluating these new processes.

Another group of educators described the use of HPS in neonatal nursing training (Yaeger et al., 2004). The educators suggest that HPS is a valid way to teach neonatal nursing skills to novice nurses. Most preceptors or role models on the units are not trained in educational methodologies, making the use of HPS a valid alternative to time spent with untrained preceptors. The educators suggest that practice with HPS that includes a reflective, debriefing process offers many advantages to traditional educational techniques, with the potential to

improve human performance, enhance confidence, and reduce patient risk due to the ability to practice critical events in a safe, non-threatening environment.

2.5 THE USE OF LOW AND HIGH FIDELITY SIMULATION IN NURSING EDUCATION

Computer simulation has been used with success in nursing education to re-create real-world situations and facilitate the development of critical thinking skills (Anonymous, 2002; Boyce & Winne, 2000; Issenberg et al., 2000; Ribbons, 1998; Weis & Guyton-Simmons, 1998), but few studies have focused on the use of computer simulation with baccalaureate nursing students (Rhodes & Curran, 2005). The actual effect of the use of simulations upon educational outcomes is inconclusive (Cioffi, Purcal, & Arundell, 2005), partly due to lack of valid and reliable outcome assessment tools (Ravert, 2002). In addition, Seropian (2004b) suggests that although the use of simulation products in nursing education has increased over the past few years, there has been little or no instruction related to it's implementation, use, and value in the curriculum.

Ravert (2002) performed an integrative review of computer-based simulation in the education process and found 513 references, with only nine quantitative studies meeting her inclusion criteria of 1) containing some type of computer-based simulation, and 2) utilizing an outcome measure related to education. Based upon this review, she concluded that there is inconclusive evidence documenting the effectiveness of computer-based simulation on knowledge and skill acquisition. She also found that the number of studies involving healthcare

education was surprisingly low, suggesting that further studies in healthcare, and particularly nursing education is needed to fully validate the effectiveness of this educational intervention.

When incorporating multimedia or technology based educational resources into the nursing curriculum, it is important to consider those systems that provide formative feedback to the student, although these can be very costly (Garrett & Callear, 2001). One group of educators used a computer simulation of a community health situation to stimulate student interest and understanding community health issues (Bareford, 2001). Although a specific critical thinking instrument was not utilized, the researcher felt that student's critical thinking skills were enhanced due to the increased ability of the students to perform community assessments.

Roberts (2000) conducted an exploratory study with senior nursing students to describe students' care planning approaches with respect to a videotape simulated case study. Results revealed differences between the three groups of nursing students studied with respect to type of educational program, with those in a degree program scoring higher than those in a diploma program. The researcher suggests that the use of simulated experiences can provide an objective means to evaluate performance, but the evaluation tool should be reliable and valid.

One group of educators studied the effect of low-fidelity simulations, case study and role playing scenarios, upon baccalaureate nursing student's self-efficacy (Goldenberg, Andrusyszyn, & Iwasiw, 2005). In this descriptive study, a nonprobability convenience sample of 22 nursing students completed a researcher-developed 63 item Baccalaureate Nursing Student Teaching-Learning Self-Efficacy Questionnaire self-efficacy questionnaire describing their perceptions of self-efficacy both before and after the 2-day workshop incorporating the low fidelity simulations. Due to study constraints, students were administered both the pre and posttest at the same time, which may have interfered with the true meaning of the results. Results revealed that the

students' self-efficacy scores related to health teaching were significantly higher after the simulation experience ($p=0.001$). Significant differences between the pretest and posttest scores were also found with respect to the assessment, implementation, and evaluation phases of health teaching. When asked to evaluate the effectiveness of the simulations as a teaching method, over one-half rated them as effective, while one-third rated them as ineffective. The researchers recommend replicating the study with a larger sample size and performing the self-efficacy testing both before and after the simulations.

Another group of educators utilized an experimental design to investigate how the learner's cognitive style (verbal or visual learners) interacted with the computer interface design to affect the novice nurse's ability to learn using a computer simulation (Effken & Doyle, 2001). Eighteen nursing students were asked to solve three problems related to hemodynamics. Three different interface designs were used: a strip-chart display, an integrated balloon display, and an etiologic display. Two minutes were given for students to administer six different medications to correct the problem. Mixed design of analysis of variance was utilized to determine the effects of the computerized interface design and the cognitive learning styles of the students. Results revealed that students corrected more problems with the etiologic display than with the others, suggesting that the design of the simulation must correlate with the student's cognitive learning style. These researchers stress the importance of considering computer interface design and the student's learning style when developing simulations for nursing students.

In an effort to focus computer simulations on those issues deemed to be "important" to professional nurses, Rystedt and Lindstrom conducted a qualitative study to explore the educational values of these new technologies (2001). Fifteen professional nurses with varying levels of experience were interviewed about specific tasks in nursing which they felt were most

difficult to learn. Iterative analysis of scripts revealed six different aspects of nursing: judging the patient's health status, monitoring care interventions, prioritizing and carrying out interventions efficiently, communicating with patients and their relatives, cooperating with other members of the staff, and managing complexity. After these six themes were identified, an analysis was conducted to determine the participant's views on how the integration of simulation might contribute to the learning of these tasks. The respondents emphasized the importance of interpreting vague signs and symptoms, focusing on continuous monitoring in the care environment, responding to the dynamic care environment, the importance of interpreting both verbal and non-verbal communication cues, maintaining a cooperative approach among team members, and managing complex tasks, suggesting that all of these concepts be incorporated into simulation scenarios within a nursing curriculum (Rystedt & Lindstrom, 2001).

Weis and Guyton-Simmons describe the use of computer simulations in nursing education for teaching critical thinking skills (1998). The authors describe the design of a two dimensional computer scenario based upon the care of a patient with acute abdominal pain. The scenarios were written based upon the student's level of education and experience, with particular attention being paid to stimulating higher order thinking. The scenarios were then tested with a group of students, who were forced to interpret data, make decisions, and develop systematic plans of action, which, the authors felt, stimulated critical thinking abilities. Student response to the computer simulations was generally positive, and the authors stress the benefit of allowing students the opportunity to use HPS to practice in a safe environment.

2.6 HPS-HIGH FIDELITY SIMULATION IN NURSING EDUCATION

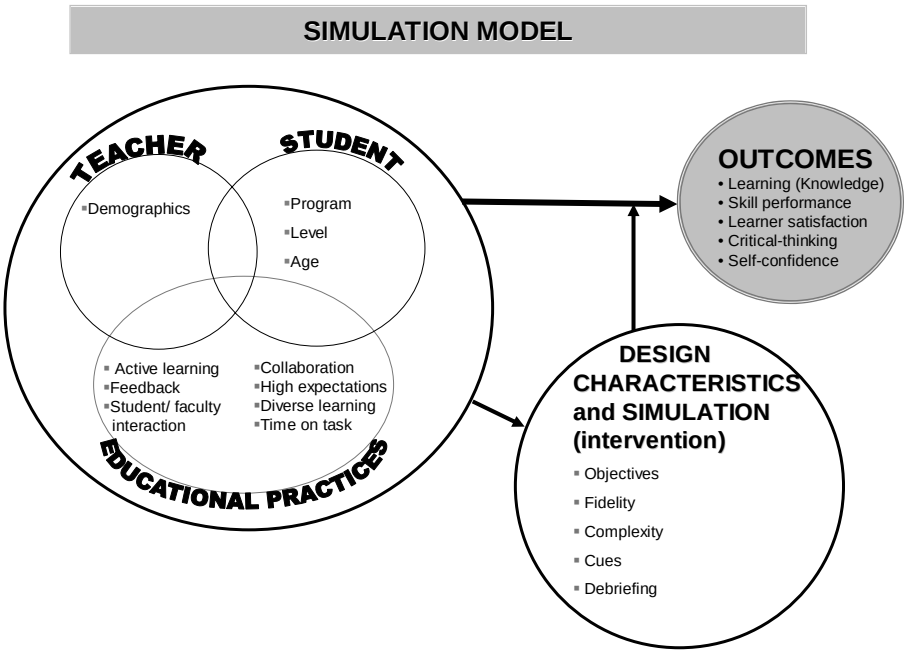
During the HPS process, nursing students experience a real-life patient problem and follow the nursing process by actually interacting with the HPS. The nursing student collects data on the HPS through the assessment process, analyzes this data, and intervenes based upon the patient situation. The HPS is programmed to respond appropriately to the student's intervention, whether it is correct or incorrect. Therefore, the HPS can either recover from the problem or suffer demise by the lack of intervention or as a result of an inappropriate intervention by the student. Following the simulated patient scenario, debriefing is performed by the faculty member to give the student immediate feedback regarding his or her performance (Bruce et al., 2003; Hravnak et al., 2005). During the debriefing process, the faculty member and student discuss performance during the simulated patient scenario, explore alternative actions, and allow the student an opportunity to ventilate feelings and reflect upon performance; this process is integral to the learning process (Alinier, 2003; Haskvitz & Koop, 2004; Seropian et al., 2004b; Thiagarajan, 1998). It is during this process that students have been observed to have intense emotional responses, especially when a patient suffered a negative outcome (Laerdal, 2005; Seropian et al., 2004b) The debriefing process, while usually constructive, can invoke psychological trauma for some, and therefore should be led by someone trained in this skill (Seropian et al., 2004b).

To maximize learning through the use of HPS, the simulation scenario must be properly designed (Cioffi, 2001; Jeffries, 2005a; Rystedt & Lindstrom, 2001). While developing two sets of childbirth simulations, one nurse educator utilized the following process: identify the assessment situation, obtain actual medical records of patients who present with these situations, create an introductory statement to be used by the "patient" in addition to a question and answer

series, test the content validity of the simulations by inviting an expert panel to review the scenario, and modify the simulations based upon the evaluation (Cioffi, 2001). Pilot testing with these scenarios was implemented with novice level clinicians to elicit anecdotal feedback. Responses were overwhelmingly positive, suggesting that adult learners may experience increased motivation and interest in the learning process when exposed to HPS as a teaching strategy. Cioffi suggests that clinical practice simulations need to have established validity, be process-based, and best mimic reality when minimal information is provided initially to the student (2001).

In response to the poverty of research and articles related to the implementation of simulation experiences in the nursing curriculum, the National League for Nursing in partnership with the Laerdal Corporation developed a simulation framework based upon empirical and theoretical literature (Jeffries, 2005a). This framework is useful for nursing education in an effort to assist with designing, implementing, and evaluating simulations used for teaching strategies. The simulation model is composed of five major components: teacher characteristics, student characteristics, educational practices, design characteristics of the simulation (the educational intervention), and outcomes.

Figure 1: Simulation Model



Within each component, variables exist that should be addressed when designing simulations. For example, teachers need to be facilitators of learning in this student-centered environment. In addition, teachers may need support with technology and simulation design. Within the simulation environment, students are expected to be self-motivated and responsible for their own learning, and their roles within the scenario should be clearly defined. Educational practices consist of active learning, providing appropriate feedback, facilitating student-faculty interaction, and fostering diverse, collaborative learning. A time frame for each scenario should be established. The simulation design focuses on the level of fidelity, which, for this study, is considered to be highly reality-based with the use of the HPS. Objectives should be clearly defined, and students will receive relatively little information at the start of the scenario, with the opportunity for the student to analyze the situation and ask appropriate questions to gather more data. The researchers suggest that debriefing may be the most powerful tool used following the

HPS experience, allowing students to reflect and analyze their performance critically, and adequate time should be allowed for this activity. Finally, the outcomes of a simulated experience should be those of knowledge attainment, improved skill performance, learner satisfaction, and increased self-confidence. Utilizing this framework can maximize the amount of student learning that occurs.

Nehring, Lashley, & Ellis, a group of nursing educators from Southern Illinois University, offered suggestions for using HPS for competency based instruction and teaching critical incident nursing management to undergraduate and graduate nursing students (2002). They defined critical incident nursing management (CINM) as a learner centered and interactive environment for educating students, while providing the objective means of using the HPS for evaluation. Structuring the scenarios from simple to complex is recommended as the students progress throughout the curriculum. The educators emphasize the importance of the debriefing process as a formative evaluative process, and also suggest using the HPS for summative evaluation in the form of performance skills checklists for each situation. Faculty considerations include: fostering a strong commitment from faculty to implement this innovative technology; designating one faculty member as central to the operation of the simulation programs; placing the computer software on individual faculty computers to foster scenario development and integration in the curriculum; instructing and orienting faculty with respect to the technology; and incorporating lesson plans that include objectives, prerequisite knowledge, relevant reading assignments, props, and a performance outline. Administrative considerations include the cost of the equipment and the time needed for faculty training and practice. To offset these costs, the authors suggest offering continuing education opportunities for professional nurses utilizing the HPS and charging a fee. The authors also suggest further studies with students to determine their

particular perceptions regarding the HPS experience, although their group of students was very enthusiastic (Nehring et al., 2002).

The use of simulations was implemented during the objective structured clinical examination (OSCE) with 86 nursing students at the University of Hertfordshire (Alinier, 2003). The OSCE in this particular study was comprised of several skills stations, some of which consisted of problem-based scenarios incorporating the HPS requiring students to demonstrate their critical thinking abilities. Overall, student response to the OSCE was extremely favorable, with several students desiring additional "hands-on" training. The researchers state, though, that if problem-based scenarios are incorporated throughout the OSCE process, students should be warned that they may be exposed to unfamiliar situations so that their level of confidence is not compromised in the process. Negative feelings could prevent future participation in another OSCE and could become a barrier to learning. Additional results revealed that those exposed to simulation training utilizing HPS performed better on the OSCE than those who did not receive the intervention (Alinier, Hunt, & Gordon, 2004), thus supporting the use of HPS to enhance learning outcomes.

A group of educators from the University of Arizona evaluated both student and faculty perceptions with respect to the use of the HPS with baccalaureate nursing students (Feingold et al., 2004). Ninety-seven students enrolled in an Advanced Acute Care of the Adult course participated in two simulation experiences during the semester, and their satisfaction was evaluated according to the realism of the scenario, ability to transfer the skills to the real world, and perceived value of the simulation. In addition, faculty member feedback was solicited by use of a 17 item Likert-type survey. Data analysis revealed that nearly half of the students felt that the HPS increased their confidence, clinical competence, or prepared them to perform in the

real-world setting, while 100% of the faculty felt that the HPS experiences would be transferable to the clinical setting. With respect to realism, the younger students felt that the HPS scenarios were more realistic than the older students. When analyzing the "value" subscore, results revealed that a majority of students believed that the experience with the HPS recreated real-life situations, reinforced clinical objectives, tested clinical skills and decision-making, and enhanced learning. One hundred percent of the faculty valued the HPS experiences. The researchers suggest that further studies be conducted to examine the actual "transferability" of the skills and knowledge acquired during the HPS experience to the clinical setting. They also suggest that qualitative research be conducted to examine the learner's experience with the HPS. Finally, the importance of the adequate acquisition of funding is stressed, as these funds are required for continued faculty development and technology upgrades for the HPS experiences to be successful (Feingold et al., 2004)

One group of nurse educators described the process of creating a scenario utilizing HPS that enhanced critical thinking in baccalaureate nursing students (Rhodes & Curran, 2005). Twenty-one students enrolled in a senior level acute medical-surgical course participated in the case scenario focusing on the management of hemorrhagic shock. The scenario consisted of a presimulation orientation, the simulation scenario, and a debriefing session that included the review of a videotape of the experience. Involved faculty evaluated the simulation experience and the case scenario and found that the students used critical thinking through their actions and decision making during the simulation, and this was further evidenced during the student's statements during the debriefing process. Student perception of the experience was obtained through the use of a 13-item faculty developed survey, with results reflecting a positive and beneficial experience by the students. Many students noted that they were using critical thinking

skills. In summary, the researchers felt that although the use of the HPS can be anxiety producing, students were able to provide better care due to the inability to harm the "patient". They also suggest that more descriptive articles and research studies be published to add to the poverty of information in the nursing literature regarding the use of HPS in undergraduate nursing education (Rhodes & Curran, 2005).

Educators at Brigham Young University utilized the HPS as an alternative clinical experience with two groups of students and instructors (Bearnson & Wiker, 2005). The students were part of the scenario for two hours with the goal being to practice medication administration skills. A 4 point Likert-type survey was administered following the simulation to assess the student's perceived increase in knowledge regarding medication administration principles, including side effects, patient responses, and confidence in skills. In addition, two open ended questions asked students what they had learned and whether or not they would recommend experiencing HPS again. Statistical analysis revealed positive learning experiences related to the use of HPS. Qualitative analysis of open-ended responses revealed positive comments regarding the importance of learning proper assessment as related to medication administration, recognizing and reporting of abnormal findings, and the utilization of critical thinking skills. While students agreed that the HPS was valuable, none suggested that it replace clinical experience at the patient's bedside. Finally, the researchers concluded that although the use of HPS appears to be a valuable tool for safe and effective experiential learning, continued studies must be conducted to determine the best ways and times to implement this strategy in the nursing curriculum (Bearnson & Wiker, 2005).

Supporting the use of HPS in undergraduate education, Thomas Doyle, in an interview for *Nursing Education Perspectives*, described the success of this technology in teaching a

difficult concept, disseminated intravascular coagulation (DIC), to associate degree nursing students. He states that although he has been teaching this concept for close to 15 years, students didn't quite "get it" until he utilized the HPS to simulate the condition. He also suggests using the HPS to allow nursing students to practice both their analytical skills and therapeutic communication techniques (Anonymous, 2002).

Medley and Horne describe the integration of HPS to enhance baccalaureate education and offer suggestions for its use (2005). The educators emphasize the importance of "leveling the content" from simple to complex when developing the scenarios, creating scenarios that are as realistic as possible, and allowing adequate time and resources in order to support faculty while learning this highly technical educational skill. To assist faculty, the educators recommend having a few faculty "champions" as resources for the entire faculty and starting with small, rather than complex, scenarios. The educators also suggest that faculty proponents of HPS pair with researchers to document educational outcomes with respect to HPS.

Long (2005) describes the integration of HPS in educational strategies meant to enhance learning of resuscitation scenarios. She describes the simulation sessions with nursing students, experienced nurses, nurse anesthetists, physicians, and respiratory therapists, and offers advice for those integrating HPS as a learning strategy. The scenario developer must consider the learner's developmental level when creating the scenarios. Patricia Benner's Novice to Expert Theory (1984)was used as a guide to scenario development. For the nursing students at the novice level, the scenarios were kept simple and positive, not punitive, and were created to reflect the current course content. Advanced beginners, such as new graduate nurses taking an advanced cardiac life support class for the first time, were expected to prioritize the care for a patient experiencing a life-threatening arrhythmia, but were not expected to sort out the

relevance of the actions, which is in accordance with Benner's theory. The competent performer has the ability to establish relevancy, which was demonstrated by the nurse who was able to deliberately lead the resuscitation group through the prioritized interventions. The proficient performer intuitively grasped the scenario which was based upon a deeper understanding as reflected upon experience. The educator suggests developing scenarios for the proficient performer with the inclusion of irrelevant, erroneous data in order to challenge the nurse into sorting out the meaningful data. Finally, the expert practitioner uses theoretical knowledge and experience to interpret data, often basing their decisions upon their intuitive or "gut" feelings. The educator recommends using complex situations with multiple algorithms for this level of nurse. In summary, Long (2005) recommends continued exploration of best practices of HPS that measure educational outcomes, while examining the cost-benefit ratio. Also, the educator states that randomized controlled trials in education are not the most appropriate as it is unethical to deny a group of learners the benefit of the intervention.

2.7 THE USE OF HPS IN GRADUATE NURSING EDUCATION

The integration of HPS with graduate students has been reported the literature (Cioffi et al., 2005; Fletcher, 1995; Hravnak et al., 2005). The use of HPS with nurse anesthesia training can realistically recreate the entire work setting of the anesthetist (Monti, Wren, Haas, & Lupien, 1998), and the learner can have the opportunity to practice with low-occurrence, high-risk situations that one might not see routinely in the clinical setting ((Fletcher, 1995). Fletcher also reinforces the importance of allowing the student to commit critical errors in the safe-environment of the HPS, so as to minimize patient risk.

A group of educators at the University of Pittsburgh School of Nursing have described the integration of HPS in acute care nurse practitioner and clinical nurse specialist programs (Hravnak et al., 2005). They describe the use of the HPS for the acquisition of critical care technical and cognitive skills, and the development of an evaluation tool. The importance of the debriefing process is stressed and anecdotal data regarding the student's positive satisfaction with the learning strategy are reported. In addition, the educators recommend having the students sign a confidentiality agreement prior to participating in the scenario, so that the scenarios are not discussed with other students. When HPS is used for evaluation purposes, this is of the utmost importance when ensuring equity among students. Advantages of the use of HPS, according to the authors, include the absence of risk to patients, promotion of critical thinking, exposure to low-occurrence situations, promotion of psychosocial skill development, and the ability for faculty to directly observe the students. Alternatively, some disadvantages of utilizing HPS include the cost of the simulator, technical support needed, and the challenge of creating a realistic environment. More disadvantages may include the increased anxiety levels among students, although the educators suggest that it is better for these students to experience anxiety in a controlled, non-threatening setting, rather than a real clinical setting where patient harm could occur. The educators suggest that outcome data be obtained in future studies to validate the effectiveness of this educational intervention (Hravnak et al., 2005).

The integration of HPS into an anesthesia crisis resource management (ACRM) skills course for nurse anesthetists at the University of Pittsburgh is described by O'Donnell, et al. (1998). Several factors limited the access to an ACRM course, such as cost, availability of a simulation center, lack of adequately trained faculty, and time limitations. Therefore, this group of nurse anesthesia educators developed and implemented their own ACRM course using HPS.

The course was successfully implemented, and positive feedback from students and faculty was obtained. The authors describe the process of course development and offer suggestions for future anesthetists when developing similar courses.

One group of researchers studied the effects of a simulation strategy on the clinical decision making of midwifery students (Cioffi et al., 2005). The simulation used in this case consisted of the pairing of two students, with one being the "simulator" and one being the "decision-maker", with the simulator acting in accordance with a pre-determined scenario. A posttest-only, control group design was utilized to investigate the effects of simulation upon 36 midwifery students at a university in Sydney, Australia. During the simulation, the decision-maker (midwife) utilized a thinking-aloud approach to decision making, and results were analyzed according to a pre-determined set of "rules" which should have been followed. The main finding of this study was that the students who received the simulation strategy "collected more clinical information, revisited collected clinical information less, made fewer formative inferences, reported higher confidence levels, and for the posttest normal labor simulation, reached a final decision more quickly" (p. 131). While these results seem to support the use of simulations in nursing education, the researchers suggest further research be conducted with larger sample sizes and more rigorous data collection.

The use of the HPS has been suggested as a remediation activity for nursing students who are struggling in clinical. One pair of educators developed a remediation plan for nurse anesthesia students whose performance was substandard in the clinical setting, and recommend setting clear, measurable, and well-defined goals when utilizing the HPS for remediation (Haskvitz & Koop, 2004). Also, the objectives for the remediation must be amenable to the use

of the HPS, and the students must have the desire to improve their performance for the experience to be considered successful.

Administrative Concerns and the Use of HPS

Administratively, the use of HPS in nursing education is associated with extreme costs related to the purchasing and maintenance of equipment (Nelson, 2003), the planning of an appropriate instructional space, and the training and practice of faculty members regarding the use of the simulation technology (Feingold et al., 2004; Nehring et al., 2002; Seropian et al., 2004a; Ziv et al., 2000). The equipment itself can cost between $28,000 and $150,000 depending upon the amount of support technology such as laptops, videotaping equipment, etc. is purchased. Faculty need appropriate training to learn the software and understand how to implement this technology into the curriculum with the students (Nehring et al., 2002; Rystedt & Lindstrom, 2001) because a major barrier to the incorporation of HPS in education is the lack of proper faculty training (Rystedt & Lindstrom, 2001; Ziv et al., 2000). Too often, the HPS are purchased without a plan for implementation and without consulting faculty regarding their willingness to learn and implement these innovative educational strategies (Medley & Horne, 2005). Administration should develop an appropriate vision and business plan outlining the costs and use for simulation prior to purchasing the equipment (Long, 2005; Seropian et al., 2004a). Additional research must be conducted that examines the cost benefit ratio (Anonymous, 2003; Ziv et al., 2000) with respect to the integration of simulation into the nursing curriculum (Ravert, 2002; Rystedt & Lindstrom, 2001). Seropian (2004a) suggests considering the following administrative issues when implementing simulation as an education tool, in addition to developing an appropriate vision and business plan prior to the purchase of the HPS:

curriculum development, curriculum integration, scenario writing, scheduling, equipment, audiovisual aids, simulation specialist, and a debriefing facilitator.

2.8 THEORETICAL FRAMEWORK – THE EFFECT OF STRESS ON LEARNING AND KOLB'S THEORY OF EXPERIENTIAL LEARNING

The ability to transfer theoretical knowledge and apply this in a practice setting leads to the acquisition of knowledge according to the Theory on Experiential Learning (Kolb, 1984). The traditional methods of teaching in a lecture format, with the instructor sharing facts with the students is perhaps not the best teaching method for service learning professions such as nursing (Dewey, 1938; Kolb, 1984). The learners need to be able to apply these abstract classroom concepts during a practical learning experience in order to enhance cognitive development. According to the theory, learning is enhanced when students are actively involved in gaining knowledge through experience with problem solving and decision making, and active reflection is integral to the learning process (Dewey, 1938; Kolb, 1984). Education is a result of experience (Dewey, 1938). The process of reflection is a cognitive process that can be enhanced through a structured learning activity. Kolb's theory has been used many times in the service learning industry to explain the necessity for the incorporation of practice into the curriculum, such as through nursing student's clinical experiences. The theory also provides a framework for the use of HPS in that students are able to apply their nursing knowledge to the care of a simulated patient within a safe environment, which will lead to the improved acquisition of knowledge. The debriefing experience used with students after the HPS experience directly mirrors the importance of reflection as an integral part of the learning process. It is during this

experience that students can cognitively and purposefully think about the learning experience so that those abstract principles learned in the classroom can become concrete as a result of their application.

Stress can be viewed as the vague and ill-defined response of an organism to any challenge placed upon it (Caine & Ter-Bagdasarian, 2003; Selye, 1973). Acute stress can cause the organism to remain in a heightened state of awareness, and as this state is prolonged, can interfere with cognitive functioning (Caine & Ter-Bagdasarian, 2003; Selye, 1973). A critically stressful situation occurring in the health care setting can significantly degrade human performance, often causing clinicians to make medical errors (Leonard, 2003). One author reports a high level of performance-related stress among medical students related to working with simulated patients (Bokke, van Dalen, & Rethans, 2004). Others reported that nurse anesthesia students expressed feelings of inadequacy and anxiety related to the simulated learning experience (Henrichs, Rule, Grady, & Ellis, 2002). Some authorities suggest that since student responses to simulation are unpredictable, more faculty resources are required to implement simulation successfully(Seropian et al., 2004b). It is important to note, though, that many students had positive feelings regarding the simulation experience and experienced increased self-efficacy following the experience (Goldenberg et al., 2005), and experiencing anxiety and stress when working with the HPS is preferred to experiencing this stress while working with real patients and possibly resulting in a life-threatening error. Although researchers support the use of a debriefing process following a simulation experience to give the student the necessary immediate feedback, there is limited research available that explores the actual experience and satisfaction of nursing students during the simulation experience and the

nature of these intense emotional responses. In addition, it is important to investigate how these emotions affect their level of confidence in the clinical setting.

2.9 SUMMARY

In summary, the use of high fidelity human patient simulators as an instructional and evaluation strategy has been successfully reported in health care education. Benefits of incorporating this high technology instructional method in higher education include:

- Being able to re-create "real-life" situations for nursing students without incurring risk to a live patient
- The ability to objectively provide summative evaluation of a student's performance
- Applying adult learning principles of immediate application allowing for increased motivation
- Providing opportunities for students to incorporate the principles of Experiential Learning and apply abstract concepts learned in the classroom to a practice setting in order to enhance learning
- The ability to use the HPS for formative evaluative purposes, either by stopping the simulation to offer critique, or during the debriefing process where the student can reflect upon performance
- Providing opportunities for repetition of skills to enhance learning and performance
- Building simulations on prior experience, thus supporting cognitive development and learning that is incremental and based upon prior knowledge
- Promoting active, problem-based learning

- Allowing students to become comfortable with technology, thus focusing on patient care
- Possibly reducing anxiety in the clinical setting, when actually experiencing critical situations
- Allowing students the opportunity to practice may increase critical thinking skills related to clinical judgment and decision making
- Re-creating low incidence but high risk situations that the student may encounter in clinical practice

The drawbacks to using HPS as an instructional strategy in higher education include:

- The tremendous cost for equipment and space
- The cost for training of faculty
- No studies that examine the cost-benefit ratio in higher education
- Minimal evidence that demonstrates the use of HPS in positively impacting learning outcomes
- No research examining the use of HPS and the impact upon critical thinking skills
- Minimal studies involving the use of HPS with baccalaureate nursing students
- No evidence that supports that the knowledge gained during the HPS is transferable to the clinical setting
- Minimal studies focusing on the learner's experience and anxiety related to the use of the HPS
- Few articles that describe "best practices" when incorporating HPS within a nursing curriculum

Therefore, there is a need for additional HPS research in higher education to fill these gaps in the literature. Although the use of HPS has increased in frequency, minimal research has

been conducted with baccalaureate nursing students. More research is needed to validate the actual student outcomes of enhanced critical thinking abilities, improved clinical decision making, and increased clinical competence (Cioffi, 2001). In a study evaluating student and faculty perceptions regarding the use of HPS, researchers found that while 100% of the faculty agreed that the skills learned during the simulation would be transferable to a real clinical setting, *only half* of the students agreed (Feingold et al., 2004). Others recommend increased research regarding the issues surrounding pedagogy and the integration of new technologies in nursing education, and their impact upon students (Mallow & Gilje, 1999). While more research is needed, randomized clinical trials in education may not be the best approach in that the choice of educational method is removed from the participants, and quality and utility are not examined (Long, 2005). In addition, measuring educational outcomes of simulation through the use of appropriate evaluation tools must become established practice (Long, 2005).

3.0 RESEARCH METHODOLOGY

This nursing education research study examined the use of simulation as an educational strategy with nursing students. The researcher sought to compare this innovative educational strategy with the use of a more traditional pedagogical strategy, the interactive case study, to determine if the use of this innovative educational technology could enhance knowledge and critical thinking abilities. In addition, this study examined the perspective of the nursing student with respect to the educational interventions using simulation and case studies.

3.1 DESIGN

The design for this study was a quantitative quasi-experimental two group pre-test and post-test design. This design was chosen because the researcher attempted to measure the effect of the HPS educational intervention upon medical-surgical nursing knowledge and critical thinking abilities, thus examining causality. The independent variable / educational intervention was the HPS educational strategy. The dependent variables were medical-surgical knowledge gain and critical thinking abilities. The comparison group participated in an interactive case study educational intervention, and the experimental group participated in the HPS educational intervention.

The educational design for the HPS educational intervention was based upon the National League for Nursing's framework (Jeffries, 2005a). The researcher developed two scenarios for this study: care of the acute coronary syndrome (ACS) patient and care of the acute ischemic stroke patient (Appendix A). Prior to development of the scenarios, the researcher attended workshops provided by the Laerdal Corporation and the Peter Winter Simulation and Education Research (WISER) institute to gain knowledge and experience with nursing scenario creation. Scenarios were reviewed by nurse educator content experts in these areas of nursing practice. After the two scenarios were developed, pilot testing occurred using additional nurse educators acting as students in order to ensure content validity and ease of use with students. Following the pilot tests, the scenarios were adapted accordingly, based upon constructive input from the expert nurse educators. All scenarios included specific learner objectives, a pre-scenario powerpoint activity, the actual videotaped scenario with specific roles assigned to each student, and a debriefing process that included viewing of the videotape.

In addition, two written case studies based upon the Care of the ACS patient and Care of the Acute Ischemic Stroke Patient were used with the comparison group (Appendix B). The published case studies were obtained from the instructor resources from the Evolve Corporation related to the text: *Medical-Surgical Nursing: Assessment and Management of Clinical Problems* (6^{th} Ed.). The instructor had obtained permission to use these course materials since this was the text used in the class (Appendix C).

3.2 SAMPLE

The convenience sample for this study consisted of senior level traditional and second degree accelerated nursing students enrolled in a baccalaureate nursing program at Robert Morris University (RMU) and senior level students enrolled in the Sharon Regional Hospital School of Nursing, a diploma program at a hospital-affiliated school of nursing. Fifty students were recruited for the study, and all agreed. The baccalaureate nursing curriculum is a four year program, with the first two years consisting of a strong science foundation in addition to courses needed to fulfill the baccalaureate requirements, and the third and fourth years focusing on providing nursing care to patients. The baccalaureate senior level students were enrolled in an advanced medical-surgical nursing course in the semester prior to graduation. These students attended 84 hours of clinical education per course, where students actually applied their knowledge in the practice setting, in addition to participating in the didactic portion of the course. Following this semester, the students completed their course and clinical education requirements in a transitions and leadership course. Upon completion of the baccalaureate program, students received a baccalaureate of science in nursing degree and were qualified to take the national licensure exam to obtain their RN license.

The RMU baccalaureate program consisted of two tracks: a traditional and accelerated second-degree track. The nursing courses for both tracks of students was identical, until the beginning of the senior year, when the second-degree students were allowed to “accelerate” the program by continuing through the summer and completing the baccalaureate requirements in the fall. Therefore, all study participants from the baccalaureate program received the same nursing courses up until study implementation.

The students enrolled in the Sharon Regional Hospital School of Nursing were taking an advanced medical-surgical nursing course in the semester prior to their graduation. The hospital based diploma program was a 16 month nursing program, beginning in September of one year, and concluding in May, sixteen months later. Prior to beginning the program, students completed prerequisite science courses offered at a community college. Once enrolled, the students attended clinical education on a hospital unit 16 hours per week in addition to having theory presented in lecture format. The diploma students in this study were enrolled in their third semester of study in a medical-surgical nursing care course. Following this semester, the students completed their course and clinical requirements in a transitions and leadership course. Upon completion of the hospital based program, students received a diploma in nursing and were qualified to take the national state board licensure exam to obtain their RN license.

These students were selected because they had no prior experience with the use of HPS in their educational process, were similar in their educational level within their respective nursing education programs, and were a sample of convenience. All nursing students from both schools were required to participate in the HPS educational intervention, including the videotaping, as part of their course; so for the purpose of the study, the students had to agree only to participate with the pretest and posttest. The sample in the summer semester consisted of the second degree accelerated students. The sample in the fall semester consisted of the traditional baccalaureate students and the students from the hospital based diploma program.

Power analysis for the use of the Analysis of Covariance (ANCOVA) statistical test revealed that a total sample size of 50, or 25 students per group, would yield a power of 0.8 with the necessary effect size being medium to large (Cohen's f =0.33). One student dropped out of the study due to experiencing extreme neck spasm after the pretest was taken (n=49).

3.3 SETTING

The setting for this research study was a small private university, Robert Morris University, located in Southwest Pennsylvania. The baccalaureate nursing students were recruited from the same university and the diploma nursing students were recruited from a hospital-affiliated nursing program located one hour away, Sharon Regional Hospital School of Nursing. The HPS educational intervention for all students was implemented at RMU. One room within the skills lab was dedicated to the use of the HPS. The HPS was located in a hospital bed with a cardiac monitor placed at the head. Video equipment was permanently located within the room to record the experience for students to view and critique during the debriefing process. During the HPS educational intervention, the instructor was located beside a laptop computer located outside the room, while the students provided "care" for the HPS based upon a pre-planned scenario. Following the simulation, students re-located to a classroom to view and critique their performance utilizing the videotape and simulation log.

Students participating in the interactive case study were placed in a room separate from the nursing skills lab with an instructor available to guide the process and assist with learning. The instructor had clear guidelines and objectives to follow during the implementation of the case studies.

3.4 INSTRUMENTATION

A 20 question exam created by the Health Education Systems, Inc (HESI) was used to measure knowledge gain and critical thinking ability in an effort to answer the following research questions:

1. How does the effect of an educational intervention using the HPS on nursing students' knowledge of medical-surgical nursing compare to the effect of an educational intervention using an interactive case study?
2. How does the effect of an educational intervention using the HPS on nursing students' critical thinking abilities compare to the effect of an educational intervention using an interactive case study?

The HESI corporation is a proprietary organization. Therefore, the pretest and posttest blueprints are provided in Appendix D as evidence of the exam content. Once the study received committee approval, the nursing research specialist at HESI created the tests, free of charge, with the researcher input based upon content related to the scenarios. Twenty content related questions were included, with fifteen "distracter" questions added so that the pretest – posttest effects could be minimized due to the close proximity of the two tests. These distracter questions were not related to the content in the educational strategies and were not included in the test analysis. The students took this computer based exam in a computer lab, and the results were analyzed by the HESI corporation immediately. Analysis of the pretest exam revealed an average point biserial correlation coefficient (PBCC) of 0.14, average difficulty level of 0.70, and reliability (KR-20) of 0.93. Analysis of the posttest exam revealed a PBCC of 0.16, average difficulty level of 0.71, and reliability (KR-20) of 0.94. Possible explanations for the low PBCC are the small sample size, small number of questions on the exam, and the limited variability of

the sample. Scoring of the HESI exam resulted in two scores: the HESI score which can range from 0 to over 1,000 and can be as high as 1500 depending on the difficulty of the exam, and the Conversion Score, which is a weighted percentage score that considers the average difficulty of the exam and the average difficulty of the test items the student answered. All test items are weighted according to difficulty. In addition, the HESI corporation computes a "critical thinking score" based upon the items answered and the difficulty level. Scoring of the HESI exam was based upon the HESI predictability model (HPM). A sample test score is provided in Appendix E.

A researcher developed Simulation and Case Study Evaluation Survey (Appendix F) was used to evaluate the student perceptions related to the simulation educational interventions, and to answer the research question: What is the nursing student's perspective of the simulation educational intervention? The questions in the survey were:

To what degree does the student feel that the simulation / case study experiences:

a. Enhanced learning?

b. Are realistic?

c. Are a valuable educational component?

d. Invoke anxiety?

e. Have the ability to reduce anxiety in the actual clinical setting?

f. Should be a substitute for actual clinical experiences?

g. Should be included in the nursing curriculum?

h. Stimulate critical thinking abilities?

i. Enhanced learning that can be *transferred* to the clinical setting

This 4-point Likert-type survey was developed by the researcher based upon the review of literature and discussions with experts in the field of simulation education. After development, the tool was reviewed by nurse educators for content validity, then further revised. After revisions were made, the tool was re-evaluated and pilot tested by the nurse educators and approved. Internal consistency was determined by Cronbach's Alpha (0.87), suggesting that the tool was reliable.

In addition, demographic data regarding age, type of nursing student (traditional baccalaureate, second degree accelerated baccalaureate, diploma), and gender will be collected with each instrument.

3.5 PROCEDURE FOR DATA COLLECTION

It is important to note that all nursing students involved in the sample were required to experience the HPS and ICS educational intervention as a requirement for their course and clinical. After Institutional Review Board approval was received from RMU and the University of Pittsburgh, with a support letter from Sharon Regional Hospital IRB, nursing students were asked to voluntarily participate in this research study. Students were approached during their advanced medical-surgical nursing course to briefly explain the study and request their voluntary participation in this study, which consisted of taking a pre-test and post-test with respect to their course-related HPS and ICS educational intervention (Appendix G). Student confidentiality was assured through the use of assigned codes for the HESI computerized testing (Appendix H). The participating students were randomly assigned to either the comparison or experimental group via a coin toss, and both groups completed the HESI pretest and posttest.

The following activities occured during the “Simulation Day”

1. All students reported to the RMU computer lab for pretesting with the HESI exam. Students were given “dummy” exam codes to use to access the computerized exam.
2. All students reported to RMU School of Nursing Skills Lab and signed the confidentiality and permission for videotaping form. These two forms were routinely used in the course so that students did not share information with other students, thus giving future students an unfair advantage while in the simulator, and also to obtain student's permission to be videotaped for educational purposes only (Appendix H).
3. All students reviewed a pre-simulation powerpoint based upon the care of the acute coronary syndrome patient and care of the acute ischemic stroke patient.
4. Students were split into either the HPS or ICS group.
5. HPS students reported to the HPS area located in the skills lab, were oriented to the HPS, and were assigned "roles": primary nurse, secondary nurse, and family member. If a fourth or fifth student was in the group, because of clinical and course requirements, this student was assigned the role of "recorder" or “nursing assistant”. (Appendix A)
6. The clinical report of the scenario was presented to the student and the HPS Acute Coronary Syndrome (ACS) scenario was opened and engaged by the researcher who was seated by the laptop computer that controls the HPS.
7. The HPS exhibited clinical signs and symptoms of a patient experiencing ACS and the students provided care for the patient based upon the nursing process. In addition, the student assigned to the role of "family member" asked the "primary nurse" questions in order to obtain rationales for nursing actions.

8. Following the HPS scenario, a debriefing activity occurred in which students reviewed the videotape and log of their performance. This gave the students an opportunity to reflect upon their performance.
9. After the ACS scenario was completed, the process was repeated with the care of the acute ischemic stroke patient.
10. Students who experienced the ICS educational strategy were seated in the nursing skills lab classroom and were given the ACS case study. (Appendix B)
11. Students were given textbooks to use when reading and discussing the case studies. The facilitator was present during this process, and encouraged the students to independently seek answers in the text and discuss this with the other students.
12. The case study and critical thinking questions were discussed and answered under the guidance of a facilitator who was either a clinical instructor or graduate student.
13. The process was repeated with the acute ischemic stroke case study.
14. Following the 2 HPS educational strategies and the 2 ICS, students were post-tested using the HESI exam. Students used their identical assigned codes during the posttest. The code cards were destroyed afterward, with no record of how the codes matched the students. In addition, the Simulation Evaluation Surveys and Case Study Evaluation Surveys were administered (Appendix F).
15. Since the HPS was an innovative and desired educational strategy, students in the ICS group were allowed to experience the HPS educational strategy following the post-test, and students in the initial HPS group were allowed to experience the case studies.
16. Following the "simulation day", the videotapes were erased.

The close proximity of the pretest to the posttest was planned to control for any other extraneous variables which could also affect knowledge gain or critical thinking abilities, such as additional clinical experiences or readings which the students could use to increase knowledge and therefore contaminate the dependent variable. In addition, the pretest and posttest were not identical, but were based upon the same test blueprint in an effort to decrease the pretest – posttest effects.

The results of the HESI test were transmitted directly to the HESI corporation for analysis. The researcher accessed the results only after the course was completed, thus ensuring the confidentiality of the study participants. All data will be stored in a locked cabinet for 3 years and then destroyed.

Due to curricular constraints, the following timeline represents the data collection process:

Month 1

- Research assistant requested voluntary participation for testing from first group of nursing students from Robert Morris University
- "Simulation Day" occured at RMU with nursing students

Month 3

- Researcher requested voluntary participation for testing from first group of nursing students from Sharon Regional Hospital School of Nursing
- "Simulation Day" occured at RMU with nursing students from Sharon Regional Hospital School of Nursing

Month 4

- Researcher requested voluntary participation for testing from second group of nursing students from Robert Morris University

- "Simulation Day" occured at RMU with nursing students

Month 5

- Researcher requested voluntary participation for testing from second group of nursing students from Sharon Regional Hospital School of Nursing
- "Simulation Day" occured at RMU with nursing students from Sharon Regional Hospital School of Nursing

Month 6

- Researcher requested voluntary participation for testing from third group of nursing students from Robert Morris University
- "Simulation Day" occured at RMU with nursing students

Month 7

- Researcher requested voluntary participation for testing from third group of nursing students from Sharon Regional Hospital School of Nursing
    - "Simulation Day" occurs at RMU with nursing students from Sharon Regional Hospital School of Nursing

3.6 DESCRIPTION OF THE SIMULATION EXPERIENCE

Students in the simulation group viewed a 10 minute powerpoint presentation reviewing the care of the patient with acute coronary syndrome and cerebrovascular accident. After this, all of the students proceeded to the simulation room and received a 15 minute orientation to the HPS. Students were shown how to measure vital signs, listen to breath sounds, listen to heart sounds, feel a pulse, administer intravenous and oral medications, and how the HPS could

"speak" via the microphone. They also received an orientation to the "crash cart" and all of the contents. The cardiac monitor was demonstrated to the students in addition to the recording equipment. After this, students blindly chose index cards to determine the "role" that they would play in the ACS scenario: primary nurse, secondary nurse, family member, and nursing assistant. The instructor gave the students a verbal patient report and the students began "caring for" the simulated patient. Students asked the HPS questions to document a patient history, performed a head-to-toe assessment, analyzed this data, and intervened with the critically ill "patient." Following the scenario which lasted approximately 15 minutes, the students and instructor reviewed the videotape, stopping frequently to reinforce important concepts and clarify difficult issues. This "debriefing period" could last up to 45 minutes, depending upon the student performance. After this period, the students were given a five minute break, the students once again were assigned roles by choosing index cards, and the simulation experience was repeated with the CVA scenario. Both simulation experiences lasted approximately 2.5 hours.

3.7 DESCRIPTION OF THE INTERACTIVE CASE STUDY EXPERIENCE

Students in the ICS group viewed the same 10 minute powerpoint presentation reviewing the care of the patient with acute coronary syndrome and cerebrovascular accident as the simulation group. Following this presentation, the students proceeded to a conference room that had three medical-surgical nursing textbooks. Students received a copy of both the ACS and CVA case studies and proceeded to read the questions and discuss possible answers. Students utilized the textbooks and conversations with one another to answer these questions. The instructor did not guide the students until the completion of the case studies. Once students had

answered the ACS and CVA questions by writing the answers on a separate sheet of paper, the instructor reviewed the correct answers with the students and clarified any difficult concepts. The ICS experience lasted approximately 2 hours.

3.8 ETHICAL CONSIDERATIONS

Institutional review board approval was obtained from both the University of Pittsburgh and Robert Morris University. This research study posed minimal risk to the participants. Since all study participants were required to participate in the simulation educational intervention including videotaping as a course requirement, with respect to this research study, participants agreed to take the pretest and posttest, in addition to completing the Simulation and/or Case Study Evaluation. Although participation in the simulation activity was a course requirement, participation in this research study, which involved taking the HESI exams and evaluation surveys, was entirely voluntary, although no students refused. The students were informed that they could withdraw from the study at any time without incurring penalties or negative treatment. The students' grades were not affected if they chose not to participate. The results were kept confidential, and the subjects' anonymity was protected. The students were informed of the study via a copy of the script. Students in the summer semester were recruited and tested by a research assistant because the researcher was the students' instructor. Students in the fall semester were recruited and tested by the researcher. All students enrolled in the advanced medical-surgical nursing courses had the opportunity to participate in the study. If data analysis revealed a significant finding that would potentially impact the student's performance in the

nursing program, the researcher agreed to share this with the student after the course grades were submitted.

3.9 DATA ANALYSIS

Analysis of covariance (ANCOVA) statistical tests were performed using SPSS statistical software to compare the average HESI posttest scores of the two groups after statistically adjusting for differences in pretest scores. The HESI score, Conversion Score, and Critical Thinking Score was used for analysis. The ANCOVA allows compensation for systematic biases among the two samples, thus reducing sampling error. Pearson Correlation coefficient was used to calculate correlations between instruments. The responses from the Simulation Evaluation Survey were analyzed using descriptive statistics: mean, standard deviation. The two group's responses were compared utilizing the independent samples t-test. Statistical analysis was performed by the researcher.

4.0 RESULTS

The purpose of this study was to determine whether the use of the human patient simulator (HPS) as an educational intervention with nursing students was more effective than the use of written case studies with respect to knowledge gain and critical thinking abilities in an effort to inform nurse educators regarding effective pedagogical strategies. In addition, this study assessed the learner's perspective related to the HPS experience. Data were collected from July, 2006 – December, 2006, and analysis occurred immediately following the conclusion of data collection. This chapter includes a description of the sample and the statistical analysis related to each research question.

4.1 SAMPLE DEMOGRAPHICS

The sample size consisted of 49 pre-licensure nursing students from Robert Morris University School of Nursing and Sharon Regional Hospital School of Nursing. Tables 1, 2, and 3 summarize these findings. With respect to program, 13 were enrolled in the traditional baccalaureate program at RMU, 13 were enrolled in the second degree accelerated program at RMU, and 23 were enrolled in the diploma program at Sharon Regional Hospital School of Nursing. With respect to gender, nine males and 40 females participated. Although there were less males than females, this closely mirrors the demographics currently representing the nursing

profession with 6% of all professional nurses being male (Hodes, 2005). The age breakdown is as follows: nine subjects between the ages of 18-24 years; 18 subjects between the ages of 25-31 years; 12 subjects between the ages of 32-38 years; seven subjects between the ages of 39 -45 years; and three subjects over the age of 45 years. There were 25 participants in the simulation group and 24 participants in the case study group. The following tables 1,2 and 3 summarize the sample characteristics of the simulation and case study groups.

4.1.1 Simulation Group

Of the 25 simulation students, eight (32%) were enrolled in the traditional baccalaureate program at RMU, five (20%) were enrolled in the second degree accelerated program at RMU, and 12 (48%) were enrolled in the Sharon Regional Hospital diploma program. The simulation group consisted of seven (28%) males and 18 (72%) females.

The age range of the simulation group was: five subjects (20%) between the ages of 18-24 years; nine subjects (36%) between the ages of 25-31 years; four subjects (16%) between the ages of 32-38 years; five subjects (20%) between the ages of 39-45 years; and two (8%) over the age of 45 years (Table 6).

4.1.2 Case Study Group

The case study group consisted of 24 students. Of these 24 students, five (20.8%) were enrolled in the traditional baccalaureate program at RMU, eight (33.3%) were enrolled in the second degree accelerated program at RMU, and 11 (45.8%) were enrolled in the Sharon

Regional Hospital Diploma program. Breakdown by gender revealed two males (8.3%) and 22 females (91.7%).

The age breakdown of the case study group was: four subjects (16.7%) between the age of 18 – 24 years; nine subjects (37.5%) between 25-31 years; eight subjects (33.3%) between 32-38 years; two subjects (8.3%) between 39-45 years; and one subject (4.2 %) over the age of 45 years.

When comparing demographic characteristics between the groups, Chi-Square analysis revealed non-significant differences with respect to age p=.550 (df=4), program p=.495 (df=2), and gender p=.076 (df=1). This suggests that the groups were similar with respect to the variables studied (Table 1,2 and 3).

Table 1: Comparison of Groups with respect to Age using Chi Square

	18-24	25-31	32-38	39-45	45+
Simulation	5	9	4	5	2
	20%	36%	16%	20%	8%
Case Study	4	9	8	2	1
	16.7%	37.5%	33.3%	8.3%	4.2%
Chi Square: p(.550)					

Table 2: Comparison of Groups with Respect to Type of Nursing Program using Chi Square

	Traditional	**Second Degree Accelerated**	**Diploma**
Simulation	8	5	12
	32%	20%	48%
Case Study	5	8	11
	13%	26.5%	46.9%
Chi Square: p(.495)			

Table 3: Comparison of Groups with respect to Gender using Chi Square

	Male	Female
Simulation	7	18
	28%	72%
Case Study	2	22
	8%	92%
Chi Square: p(.076)		

4.2 RESEARCH QUESTIONS

This section summarizes the research findings related to each of the three research questions.

4.2.1 Research Question One

How does the effect of an educational intervention using the HPS on nursing students' knowledge compare to the effect of an educational intervention using an interactive case study?

Students were scored using a customized HESI pretest and posttest exam based upon knowledge of care of the patient with a myocardial infarction and care of the patient with a cerebrovascular accident. Students received a HESI score and a Conversion Score. The HESI score can range from 0-1000 and the conversion score is reported as a percentage.

4.2.1.1 Results of ANCOVA on Posttest using HESI Score

A one-way between subject analysis of covariance (ANCOVA) was performed using SPSS statistical software to compare the average HESI posttest scores of the two groups after statistically adjusting for differences in pretest scores. The results are shown in Table 4.

Table 4: Results of ANCOVA on Posttest using HESI Score

Group		Simulation			Case Study	
		M	SD		M	SD
Pretest (Covariate)		713.12	153.56		786.17	184.81
Observed Postest		738.00	131.01		670.08	181.83
Adjusted Posttest		750.42	--		657.14	--
For test of equality of adjusted means						
F(1,46)=4.63, p=.037						

The covariate, pretest, mean HESI score for the simulation group was 713.12 (SD=153.56). The observed posttest mean HESI score for the simulation group was 738.00 (SD=131.01) and the adjusted posttest mean after ANCOVA analysis was 750.42. The covariate, pretest, mean HESI score for the case study group was 786.17 (SD=184.81). The observed posttest mean HESI score for the case study group was 670.08 (SD=181.83) and the adjusted posttest mean after ANCOVA analysis was 657.14. As shown in table 4, the case study group had a higher mean than the simulation group on the pretest. For that reason, the adjusted mean for the case study group is less than the observed mean to compensate for being at an advantage with respect to the pretest. The adjusted mean for the simulation group is greater than the observed mean to compensate for being at a disadvantage with respect to the pretest. The test for equality of adjusted means was significant, meaning that after adjusting for differences on the pretest, the posttest score for the simulation group was significantly higher than the posttest score for the case study group $F(1,46)=4.63$, $p=.037$.

4.2.1.2 : RESULTS OF ANCOVA ON POSTTEST USING CONVERSION SCORE

A one-way between subject analysis of covariance (ANCOVA) was performed using SPSS statistical software to compare the average conversion posttest scores of the two groups after statistically adjusting for differences in pretest scores. The results are shown in Table 5.

Table 5: Results of ANCOVA on Posttest using Conversion Score

Group		Simulation			Case Study	
		M	SD		M	SD
Pretest (Covariate)		67.25	11.11		72.34	12.88
Observed Postest		73.16	10.47		67.77	13.80
Adjusted Posttest		74.34	--		66.43	--
For test of equality of adjusted means						
F(1,46)=6.02, p=.018						

The covariate, pretest, mean conversion score for the simulation group was 67.25% (SD=11.11). The observed posttest mean conversion score for the simulation group was 73.16% (SD=10.47) and the adjusted posttest mean after ANCOVA analysis was 74.34%. The covariate, pretest, mean conversion score for the case study group was 72.34% (SD=12.88). The observed posttest mean conversion score for the case study group was 67.77% (SD=13.80) and the adjusted posttest mean after ANCOVA analysis was 66.43%. As shown in Table 5, the case study group had a higher mean conversion score than the simulation group on the pretest. For that reason, the adjusted mean for the case study group is less than the observed mean to compensate for being at an advantage with respect to the pretest. The adjusted mean for the simulation group is greater than the observed mean to compensate for being at a disadvantage with respect to the pretest. The test for equality of adjusted means was significant, meaning that

after adjusting for differences on the pretest, the posttest score for the simulation group was significantly higher than the posttest score for the case study group F(1,46)=6.02, p=.018.

4.2.2 Research Question Two

How does the effect of an educational intervention using the HPS on nursing students' critical thinking abilities compare to the effect of an educational intervention using an interactive case study?

Students also achieved a critical thinking score using the customized HESI pretest and posttest exam based upon knowledge of care of the patient with a myocardial infarction and care of the patient with a cerebrovascular accident. A one-way between subject analysis of covariance (ANCOVA) was performed using SPSS statistical software to compare the average HESI posttest scores of the two groups after statistically adjusting for differences in pretest scores. The results are shown in Table 6.

Table 6: Results of ANCOVA on posttest using Critical Thinking Score

Group		Simulation			Case Study	
		M	SD		M	SD
Pretest (Covariate)		700.72	156.64		770.04	185.70
Observed Postest		737.56	131.57		668.25	162.66
Adjusted Posttest		747.71	--		657.67	--
For test of equality of adjusted means						
F(1,46)=4.03, p=.051						

The covariate, pretest, mean critical thinking score for the simulation group was 700.72 (SD=156.64). The observed posttest mean critical thinking score for the simulation group was 737.56 (SD=131.57) and the adjusted posttest mean after ANCOVA analysis was 747.71. The covariate, pretest, mean critical thinking score for the case study group was 770.04 (SD=185.70). The observed posttest mean critical thinking score for the case study group was 668.25 (SD=162.66) and the adjusted posttest mean after ANCOVA analysis was 657.67. For the test of equality of adjusted means, an observed p-value of .051 was found. Therefore, strictly speaking, the researcher cannot state that $p<.05$, but it is true that $p=.05$. Using $p<=.05$ as the standard, the results may be considered significant. $F(1,46)=4.03$, $p=.051$.

4.2.3 Correlations Between Instruments

To gain further insight into the instrumentation, Pearson Correlation was used to correlate the HESI pretest and corresponding posttest scores. Table 7 summarizes these findings.

Table 7: Correlations between Instruments

		HESI Pretest	Conversion Pretest	Critical Thinking Pretest	HESI Posttest	Conversion Posttest	Critical Thinking Posttest
HESI Pretest	Pearson's r	1	.952**	.961**	.310*	.338*	.310*
	Significance	--	.000	.000	.030	.018	.030
Conversion Pretest	Pearso's r		1	.909**	.361*	.400**	.360*
	Significance		--	.000	.011	.004	.011
Critical Thinking Pretest	Pearson's r			1	.262	.287*	.262
	Significance			--	.069	.046	.069
HESI Posttest	Pearsons r				1	.946**	.999**
	Significance				--	.000	.000
Conversion Posttest	Pearson's r					1	.939**
	Significance					--	.000
Critical Thinking Posttest	Pearson's r						1
	Significance						--
**Correlation is significant at the 0.01 level							
*Correlation is significant at the 0.05 level							

When comparing the HESI pretest and posttest scores, and the conversion pretest and posttest scores, significant correlations were found between all of the HESI and conversion

pretests and posttests as indicated by the table. This suggests that the instruments used were reliable with respect to the concepts studied.

But, when correlations between instruments were calculated with the specific groups, the following results were found as illustrated by Table 8.

Table 8: Correlations by Group

Relationship	Group	r	One-tailed p
Conversion Pretest – Conversion Posttest	Simulation	.437	.015
	Case Study	.491	.008
HESI Pretest – HESI Posttest	Simulation	.370	.035
	Case Study	.376	.035
Critical Thinking Pretest – Critical Thinking Posttest	Simulation	.339	.049
	Case Study	.309	.071

The previous table demonstrates that although the correlations coefficients calculated with the different groups were similar, the correlations between instruments revealed moderate to weak correlations with r=.309 - .491 suggesting that the questions on the pretest and posttest, although based upon a similar test blueprint, were measuring different dimensions and were not parallel forms.

4.2.4 Research Question Three

What is the nursing student's perspective of the simulation activities?

All students were given a researcher developed Simulation Evaluation Survey (n=25) or Case Study Evaluation Survey (n=24) to answer research question three. The responses from the

Simulation Evaluation Survey were analyzed using descriptive statistics: mean, standard deviation. In addition, the responses of the two groups were analyzed using the Independent Samples t-Test. The students responded on a Likert scale from 1-4 (1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree) with respect to the following statements. See table 9 below for a summary of these findings.

Table 9: Results of Independent samples t-test on Survey Data

	Simulation		Case			
	M	SD	M	SD	t	p
Helped to stimulate critical thinking abilities	3.84	.37	3.50	.83	1.85	**.070
Was a valuable learning experience	3.80	.41	3.13	.68	4.23	*.0004
Knowledge gained from the experience can be transferred to the clinical setting	3.80	.41	3.46	.78	1.93	**.059
Should be included in our undergraduate education	3.76	.44	3.29	.751	2.68	*.010
Helped me better understand concepts	3.72	0.46	3.25	0.74	2.69	*.010
Experienced nervousness during the educational intervention	3.56	.51	1.67	.82	9.78	*.0004
Were realistic	3.56	.51	3.46	.72	.573	.569
Because of the educational intervention, I will be less nervous in the clinical setting when providing care for similar patients.	3.00	.82	2.58	.78	1.83	**.074
Can be a substitute for clinical experiences in the hospital.	2.56	.92	1.92	1.10	2.28	*.027
* Significant at p<.05 **Significant at p<.10						

4.2.4.1 Responses According to Questionnaire Items

The simulations / case studies helped to stimulate critical thinking abilities. The mean score for the respondents in the simulation group was 3.84 (SD=.37) and the mean score for the respondents in the case study group was 3.50 (SD=.834). Results of independent samples t-test were significant at the p<.10 level, but not at the p<.05 level: t(47)=1.85; p=.070. This

significant difference suggests that the simulation group felt their experience helped to stimulate critical thinking abilities more than those in the case study group.

The simulations / case studies were a valuable learning experience. The mean score for the respondents in the simulation group was 3.80 (SD=.41) and the mean score for the respondents in the case study group was 3.13 (SD=.68). Results of independent samples t-test revealed a significant difference between the two groups: $t(47)=4.23$; $p=.000$. The mean score for the simulation group was significantly higher than the mean for the case study group, suggesting that the simulation group felt their experience was more valuable than the case study group.

The knowledge gained through the simulation / case study experiences can be transferred to the clinical setting. The mean score for the respondents in the simulation group was extremely high at 3.80 (SD=.41) and the mean score for the respondents in the case study group was 3.46 (SD=.78). Results of independent samples t-test were significant at the $p<.10$ level, but not at the $p<.05$ level: $t(47)=1.93$; $p=.059$. The mean score for the simulation group (3.80) was significantly higher than the mean score for the case study group (3.46), suggesting that the simulation group more strongly agreed that the knowledge gained could be transferred to the clinical setting when compared to the case study group..

Simulation / case study experiences should be included in our undergraduate education. The mean score for the respondents in the simulation group was 3.76 (SD=.44) and the mean score for the respondents in the case study group was 3.29 (SD=.75). Results of independent samples t-test revealed a significant difference between the two groups: $t(47)=2.68$; $p=.010$. A significant difference existed between the two groups suggesting that the simulation group felt stronger that the HPS experience should be included in undergraduate education.

The simulation / case study experience helped me to better understand nursing concepts. The mean score for respondents in the simulation group was 3.72 (SD=.46) and the mean score for the respondents in the case study group was 3.25 (SD=.74). Results of independent samples t-test revealed a significant difference between the two groups: t(47)=2.69; p=.010. The mean for the simulation group (3.72) was significantly higher than the mean of the case study group (3.25), suggesting that the simulation group felt that the HPS intervention helped them gain a better understanding of nursing concepts as compared to the case study group.

I was nervous during the simulation / case study experience. The mean score for the respondents in the simulation group was 3.56 (SD=.51) and the mean score for the respondents in the case study group was 1.67 (SD=,82). Results of independent samples t-test revealed a significant difference between the two groups: t(47)=9.80; p=.000. The mean score for the simulation group (3.56) was significantly higher than the mean score for the case study group (1.67), suggesting that the simulation group more strongly agreed with the statement than the case study group. In fact, the case study group strongly disagreed that the experience invoked nervousness.

The simulation / case study was realistic. The mean score for the respondents in the simulation group was 3.56 (SD=.51) and the mean score for the respondents in the case study group was 3.46 (SD=.72). Results of independent samples t-test revealed a non-significant difference between the two groups: t(47)=.573; p=.569, suggesting that both the case study and the simulation group felt the interventions were realistic.

Because of the simulation /case study experience, I will be less nervous in the clinical setting when caring for similar patients. The mean score for the respondents in the simulation

group was 3.00 (SD=.82) and the mean score for the respondents in the case study group was 2.58 (SD=.78). Results of independent samples t-test were significant at the $p<.10$ level, but not at the $p<.05$ level: $t(47)=1.83$; $p=.074$. A significant difference existed between the groups suggesting that the simulation group will feel less nervous in the clinical setting as compared to the case study group when caring for similar patients.

Simulation / case study experiences can be a substitute for clinical experiences in the hospital. The mean score for the respondents in the simulation group was 2.56 (SD=.92) and the mean score for the respondents in the case study group was 1.92 (SD=1.06). Results of independent samples t-test revealed a significant difference between the two groups: $t(47)=2.28$; $p=.027$. A significant difference between the two groups existed, but both of these responses demonstrate that both the students felt that simulation and case studies should not be substituted for clinical experiences in the hospital.

Students had the opportunity to answer an open ended question stating "please add any additional comments regarding the educational experience" at the end of the survey. Three students in the case study group added:

- Really enjoyed the case study. It was a valuable learning experience
- I think that the case study was valuable, but I don't think it should be a substitute for clinical experience in the hospital.
- Didn't improve HESI scores

Seven students in the simulation group added:

- We should include more simulations especially before clinicals begin
- Simulation experiences should be included in undergraduate education much sooner than senior year. Perhaps second semester of sophomore year.

- I feel that these simulations should be used throughout the curriculum. Anyone can answer A, B, C, or D, but to be able to critically think in a "critical situation" does not allow for the right answer to jump out at you on paper. In the clinical setting, either you know what you're doing or your patient is in poor hands.
- Great experience
- I think we should have a few more days to work with Simman. He is an excellent teaching tool. We learn from our mistakes quicker than studying for exams.
- I believe that the students should be able to perform simulation activities in every class. It was very helpful.
- Helped me learn to actually react without being pre-prepared. THANKS.

5.0 DISCUSSION AND CONCLUSIONS

This chapter includes a discussion of the findings related to each research question, implications for nursing education, nursing practice, and higher education administration, and recommendations for further research.

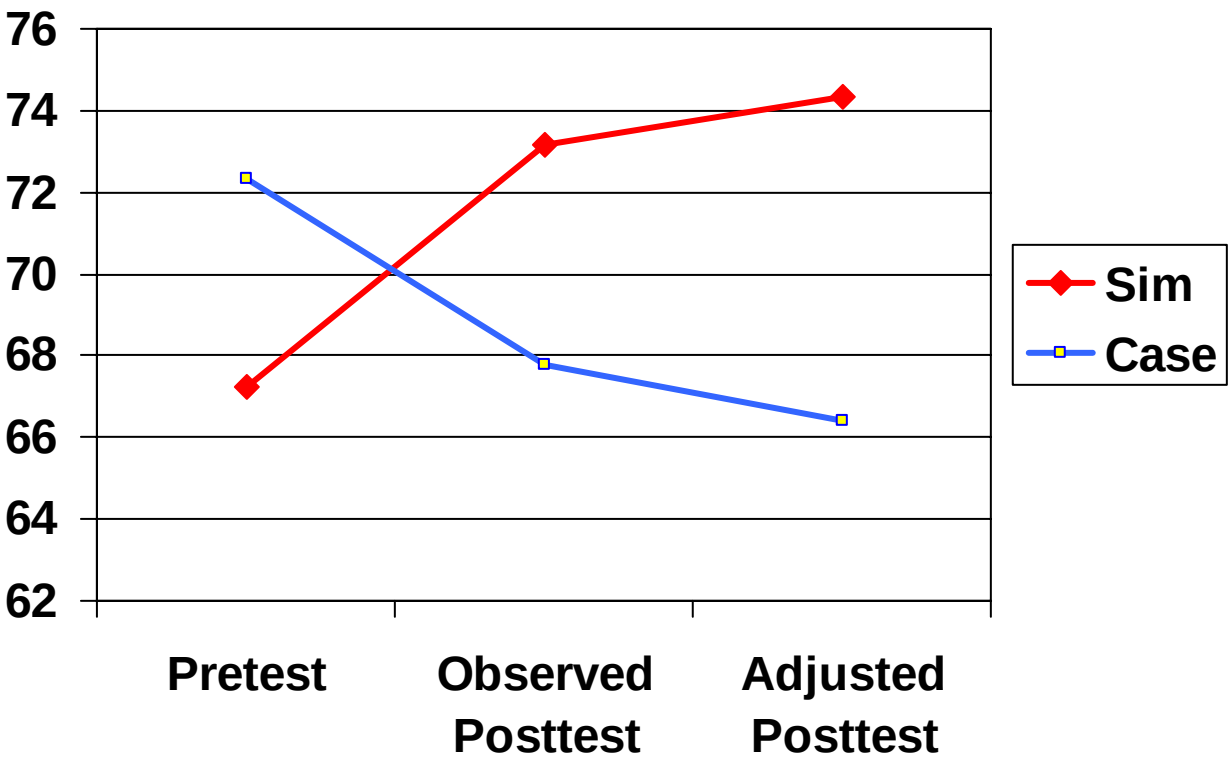
5.1 DISCUSSION OF RESEARCH QUESTIONS

Research Question 1: How does the effect of an educational intervention using the HPS on nursing students' knowledge compare to the effect of an educational intervention using an interactive case study?

The results of this study indicate that the educational intervention utilizing the HPS was far superior to the ICS approach with respect to medical-surgical knowledge, as measured by a highly reliable and valid instrument, the HESI customized exam. With respect to the mean pretest HESI score, the case study group started at an advantage (786.17) as compared to the simulation group (713.12). Even with this advantage, the case study scores decreased 116.09 points (670.08), while the simulation group score increased 24.88 points (738.00). The adjusted posttest scores calculated by ANCOVA show an even greater, significant difference between the pretest and posttest scores of both groups (p=.037). This suggests that the HPS is a more

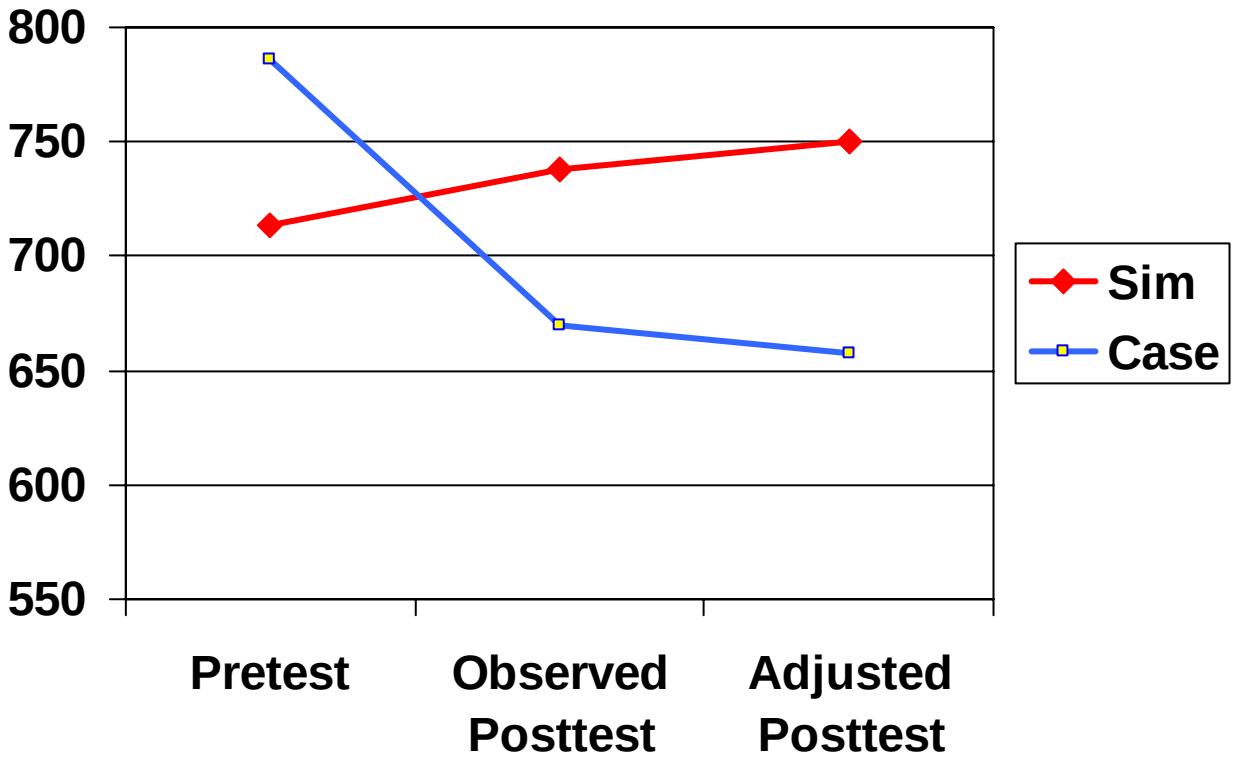
beneficial educational strategy with respect to increasing knowledge of medical-surgical nursing, when compared to the ICS approach. The following figure illustrates this concept.

Figure 2: Results of ANCOVA on Posttest using HESI Conversion Score



Likewise, when using the HESI conversion score, the results are similar. With respect to the mean pretest conversion score, the ICS group started at an advantage (72.34%) as compared to the simulation group (67.25%). Even with this advantage, the mean case study score decreased 4.56% (67.77%), while the mean simulation group score increased 5.91 % (73.16 %). The adjusted posttest scores calculated by ANCOVA show an even greater, significant difference between the pretest and posttest scores of both groups (p=.018). The following figure further illustrates this concept.

Figure 3: Results of ANCOVA on Posttest using HESI Score



This further reinforces that, with respect to this study, the HPS had a greater impact upon knowledge gain than the ICS approach. Several of the open ended comments by students support this finding. Students reported, "I think we should have a few more days to work with Simman. He is an excellent teaching tool. We learn from our mistakes quicker than studying for exams.", and "Helped me learn to actually react." In addition, one of the students in the ICS group stated, the case study "did not improve the HESI scores." The open ended comments suggested that the students in the simulation group felt the HPS had a greater impact upon their learning than those in the case study group. The results of this study correlate with those in the literature, in that the use of HPS can enhance learning outcomes in nursing education (Alinier, 2003; Cioffi et al., 2005).

5.1.1 Support of Kolb's Experiential Learning Theory

These findings support Kolb's Experiential Learning Theory, in that the actual experience of providing care to the HPS helped in transferring abstract knowledge, through practical application of this knowledge, into the concrete, useful information that the nursing student needs to be successful on the HESI exams. The traditional methods of teaching in a lecture format, with the instructor sharing facts with the students is perhaps not the best teaching method for service learning professions such as nursing (Dewey, 1938; Kolb, 1984). The learners need to be able to apply these abstract classroom concepts during a practical learning experience in order to enhance cognitive development. According to the theory, learning is enhanced when students are actively involved in gaining knowledge through experience with problem solving and decision making, and active reflection is integral to the learning process (Dewey, 1938; Kolb, 1984). Education is a result of experience (Dewey, 1938). The process of reflection is a cognitive process that can be enhanced through a structured learning activity. Kolb's theory has been used many times in the service learning industry to explain the necessity for the incorporation of practice into the curriculum, such as through nursing student's clinical experiences. This active learning strategy assisted in reinforcing important concepts, thus leading to a better understanding of care of the medical-surgical patient experiencing an acute MI and a CVA, resulting in higher test scores.

A bigger question remains, though, with respect to this study: why did the scores in the case study group decrease from pretest to posttest? One possible answer is that the case study method, as an educational intervention, is a much more passive learning strategy when compared to the use of the HPS. After the experience of the HPS, the students had been actively thinking, analyzing situations, making decisions, and experiencing the effects of these decisions. The ICS

group merely sat in a room with books and a facilitator, and answered questions with the other members of their groups, suggesting a less active learning strategy. In addition to the educational methods, the students may have felt extremely tired at the end of the case study experience. Pretests were administered at 8am, followed by a powerpoint presentation, case study intervention, and a posttest at 11am. Following this, lunch was served. The students in the case study group may have felt more fatigue than those in the simulation group, since the case study was a less active learning strategy. This may explain the decrease in posttest scores.

Another possible explanation is that the HPS may have been perceived as the "new and improved" educational intervention. Students typically respond more favorably to the "new" and exciting intervention, which may have occurred in this study.

Another possible explanation is that the simulation group was facilitated by the researcher and the case study group was facilitated twice by a clinical instructor and four times by a graduate student. Perhaps the students in the case study group did not respect the facilitators as much as the actual researcher, thus leading to less motivation to perform on the posttest. In addition, the researcher did not plan for a common facilitator in the case study group, which may have led to erroneous findings. In future studies, the simulation facilitator and the case study facilitator should vary, thus eliminating a potential source of bias. Finally, correlations between the HESI pretest and posttest using the conversion scores and HESI scores revealed moderate to weak correlations (r=.370-.491) which could suggest that the pretest and posttest, although based upon similar test blueprints, were not measuring the same dimensions and were not parallel forms.

The researcher does not believe that "un-learning" occurred between the pretest and the posttest for the case study group. As previously mentioned, this group may have been

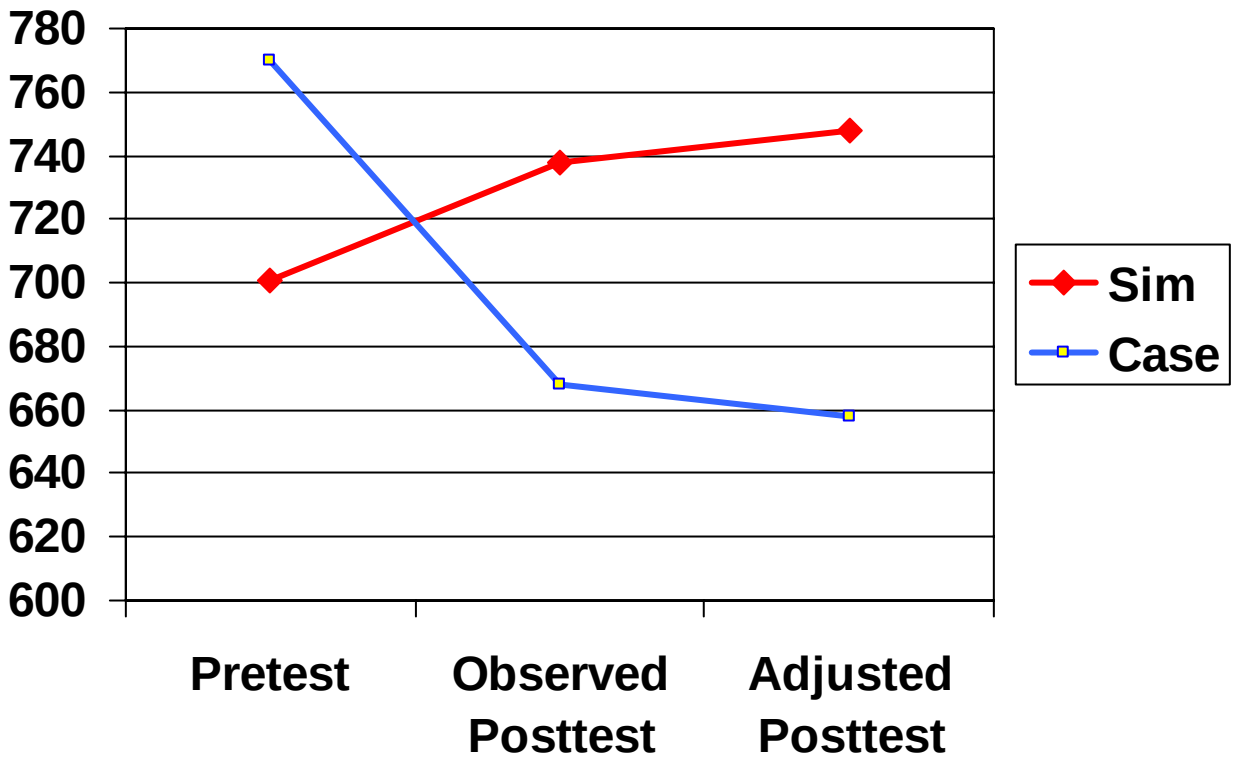
experiencing extreme fatigue, thus leading to less motivation to achieve well on the posttest. An experienced educator is aware of the qualities that exist in the "ideal" testing situation: calm, quiet testing area, fully rested student, and free from any physical stressors. As well as being fatigued, this group could also have experienced hunger, as lunch was served immediately following the posttest. Perhaps the physical stressors of hunger and fatigue were more evident to the case study group, due to the less active learning strategy.

To summarize, the results of this study support the beneficial use of the HPS as an educational intervention as compared to the ICS approach with respect to knowledge gain for the nursing student.

Research Question 2: How does the effect of an educational intervention using the HPS on nursing students' critical thinking abilities compare to the effect of an educational intervention using an interactive case study?

In addition to the HESI and conversion scores, the critical thinking score is a subscore of the total HESI score, based upon the HESI predictability model. This critical thinking score, calculated by the HESI corporation, uses the difficulty level of each question that is written based upon Critical Thinking Theory (Paul, 1993). Once again, the case study group started with a clear advantage with a mean pretest score of 770.04 as compared to the simulation group at 700.72. Even with this initial advantage, the mean case study score decreased from pretest to posttest (668.25), while the mean for the simulation group increased to 737.56. The adjusted posttest scores calculated by ANCOVA show an even greater, significant difference, using $p<=.05$, when an observed p value of 0.051 was found. This suggests that the educational intervention of the HPS was more effective at enhancing and promoting critical thinking abilities than the case study intervention. The following figure illustrates this concept.

Figure 4: Results of ANCOVA on Posttest using Critical Thinking Scores



One open ended response by a student in the simulation group actually addressed the critical thinking component by stating, "I feel that these simulations should be used throughout the curriculum. Anyone can answer A, B, C, or D, but to be able to critically think in a "critical situation" does not allow for the right answer to jump out at you on paper. In the clinical setting, either you know what you're doing or your patient is in poor hands." This statement emphasizes the benefit of using the HPS as an educational strategy in that the student must collect data, analyze the data, then determine an intervention based upon their analysis of the situation. With simulation, as in real life on a clinical unit, the patient can present in a variety of ways, often

times not identical to the "textbook" example. The student and nurse must determine a course of action based upon their judgment, without being able to "choose" between four actions given, knowing that a 25% chance of being correct exists. The simulation experience mimics reality and gives the students the opportunity to practice in a safe environment.

Referring back to Table 7, the pretest Critical Thinking scores were not significantly positively correlated with the posttest Critical Thinking scores, which was a surprising finding suggesting that the pretest and posttest were measuring different content, although both were based upon the same test blueprint. This could have added to the less significant findings related to the ANCOVA analysis of the critical thinking scores.

Utilizing the operational definition for critical thinking, the ability to reason, deduce, and induce based upon current research and practice findings (Conger & Mezza, 1996) which is the foundation for sound clinical decision-making in nursing, clearly the use of the HPS can have a greater effect upon this process. While caring for the HPS, the nursing student is presented with a pattern of data, indicating an abnormal patient condition. The nursing student then uses this information to deduce and determine the actual patient problem. Once the problem is identified, the nursing student must use their reasoning skills to identify interventions, while the HPS actually responds to the interventions. The nursing students must also be able to respond to questions from the student playing the role of the "family member", and provide an accurate rationale for each intervention. For example, as the "nurse" administers nitroglycerine to the HPS, the "family member" asks the "nurse" to provide a rationale for this intervention, stimulating the inductive reasoning powers of the student.

Following the simulation, the students have an opportunity to review their performance via videotape, and reflect upon the positive and negative aspects of their performance during a

discussion with their peers and the facilitator. This is a powerful moment during the simulation experience, often described by students as the "aha" moment, where they gain deep insight into their behaviors, and actually gain important knowledge. Perhaps it is this process that adds to the increase in critical thinking abilities of the nursing students. Similar findings related to the use of the HPS for stimulating critical thinking abilities in nursing students have been reported (Rhodes & Curran, 2005).

Research Question 3: What is the nursing student's perspective of the simulation activities? Survey data analysis revealed significant differences between the groups with respect to the student's perspective of the simulation experience as compared to the case study approach**.** Students had significantly higher scores (p=.010) when asked if the HPS experience helped them to better understand concepts (M=3.72 as compared to the case study group (M=3.25), although both groups reported positively with responses being "agree" or "strongly agree". This data correlates with the ANCOVA analysis that was performed with the HESI and conversion pretest scores and the HESI and conversion posttest scores which demonstrated significantly more knowledge gain in the simulation group.

These findings support Kolb's Experiential Learning Theory which states that the ability to transfer theoretical knowledge and apply this in a practice setting leads to the acquisition of knowledge (Kolb, 1984). The students in the HPS were able to apply abstract classroom concepts related to the care of patients during a practical learning experience, which helped to enhance the student's perception of their cognitive development. The HPS requires that students are actively engaged with problem solving and decision making, after which the students use active reflection during the debriefing process to reinforce the learning process. Education is a

result of experience (Dewey, 1938). The experience of providing care to the HPS was perceived as beneficial with respect to understanding of concepts.

Another significant finding was related to the student's perceived "value" of the learning experience. Students in the simulation group had higher scores when asked if the experiences were a valuable learning experience (M=3.80) as compared to the case study group (M=3.13). Therefore, the students in the simulation group perceived the learning experience to be more valuable than those in the case study group, although both groups reported positively, answering either "agree" or "strongly agree".

In a learner responsive environment, the importance of incorporating educational activities that are valued cannot be ignored. With the changing nature of the students, especially with the addition of the adult learner, the expectation is that each assignment or activity has direct relevance upon their educational process. This changing student composition has direct implications for nursing faculty regarding appropriate pedagogical techniques (AACN, 2003). Characteristics of adult learners include: independence and self-motivation, an eagerness to learn that is related to their daily social and professional roles, a need for immediate application of knowledge gained, and the importance of experience laying the foundation for their continued life-long learning (Knowles, 1984). Therefore, they require a focused curriculum that is relevant and "no-nonsense", which is immediately applicable to their lives (AACN, 2003). This may explain why the students in the simulation group perceived greater value than the case study group. Simulation allows for immediate application of knowledge and provides a venue for gaining experience.

Another significant finding (p=.000) is that students in the simulation group experienced more nervousness (M=3.56) than those students in the case study group (M=1.67), which was

definitely expected. A mean of 3.56 lies between the statements “agree and strongly agree”, while the mean of 1.67 lies between strongly disagree and agree, suggesting that the case study group did not experience nervousness. While utilizing HPS as a learning strategy, the students are working in groups while actively making decisions, and this is recorded on videotape. Although students did not document this “nervousness” on their surveys, observation of these students by the researcher prior to the simulation experience does support this finding. Informally, students stated they were “extremely nervous” prior to the experience, then were reassured that they were not being evaluated, and to consider this simply as a learning opportunity. After these statements, the students appeared calmer. Further research should be conducted with respect to nervousness and anxiety, perhaps with a pretest / posttest approach and with an instrument such as a visual analog scale that actually measures anxiety.

Stress or anxiety can be viewed as the vague and ill-defined response of an organism to any challenge placed upon it (Caine & Ter-Bagdasarian, 2003; Selye, 1973). Acute stress can cause the organism to remain in a heightened state of awareness, and as this state is prolonged, can interfere with cognitive functioning (Caine & Ter-Bagdasarian, 2003; Selye, 1973). A critically stressful situation occurring in the health care setting can significantly degrade human performance, often causing clinicians to make medical errors (Leonard, 2003). Stress and anxiety can lead to a feeling of “nervousness”. Since performance related stress has been reported with health care students working with simulated patients (Bokke et al., 2004; Henrichs et al., 2002), faculty members using the HPS for educational purposes must be keenly aware of how this stress can impede student performance. Also, more faculty resources may be required to implement simulation successfully since student responses to simulation may be unpredictable (Seropian et al., 2004b). Although our students experienced nervousness related to the HPS,

experiencing anxiety and stress when working with the HPS is preferred to experiencing this stress while working with real patients and possibly resulting in a life-threatening error. In addition, a mild amount of anxiety can actually improve performance (Selye, 1973). This could be a possible explanation for the students in the HPS group improving on their knowledge and critical thinking scores. While some researchers report that the debriefing process, while usually constructive, can invoke psychological trauma for some, it is important to note that none of our students experienced these intense, traumatic emotional responses (Seropian et al., 2004b).

The students in the simulation group felt significantly stronger (M=2.56; p=.027) that the simulations could not be a substitute for actual clinical experiences in the hospital as compared with the case study group (M=1.10). This finding suggests that the students in the case study "strongly disagreed" with substituting case studies for clinical experiences, while the simulation group had more moderate negative feelings. Perhaps as the question was phrased, students may have felt that both educational experiences should not be a TOTAL substitute for clinical, but if the question was phrased such as "can the HPS / case study be a substitute for a PORTION of clinical hours" the results may have been different. The literature is filled with examples of how simulation is replacing a portion of the health care student's clinical hours, without suggesting that simulation be a total replacement for clinical hours.

A significant difference (p=.010) exists between the groups related to their perception that the case studies (M=3.29) and simulation experience (3.76) should be included in their undergraduate education. Students in the simulation group had a much higher mean suggesting that they strongly agreed that experience should be included. Also, several open ended comments supported this finding: "We should include more simulations especially before clinicals begin." "Simulation experiences should be included in undergraduate education much

sooner than senior year. Perhaps second semester of sophomore year." "I feel that these simulations should be used throughout the curriculum." "I think we should have a few more days to work with Simman. He is an excellent teaching tool." "I believe that the students should be able to perform simulation activities in every class."

These statements reinforce the fact that, after experiencing the HPS, students want simulation to be a part of their curriculum. This has direct implications for higher education administrators and faculty. Administratively, the use of HPS in nursing education is associated with extreme costs related to the purchasing and maintenance of equipment (Nelson, 2003), the planning of an appropriate instructional space, and the training and practice of faculty members regarding the use of the simulation technology (Nehring et al., 2002; Seropian et al., 2004a; Ziv et al., 2000). Faculty need the appropriate training to learn the software and understand how to implement this technology into the curriculum with the students (Nehring et al., 2002). Administration should develop an appropriate vision and business plan outlining the costs and use for simulation prior to purchasing the equipment (Long, 2005; Seropian et al., 2004a). Additional research must be conducted that examines the cost benefit ratio with respect to the integration of simulation into the nursing curriculum (Ravert, 2002). This study supports the benefit of simulation as an educational strategy.

The students in the simulation group felt significantly stronger (M=3.84; p=.070) that the HPS experience helped to stimulate critical thinking abilities with respect to the ICS group (M=3.50). This finding correlates with the ANCOVA analysis that was performed with the critical thinking pretest scores and the critical thinking posttest scores, revealing a significant increase in mean scores from pretest to posttest in the simulation group, with p=.051. Utilizing the operational definition for critical thinking, the ability to reason, deduce, and induce based

upon current research and practice findings (Conger & Mezza, 1996) which is the foundation for sound clinical decision-making in nursing, clearly the use of the HPS can have a greater effect upon this process. On an interesting note, as mentioned in the review of literature, many scholars and faculty members have a difficult time defining critical thinking. Therefore, how did the students define critical thinking and answer this question? Although critical thinking is stressed and discussed in the curricular courses with students, it is difficult to determine how they were defining this term in relationship to this study. But, somehow, they felt that the simulation helped to stimulate these critical thinking abilities.

The students in the simulation group felt significantly stronger (M=3.80; p=.059) that the knowledge gained through the experience could be transferred to the clinical setting when compared to the case study group (M=3.46). In fact, the students in the case study either disagreed or strongly disagreed with this statement, suggesting that the case study activity did not generate knowledge that could be transferred to the clinical setting. One should approach this finding with caution, as there are a number of studies that support the use of case studies in nursing education. In critiquing this study, perhaps the case study itself was not developed properly, although it was obtained from a leading textbook publisher. Another possible explanation is that the facilitator of the case study group was not consistent throughout the study, and perhaps was less respected than the faculty member. Therefore, the students may have felt as if they gained little knowledge through the activity.

The topic of "transfer of knowledge to the clinical setting" must be explored further through future research, because the ultimate goal of providing quality learning experiences in a nursing education program is so that patients will receive better nursing care in the actual clinical setting. Therefore, it would be interesting to measure if nurses who had the experience of

simulation as students actually performed better in the clinical setting, which would provide a challenging research design.

The students in the simulation group felt significantly stronger (M=3.00; p=.074) than the case study group (M=2.58) that because of the educational experience, they will be less nervous in the clinical setting, with the case study group mildly disagreeing with this statement. As mentioned before, severe stress and anxiety can interfere with decision making in the clinical setting, therefore necessitating educational interventions aimed at decreasing this stress. But, a moderate amount of anxiety can actually enhance performance. The results of this question suggest that practice with simulation could decrease the amount of nervousness experienced in clinical, thus positively impacting decision-making.

There was no significant difference between the groups (p=.559) when both groups were asked if the simulations / case studies were realistic. The mean score for the simulation group was 3.56 and the mean score for the case study group was 3.46, suggesting that both groups felt their educational activities were realistic. Research would suggest that the simulation experience more closely mimics reality than case study, but perhaps the case study utilized in this study was extremely realistic. The positive responses of the students in the simulation group are in alignment with those other researchers, who found that the use of the HPS was extremely valuable, the simulations were realistic, and that the knowledge learned would be transferable to the clinical setting (Feingold et al., 2004).

5.2 IMPLICATIONS FOR NURSING EDUCATION

The results of this study support the value of integrating the HPS into undergraduate education. Positive learning outcomes related to medical-surgical knowledge and critical thinking skills were documented using highly reliable and valid instruments such as the HESI exams. In addition, the student perspective of the simulation experience as compared to the case study experience was extremely positive. Students felt the simulations assisted them in understanding concepts, were a valuable learning experience, helped to stimulate critical thinking abilities, should be included in undergraduate education, and assisted with decreasing anxiety. Time and money must be devoted to faculty development in an effort to design effective simulations and learn the complicated technology in order for this intervention to be effective. Adequate time for writing objectives, programming the scenarios, pilot testing the scenarios, and revising the scenarios must allotted for faculty members. In addition, the faculty member should have time allotted for practicing with the technology and becoming more confident with the debriefing strategies. The faculty member must remember, though, that the HPS experience can be anxiety provoking for the student, so careful attention must be taken to inform the student of the objective of the simulation, whether it be strictly an educational intervention or an evaluative measure. Students in this study were reassured that they were not being graded during the simulations, which allowed them the freedom to make mistakes without suffering negative consequences. In addition, the students were allowed to share their feelings during the debriefing process. If the simulations are being used an evaluative measure, students should be aware of this prior to the experience so that they can properly prepare.

Students in this study felt that simulation should be included across the curriculum, not simply added in the senior year, which has direct implications for nursing education. Scenarios

need to be written according to the educational level of the student, beginning with the simple and working toward the complex, and faculty need to be guided in this process. It may be beneficial for schools of nursing to have one or two "simulation leaders" who understand the depth and breadth of this technology deeply, then serve as consultants for the rest of the faculty, which has direct implications for faculty workload. Workload credit should be given to those faculty members who agree to serve in these roles, so that their time and effort can be equitably rewarded.

As nurse educators face the challenge of finding optimal experiences for students to learn critical thinking skills necessary to care for patients with increased acuity, simulation appears to provide this opportunity, although should not be a substitute for all of the clinical hours. HPS allows nursing students the opportunity to work collaboratively in a simulated setting. HPS also provides for all students to have the opportunity to care for the "model" patient, whether it be one with ACS, CVA, or other disorders. HPS provides lifelike clinical experiences in a controlled environment and allows for immediate formative evaluation from clinical faculty and peers. There is no guarantee that the rapidly changing nature of the clinical unit can provide the learning opportunities necessary to expose the student to low incidence but highly critical events, but this can be done through planning simulation experiences for the students.

The use of the HPS can be extremely valuable in meeting the needs of adult learners who may demand immediate feedback and applicability of educational tasks to real life situations. In addition, the current generation of students aged 18-24 comprise the "millennial generation", a group that is proficient with the use of technology and its use in education. This group of students grew up using the world wide web, playing video games, and using digital technology to resource information. They are more comfortable with technology than previous generations,

and are less satisfied with the lecture format when used in the classroom. Therefore, by integrating simulation technology in the curriculum, current faculty members can better meet the educational needs and desires of not only the adult learners, but the current millennial generation.

5.3 IMPLICATIONS FOR NURSING PRACTICE

Students in this study felt that the knowledge gained through the simulation experience can be transferred to the clinical setting, which is extremely important as nurses attempt to provide higher quality patient care while ensuring patient safety. By exposing students to highly critical but low incidence simulation scenarios, students can practice their clinical decision-making without jeopardizing patient safety. Ultimately, the students become confident with these decision-making skills, thus decreasing anxiety on the clinical unit which may interfere with critical thinking abilities and possibly harming real patients. Confident students can become confident nurses who provide safe, quality care to their patients.

5.4 IMPLICATIONS FOR HIGHER EDUCATION ADMINISTRATION

The results of this study clearly indicate the benefits of incorporating the HPS into the nursing curriculum but may also be of interest to other health care disciplines. Therefore, administrators can begin to budget for the purchase of the technology and to plan the appropriate space and associated equipment needed to implement the technology, as the outcomes of this study justify the purchase cost. To effectively integrate the HPS into a course, not only does the

administrator need to purchase the simulator which may cost between $30,000 and $100,000 depending upon the brand, but video equipment, recording equipment, television monitors, speaker, microphones, and realistic hospital equipment must be bought to mimic the hospital environment and provide the copying equipment necessary for the debriefing process. Academic administrators must have a budget plan for this purchase.

Simply purchasing the equipment is not enough. Creating a culture of change that supports this innovative technology may be difficult in higher education. To effectively create a change in the teaching methods used by faculty members, the administration must have "buy-in" from the faculty regarding the usefulness of the technology and the necessity for integration into the curriculum. Therefore, one or two faculty members can be designated as "simulation leaders", or champions (Medley & Horne, 2005), and should be chosen based upon their knowledge of educational technology and their willingness to learn the HPS technology. After these leaders are chosen, administration should provide the monetary support and adequate time for the faculty to attend training sessions, attend simulation conferences, and actually learn how to program and implement the technology. This may require a workload reduction, and in an era of decreasing operating funds for higher education, the administrator may choose to seek grant funding to support these activities. These suggestions also correlate with those found in the literature review (Nehring et al., 2002).

Once the simulation leaders are comfortable with the technology, training sessions can be held on campus for the remaining faculty members who wish to implement the HPS into their courses. The leaders can then serve as simulation consultants. This process of integration across the curriculum may take several years, which makes the simulation leader, champion, invaluable as the change becomes embedded in the institutional culture.

5.5 RECOMMENDATIONS FOR FURTHER RESEARCH

More studies documenting the learning outcomes and educational benefits related to simulation, such as this one, need to be conducted with undergraduate nursing students and advanced practice nursing students to fill the gaps in the literature. Research should be conducted to examine the impact of HPS upon NCLEX success. Additional studies should be conducted that compare the outcomes of different educational strategies to possibly explain the decrease in case study scores. Also, this study could be replicated with a larger sample and with the addition of associate degree nursing students to determine how different types of students respond to the simulation technology. If the study is replicated, it is suggested that the instructor for both the case study and simulation content vary to eliminate bias. True experimental research is difficult to conduct in education due to the challenges of controlling for all extraneous variables, such as student characteristics, previous learning activities, and previous experience in the clinical area. Therefore, more carefully controlled quasi-experimental studies should be conducted in nursing education with respect to the use of the HPS. This study did not control for the extraneous variable of previous clinical experience with a patient experiencing a myocardial infarction or cerebrovascular accident affecting the perceptions related to the simulation experience. Future research should examine the concept of previous experience.

With respect to the student perspective of the educational experience, a qualitative design may assist the researcher in gaining richer data related to the actual student perceptions and feelings related to the simulation experience since students expressed nervousness related to the HPS. The results suggest that the simulation group experienced more “nervousness” during the intervention, so additional research should be conducted that further defines the meaning of this.

Further descriptive studies could be conducted to determine exactly how higher education institutions are implementing simulation technology. Information regarding simulation design, objectives, and the purpose of the use of the HPS, whether it is for evaluative or teaching purposes, would be valuable additions to the simulation literature. Additionally, true cost-benefit analyses could be researched to determine the actual cost of the implementation of simulation (equipment, faculty development, building space / design) and how this relates to learning outcomes or benefits for students.

5.6 CONCLUSION

In conclusion, the students in the simulation group had significantly greater knowledge gain than the students in the case study groups, suggesting that the use of the HPS is more beneficial related to learning outcomes than the case study approach. The students in the simulation group also had a significantly greater increase in critical thinking scores when compared to the case study group. Finally, the student perspective of the simulation experience was significantly more positive than the students in the case study group. Therefore, the benefits of the incorporation of high fidelity human patient simulators in an undergraduate nursing curriculum are clearly documented as a result of this study. Schools of Nursing should explore ways to effectively integrate the use of the HPS in the curriculum as an educational tool, and continue to monitor and document the learning outcomes and student perspectives related to this integration.

APPENDIX A

HUMAN PATIENT SIMULATOR SCENARIOS

Robert Morris University
School of Nursing and Allied Health
Simulation Integration Form

Course Title NURS 4020: Management of Adult II

Scenario Topic Care of the Acute Coronary Syndrome Patient

Time Allotment One hour

Instructor Valerie Howard

Student Level (# of participants, role descriptions)
Senior level students in their last advanced MS course.
Students should have had course content prior to scenario
4 Students per group: Nurse 1, Nurse 2 (helper), Wife, Observer

Learning Objectives
Upon successful completion of this scenario, the student will be able to:
1. Identify the signs and symptoms of acute coronary syndrome
- chest pain
- diaphoresis
- tachycardia
- hypertension

2. Demonstrate interventions based on the patient's response to initial care provided.
- ASA
- Oxygen
- VS
- Monitor
- IV line
- Call MD

3. Provide further appropriate interventions based upon the evaluation
- Nitroglycerine
- VS
- Morphine Sulfate

4. Demonstrate hemodynamic monitoring and assessment of pain
- Oxygen saturation
- Continuous BP monitoring
- Cardiac Monitor

5. Select appropriate diagnostic measures in the management of acute coronary syndromes.
- 12 lead EKG
- CXR
- Labs: CBC, LBCGlu, PT/PTT, Cardiac Enzymes

6. Demonstrate therapeutic communication with patient's wife

Set-up / Equipment needed
Simman-bed flat
IV Supplies (HL, flush)
Stethoscope
Oxygen supplies (NC)
Medications: ASA, Nitro, Morphine
Telephone to call MD
Patient Kardex
Video equipment - videotape
Speaker for patient voice
Chair for wife
Script for Wife

Pre-Scenario Learning Activities
Review the ACS Powerpoint presentation
Give the following 'script' for wife-role to student

Script for Wife
You are the 60 year old wife of this patient. You are concerned about your husband and are moderately anxious, asking a lot of questions. During the course of the scenario, you must ask the following questions in any order:

What is happening to my husband?
What is an MI?
Why is my husband having this heart attack?
Could this have been prevented?
It's lunch time…can he have this Kentucky Fried Chicken dinner that I got for him?
Why are you giving him that Aspirin?
What is nitroglycerine for?
Why are you giving him that oxygen? He doesn't have any lung disease.
He told me he has to use the bedpan to move his bowels. Can you please leave while I put him on it?

Instructions for Starting Scenario
Introduction to Scenario:
"You are caring for Mr. Tibble, a 67 yo male admitted to the CCU for increasing signs of angina. He was admitted with a diagnosis of r/o MI. Patient has a history of hyperlipidemia and hypertension and is on Zocor and Lisinopril. He has no known allergies. You enter the room to do your 12 noon assessment and find a diaphoretic patient sitting upright and clutching his chest."

Turn on SIMman and Start the Advanced ACS scenario

Simulator Parameters / Action	Expected Student Interventions / Events
NSR: 110 **RR 12** **SaO2 97%** **BP 150/100** **"My Chest Hurts"** **After NTG administration** **BP 140/80** **"I feel better"**	**Assessment of Patient** **Recognize S/S of ACS** **Intervene:** ASA Oxygen VS Monitor IV line Call MD Reassess

Relevant Debriefing Points (Event Management)

- **Problem Recognition**
  Student recognizes signs of ACS
- **Problem Intervention**
  Student performs VS, Assesses level of CP and associated symptoms, places patient on cardiac monitor, monitors oxygen saturation, administers Oxygen via NC, Calls for help, IV line, calls MD, administers to wife as appropriate, Gives Nitro X3 appropriately, ASA, Morphine, Considers 12 lead EKG, labs, CXR
- **Prioritization**
  Considers ABC's first
- **Rationales**
  Nurse 1 answers the wife's questions with appropriate rationales for:
  Performing each intervention (monitor, VS, IV line)
  Giving medications (ASA, Nitro, Morphine)
  Patient's risk factors and general risk factors for ACS
  Pathophysiology of possible ACS

Positive Feedback and Areas for Improvement

Remember to emphasize positive areas and give recommendations for improvement. Involve all of the students. Have the observer give comments / summarize the scenario.

Application to Clinical Practice

Ask student how they could apply this ACS scenario to "real life" situations on a MS floor or in an ED

Simulation Evaluation Survey

Robert Morris University
School of Nursing and Allied Health
Simulation Integration Form

Course Title NURS 4020: Management of Adult II

Scenario Topic Care of the Acute Ischemic Stroke Patient

Time Allotment 1.5 hours

Instructor Valerie Howard

Student Level (# of participants, role descriptions)
Senior level students in their last advanced MS course.
Students should have had course content prior to scenario
3-4 Students per group: Nurse 1, Nurse 2 (helper/recorder), husband

Learning Objectives
Upon successful completion of this scenario, the student will be able to:
1. Identify the signs and symptoms of acute ischemic stroke
- Unilateral weakness
- Difficulty speaking
- Mental status change
- Visual changes

2. Demonstrate interventions based on the patient's response to initial care provided.
- Reposition patient
- Oxygen
- Nasopharyngeal airway
- Glucose Check
- Heparin drip

3. Provide further appropriate interventions based upon the evaluation
- IV line
- Thrombolytic Screening
- Lab values
- Request CT
- Management of the intubated patient

4. Demonstrate hemodynamic monitoring
- Oxygen saturation
- Continuous BP monitoring
- Cardiac Monitor

5. Select appropriate diagnostic measures in the management of acute ischemic stroke
- 12 lead EKG

- CT scan
- Labs: Glucose, PT/PTT, H/H, Platelets

6. Identify inclusion and exclusion criteria for use of thrombolytics
   - Inclusion: Age>18 years, ischemic stroke, <3 hours from onset of symptoms
   - Exclusion: ICH, improving S&S, known bleeding tendencies, SBP> 185 or DBP> 110, Trauma <14 days ago
7. Demonstrate therapeutic communication with patient's husband

Set-up / Equipment needed
Simman with wig-lying flat
IV Supplies (HL, flush)
Stethoscope
Oxygen supplies (NC, Nasopharyngeal Airway)
Lab tubes
Telephone to call MD, order CT scan
Patient Kardex
Video equipment - videotape
Speaker for patient voice
Chair for husband
Script for Husband

Pre-Scenario Learning Activities
Review the Acute Ischemic Stroke Powerpoint presentation
Give the following 'script' for husband-role to student

Script for Husband:
You are the 60 year old husband of this patient. You are concerned about your wife and are moderately anxious, asking a lot of questions. During the course of the scenario, you must ask the following questions in any order:
What is happening to my wife?
What is a stroke?
Why is my wife having this stroke?
Could this have been prevented?
She's awfully hungry..can I get her some bacon and eggs?
What labwork do you need to send?
What are you putting in her mouth (NPA)?
Why are you giving her that oxygen? She doesn't have any lung disease.
Maybe we could get her out of bed and take her for a walk to make her feel better.
Why is her hand hanging over the bedside like that?
What can I do to help her?
What is a "thrombolytic" medication? What are the risks?
She says she can't see me over here? Why?
What is heparin used for?
I don't think she can hear me because she isn't answering my questions. Is she deaf now?

Instructions for Starting Scenario

Introduction to Scenario:

"You are caring for Mrs. Jones, a 60 year old female with a history of HTN and atrial fibrillation. The patient is admitted to the ED with a chief complaint of right-sided weakness and an inability to speak clearly. Upon arrival, patient's medications are digoxin, ASA, and an anti-hypertensive medication.

Turn on SIMman and Start the Acute Ischemic Stroke scenario

Simulator Parameters / Action	**Expected Student Interventions / Events**
AFib HR 90 **BP: 189/90** **Monitor controls** **SaO2 93%** **RR: 18** **Breath sounds: L and R stridor**	**Assessment of Patient** **Recognize S/S of Acute Ischemic Stroke** **Intervene:** Oxygen Reposition NPA D Strick Monitor Labs Thrombolytic Screening Request CT
If no intervention with airway	BP 230/0 HR 200 Hypoxic trend begins Oral intubation necessary MD enters room and intubates patient

Relevant Debriefing Points (Event Management)

- **Problem Recognition**
  Student recognizes signs of Stroke
- **Problem Intervention**
  Student performs VS, Repositions patient, administers Oxygen, applies monitor, inserts IV, checks glucose level, draws labs, considers thrombolytic screen, requests CT
- **Prioritization**
  Considers ABC's first, then glucose level
- **Rationales**
  Nurse 1 answers the husband's questions with appropriate rationales for:

Performing each intervention
Need for CT scan
Need for labs / thrombolytic screen
Thrombolytic exclusion/inclusion criteria
Patient's risk factors and general risk factors for Acute Ischemic Stroke
Pathophysiology of possible Acute Ischemic Stroke

Positive Feedback and Areas for Improvement

Remember to emphasize positive areas and give recommendations for improvement. Involve all of the students. Have the observer give comments / summarize the scenario.

Application to Clinical Practice

Ask student how they could apply this Acute Ischemic Stroke scenario to "real life" situations on a MS floor or in an ED

Simulation Evaluation Survey

APPENDIX B

WRITTEN CASE STUDIES

Lewis, et al: Medical-Surgical Nursing: Assessment and Management of Clinical Problems, 6th Edition
Case Study Questions
Chapter 33: NURSING MANAGEMENT: Coronary Artery Disease and Acute Coronary Syndrome

Myocardial Infarction

Patient Profile
Matthew, a 46-year-old, white, successful businessman, was rushed to the hospital by a rescue squad after experiencing crushing substernal pain radiating down his left arm. He also complained of dizziness and nausea.

Subjective Data
Has a history of angina pectoris and hypertension
Is overweight but recently lost 10 pounds
Rarely exercises
Has three teenage children who are causing "problems"
Recently experienced loss of best friend and business partner, who died from cancer

Objective Data
Physical Examination
Diaphoretic, short of breath
BP 165/100, pulse 120, respiratory rate 26/min

Diagnostic Studies
CK-MB elevated
Cholesterol 350 mg/dl (9.1 mmol/L)
Myoglobin elevated
ECG shows premature ventricular contractions and ST elevation in leads II, III, aVF, V5, V6
Inferolateral wall MI

Collaborative Care
reteplase (Retavase)
Morphine 2 to 4 mg IV q5min prn for chest pain
Nitroglycerin IV
Oxygen 2 L/min
ASA 325 mg per day
Bed rest
Vital signs every hour

Critical Thinking Questions
Which coronary artery was most likely occluded in Matthew's coronary circulation?
Explain the pathogenesis of CAD. What risk factors may contribute to its development? What risk factors were present in Matthew's life?
What is angina pectoris? How does angina differ from MI?
List the clinical manifestations that Matthew exhibited and explain their pathophysiologic bases.
Explain the significance of the results of the laboratory tests and ECG findings.
For each treatment measure Matthew received, explain the physiologic reason for its use.
Based on the assessment data presented, write one or more appropriate nursing diagnoses. Are there any collaborative problems?

Lewis, et al: Medical-Surgical Nursing: Assessment and Management of Clinical Problems, 6th Edition

Case Study Questions

Chapter 56: NURSING MANAGEMENT: Stroke / CVA

Stroke

Patient Profile
Suzanne, a 66-year-old white woman, awoke in the middle of the night and fell when she tried to get up and go to the bathroom. She fell because she was not able to control her left leg. Her husband took her to the hospital, where she was diagnosed with an acute ischemic stroke. Because she had awakened with symptoms, the actual time of onset was unknown and she was not a candidate for tPA.

Subjective Data
Left arm and leg are weak and feel numb
Feeling depressed and fearful
Requires help with ADLs
Concerned regarding having another stroke
Says she has not taken her medication for high cholesterol
History of a brief episode of left-sided weakness and tingling of the face, arm, and hand 3 months earlier, which totally resolved and for which she did not seek treatment

Objective Data
BP: 180/110
Left sided arm weakness (3/5) and leg weakness (4/5)
Decreased sensation on the left side, particularly the hand
Left homonymous hemianopsia
Overweight
Alert, oriented, and able to answer questions appropriately but mild slowness in responding

Critical Thinking Questions
How does Suzanne's prior health history put her at risk for a stroke?
What priority assessments and interventions must be done upon admission to the ED?
What diagnostic tests are performed to diagnose an ischemic vs. hemorrhagic stroke?
How can the nurse address Suzanne's concerns regarding having another stroke?
How can Suzanne and her family address activity issues such as driving after the stroke?
What strategies might the home health nurse use to help Suzanne and her family cope with her feeling depressed?
What lifestyle changes should Suzanne make to reduce the likelihood of another stroke?
How will homonymous hemianopsia affect Suzanne's hygiene, eating, driving, and community activities?
What factors should the nurse assess for related to outpatient rehabilitation for Suzanne?
Based on the assessment data provided, write one or more nursing diagnoses. Are there any collaborative problems?

APPENDIX C

PERMISSION TO USE EVOLVE INSTRUCTOR RESOURCES FOR CASE STUDIES

From:	<evolve-admin@elsevier.com>
To:	Valerie Howard
Date:	Thursday - April 20, 2006 3:19 PM
Subject:	Evolve Instructor Resources Request Approved
	Mime.822 (2706 bytes) [View] [Save As]

Dear Clinical Assistant Professor Valerie Howard from Robert Morris University,

This message was sent to inform you that your request for the **Evolve Instructor Resources to accompany Medical-Surgical Nursing: Assessment and Management of Clinical Problems** has been approved by the Elsevier Sales Representative in your area. Your request will be processed within 1 business day and the resources will be made available to you. For questions about the fulfillment of you request, please email evolve-admin@elsevier.com.

If you would like to have your local Elsevier Sales Representative get in contact with you, please contact the Elsevier Faculty Support team in the U.S. at **1-800-222-9570** or e-mail sales.inquiry@elsevier.com. In Canada, please phone 1-866-896-3331 or e-mail salescdn.inquiry@elsevier.com. If you are outside the U.S. or Canada, please click here for a list of Elsevier sales offices in your area.

Welcome to Evolve!.

APPENDIX D

PRETEST AND POSTTEST BLUEPRINTS

Edition Properties Report - Pretest

Howard A [Default SS-06]

Description	35 item Exam 20 scored Acute Coronary & Stroke plus 15 pilot		
Exam Type	Custom	**Minutes Allowed**	68.00
Created By	ainslie	**Acceptable Score**	85.00
Created	6/7/2006 5:51:35PM	**Recommended Score**	90.00
Pilot Questions	15		
Total Items	35	**SelfGenMode**	False
PBCC Avg	0.13	**MixedMode**	False
Diff Avg	0.70	**ScoreExam**	True
Est Rel	0.93	**PrintScore**	True
Edition ID	55321	**ShowRationale**	True
		Restarts	0

Sessions Using this edition

Organization

Edition Item Details · Pre test

	Item Name	Item Bank	Specialty	Item ID
1.	Increased ICP position	Critical Care	Critical Care/Fundamentals	21945
2.	Ventilator-ET	Critical Care	Critical Care/Medical Surgical	23371
3.	NSAIDS & aspirin	Pharmacology - Cardiac Drugs	Fundamentals	8319
4.	IV Heparin rate	Math	Fundamentals	3434
5.	CVA-unilateral neglect	Medical Surgical - Neurologic	Fundamentals/Medical Surgical	26190
6.	Eval O2 effectiveness	Fundamentals - Oxygenation	Fundamentals/Medical Surgical	25382
*7.	Contaminated specimen	Medical Surgical - Renal/Urinary	Fundamentals/Medical Surgical	22209
*8.	Crohn's diet	Medical Surgical - GI/Hepatic	Fundamentals/Medical Surgical	3755
9.	Ventilator-open airway	Medical Surgical - Respiratory	Fundamentals/Medical Surgical	3485
10.	Heparin-PTT	Medical Surgical - Cardiovascular	Fundamentals/Medical Surgical	21778
11.	Angina	Pharmacology - Cardiac Drugs	Medical Surgical	21606
12.	ASA anticlot ef	Pharmacology - Analgesics/Anesthesia/Sedatives	Medical Surgical	6063
13.	CAD risk factors	Medical Surgical - Cardiovascular	Medical Surgical	21299
14.	Hypertension-lifestyle chng	Medical Surgical - Cardiovascular	Medical Surgical	22085
15.	MI	Medical Surgical - Cardiovascular	Medical Surgical	3666
16.	Myocardial pain	Critical Care	Medical Surgical	21943
17.	Nitroglycerin-patch	Pharmacology - Cardiac Drugs	Medical Surgical	23853
*18.	Diverticulitis-diet	Medical Surgical - GI/Hepatic	Medical Surgical	3524
*19.	Jaundice-bilirubin	Medical Surgical - GI/Hepatic	Medical Surgical	21454
*20.	Paracentesis	Medical Surgical - GI/Hepatic	Medical Surgical	3736
*21.	Peritonitis	Medical Surgical - GI/Hepatic	Medical Surgical	3507
*22.	Degen joint dis	Medical Surgical - Musculoskeletal	Medical Surgical	4797
*23.	Gout drugs	Medical Surgical - Musculoskeletal	Medical Surgical	4759
*24.	Lumbar pain relief	Medical Surgical - Musculoskeletal	Medical Surgical	3857
*25.	Rheumatoid arth-fatigue	Medical Surgical - Musculoskeletal	Medical Surgical	4769
26.	Increased ICP	Critical Care	Medical Surgical	21949
27.	Stroke Broca's area-approach	Medical Surgical - Neurologic	Medical Surgical	23903
*28.	AV fistula-discharge	Medical Surgical - Renal/Urinary	Medical Surgical	27850
*29.	CRF/ARF	Medical Surgical - Renal/Urinary	Medical Surgical	3585
*30.	Cystoscopy	Medical Surgical - Renal/Urinary	Medical Surgical	4070
*31.	Peritoneal dial-home care	Medical Surgical - Renal/Urinary	Medical Surgical	22499
32.	HTN complication risk	Medical Surgical - Cardiovascular	Pathophysiology/Medical Surgical	35702
*33.	Osteoarthritis-patho	Medical Surgical - Musculoskeletal	Pathophysiology/Medical Surgical	22332
34.	CVA-patho	Medical Surgical - Neurologic	Pathophysiology/Medical Surgical	22378
35.	Atrial fib-ASA	Medical Surgical - Cardiovascular	Professional Issues/Medical Surgical	3643

Edition Properties Report Post test

Howard B [Default SS-06]

Description	35 item Exam 20 scored Acute Coronary & Stroke plus 15 pilot		
Exam Type	Custom	**Minutes Allowed**	68.00
Created By	ainslie	**Acceptable Score**	85.00
Created	6/7/2006 5:51:51PM	**Recommended Score**	90.00
Pilot Questions	15		
Total Items	35	**SelfGenMode**	False
PBCC Avg	0.15	**MixedMode**	False
Diff Avg	0.69	**ScoreExam**	True
Est Rel	0.94	**PrintScore**	True
Edition ID	55322	**ShowRationale**	True
		Restarts	0

Sessions Using this edition

Organization

Edition Item Details - Post test

	Item Name	Item Bank	Specialty	Item ID
*1.	GERD-S&S	Medical Surgical - GI/Hepatic	Community Hlth/Medical Surgical	21078
*2.	Hepatitis A Vacc	Medical Surgical - GI/Hepatic	Community Hlth/Medical Surgical	24540
3.	ICP monitoring	Critical Care	Critical Care	21976
4.	NTG-decreased BP	Pharmacology - Cardiac Drugs	Critical Care/Medical Surgical	27188
5.	Sinus brady-strip intrp	Medical Surgical - Cardiovascular	Critical Care/Medical Surgical	22632
6.	Endotracheal tube	Critical Care	Critical Care/Medical Surgical	26526
7.	Ventilator-ambu bag	Critical Care	Critical Care/Medical Surgical	23373
8.	Bolus heparin calc	Math	Fundamentals	20912
9.	Ml/hr Heparin	Math	Fundamentals	5790
*10.	Crutch walking goal	Medical Surgical - Musculoskeletal	Fundamentals/Medical Surgical	4885
11.	Wt-based heparin	Math	Fundamentals/Medical Surgical	26265
12.	Hypertension-diet	Medical Surgical - Cardiovascular	Fundamentals/Professional Issues/Medical Surgical	21436
13.	Angina-prophlatic	Medical Surgical - Cardiovascular	Medical Surgical	3687
14.	MI S&S	Medical Surgical - Cardiovascular	Medical Surgical	3674
15.	Thrombolytics	Medical Surgical - Cardiovascular	Medical Surgical	5286
16.	Tylenol v ASA prevent stroke	Pharmacology - Cardiac Drugs	Medical Surgical	23861
*17.	Ascites	Medical Surgical - GI/Hepatic	Medical Surgical	3762
*18.	TPN-reason	Medical Surgical - GI/Hepatic	Medical Surgical	3733
*19.	Ulcerative colitis-goal	Medical Surgical - GI/Hepatic	Medical Surgical	22095
*20.	Fat embolism S&S	Medical Surgical - Musculoskeletal	Medical Surgical	3900
*21.	Myelogram follow-up	Medical Surgical - Musculoskeletal	Medical Surgical	3895
*22.	SLE	Medical Surgical - Musculoskeletal	Medical Surgical	4778
23.	Stroke-dysphagia	Medical Surgical - Neurologic	Medical Surgical	27662
*24.	TURP pain assess	Medical Surgical - Renal/Urinary	Medical Surgical	20051
*25.	ARF-drug	Medical Surgical - Renal/Urinary	Medical Surgical	4095
*26.	K & gomerulonephritis	Medical Surgical - Renal/Urinary	Medical Surgical	22207
*27.	Peritoneal dial result	Medical Surgical - Renal/Urinary	Medical Surgical	4097
*28.	Post lithotripsy	Medical Surgical - Renal/Urinary	Medical Surgical	22193
29.	Oxygen admin-flow meter	Fundamentals - Oxygenation	Medical Surgical	4192
30.	Pulse oximeter low read	Fundamentals - Oxygenation	Medical Surgical	23285
31.	Ventilators-suction	Critical Care	Medical Surgical	24747
32.	Cardiogenic shock-prev	Medical Surgical - Cardiovascular	Pathophysiology/Medical Surgical	21972
*33.	Herniated disc-sciatic pain	Medical Surgical - Musculoskeletal	Pathophysiology/Medical Surgical	22331
34.	Stroke-pupil changes	Medical Surgical - Neurologic	Professional Issues/Medical Surgical	26186
35.	NTG administer	Medical Surgical - Cardiovascular	Professional Issues/Medical Surgical	3680

APPENDIX E

SAMPLE HESI TEST SCORING

Health Education Systems, INC. (HESI)
SP MS V-2 - RETEST 1 Results
Scoring Information

Name: [redacted]
School: FACULTY REVIEW - FACULTY REVIEW
HesiScore: 1306.00%
Date: 3/13/2006
Duration: 58 Minutes 52 Seconds.

Scoring Information

HESI Exams
Scoring Explanation

HESI Exams

Scoring Explanation

HESI scores range from 0 to over 1,000, and can be as high as 1,500 (depending on the difficulty level of the exam). An acceptable level of performance is 850, however, the recommended level of performance is 900 and above for all HESI scores provided.

Each school is responsible for establishing their specific standards related to outcome measures of acceptable HESI scores. Many schools choose a certain overall HESI score as a benchmark for progression, and such benchmarks are set at the discretion of the school's faculty and administrators. However, when preparing for the NCLEX, HESI recommends that students seriously remediate any subject area category in which they obtained a HESI score of less than 850.

All test items are weighted according to their difficulty level. If you answer more difficult items correctly, you will get more credit than if you answer less difficult test items correctly. Because of this scoring method, it is highly probable that two students answering the same number of test items correctly will receive different HESI scores because such scores depend not only on how many test items the student answered correctly, but also on which test items the student answered correctly.

Your HESI score reflects application of the HESI Predictability Model (HPM) to your overall score and each subject area score. Research studies have found the HPM to be highly accurate in predicting NCLEX success.

Your "conversion score" is a weighted percentage score that considers the average difficulty of the exam and the average difficulty of the test items you answered. Based on your faculty's use of this exam, a portion of your course grade may be allocated to your HESI conversion score.

The HESI score is a better predictor of NCLEX success than the conversion score because it reflects application of the HPM in its calculation, whereas the conversion score does not.

Colored graphs depicting your scores on various subject area categories are provided throughout this report. The horizontal lines within these graphs are set at the acceptable level (850) and the recommended level (900).

Health Education Systems, INC. (HESI)

SP MS V-2 - RETEST 1 Results

Scoring Information

Name: ~~Val Howard~~ Date: 3/13/2006

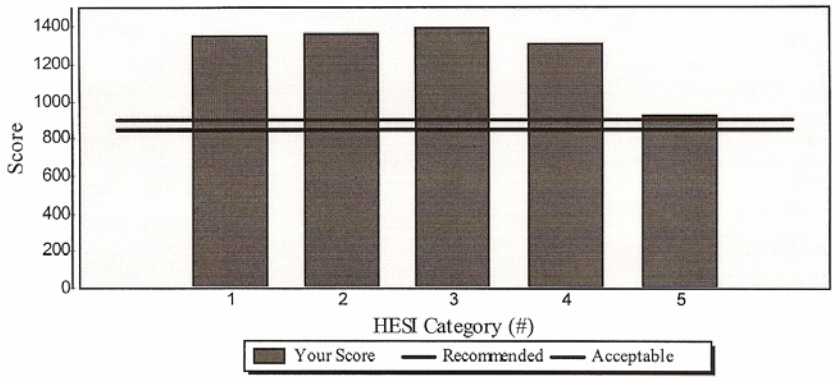
School: FACULTY REVIEW - FACULTY REVIEW

HESIScore: 1306.00% Duration: 58 Minutes 52 Seconds.

Nursing Process

Subject Area	HESI Score	Deviation From Acceptable	Deviation From Recommended	Number of Questions Answered Correctly
Nursing Process				
Assessment	1351	501	451	(18 out of 18)
Analysis	1364	514	464	(7 out of 7)
Planning	1393	543	493	(8 out of 8)
Implementation	1306	456	406	(15 out of 16)
Evaluation	923	073	023	(4 out of 5)

Scores Compared to Acceptable and Recommended Levels



Delivery ID 53207

Health Education Systems, INC. (HESI)

SP MS V-2 - RETEST 1 Results

Scoring Information

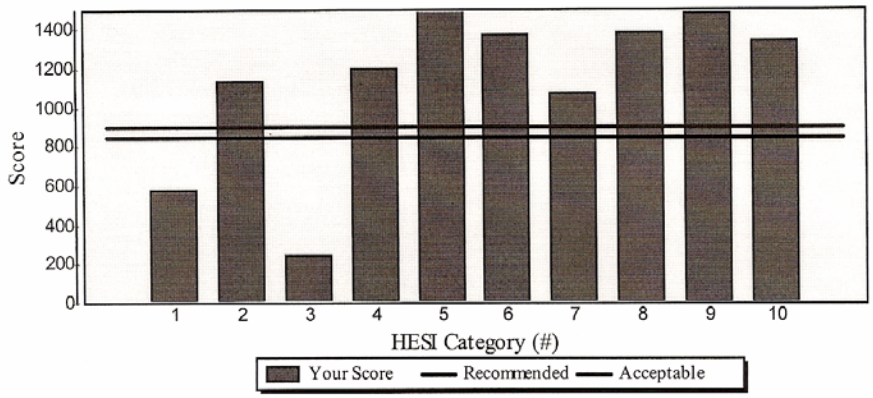
Name: [redacted]
School: FACULTY REVIEW - FACULTY REVIEW
HESIScore: 1306.00%

Date: 3/13/2006
Duration: 58 Minutes 52 Seconds.

Client Needs

Subject Area	HESI Score	Deviation From Acceptable	Deviation From Recommended	Number of Questions Answered Correctly
Client Needs				
Safe/Effective Environment	578	-272	-322	(3 out of 5)
Mgmt of Care	1136	286	236	(2 out of 2)
Safety & Infect Control	250	-600	-650	(1 out of 3)
Health Promotion & Maintenance	1202	352	302	(2 out of 2)
Psychosocial Integrity	1603	753	703	(1 out of 1)
Physiological Integrity	1373	523	473	(42 out of 42)
Basic Care/Comfort	1073	223	173	(6 out of 6)
Pharm & Parenteral Tx	1382	532	482	(5 out of 5)
Reduce Risk Potential	1480	630	580	(14 out of 14)
Physio Adaptation	1339	489	439	(17 out of 17)

Scores Compared to Acceptable and Recommended Levels



Delivery ID 53207

Health Education Systems, INC. (HESI)

SP MS V-2 - RETEST 1 Results

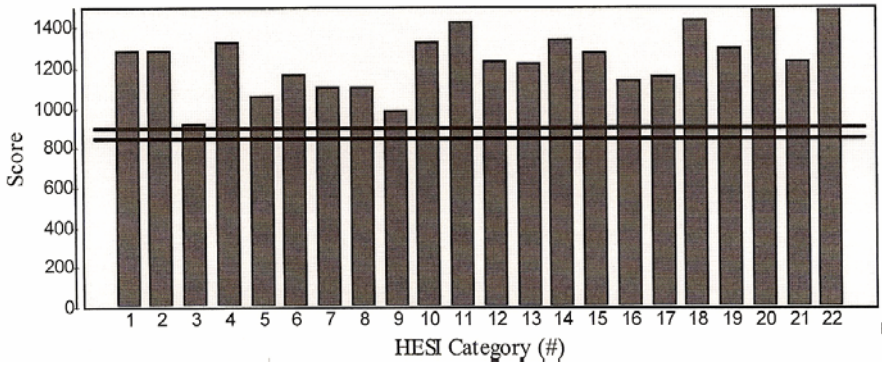
Scoring Information

Name: [redacted]
School: FACULTY REVIEW - FACULTY REVIEW
HESIScore: 1306.00%

Date: 3/13/2006
Duration: 58 Minutes 52 Seconds.

Sub-Specialty Subject Area	HESI Score	Deviation From Acceptable	Deviation From Recommended	Number of Questions Answered Correctly
Fundamentals				
Med Administration	1283	433	383	(2 out of 2)
Math	1283	433	383	(2 out of 2)
Basic Nursing Skills	918	068	018	(2 out of 3)
Maternity				
Intrapartum	1328	478	428	(1 out of 1)
Professional Issues				
Documentation	1062	212	162	(1 out of 1)
Leadership	1164	314	264	(1 out of 1)
Legal/Ethical	1103	253	203	(1 out of 1)
Teaching	1103	253	203	(1 out of 1)
Psychiatric/Mental Hlth				
Depress/Grief	988	138	088	(1 out of 1)
Clinical Concepts: Med-Surg/Pedi/Geri				
Cardiovascular	1330	480	430	(9 out of 9)
Endocrine	1426	576	526	(5 out of 5)
GI/Hepatic	1231	381	331	(7 out of 8)
Immune/Hematology	1218	368	318	(4 out of 4)
Integumentary	1334	484	434	(3 out of 3)
Musculoskeletal	1277	427	377	(4 out of 4)
Neurological	1140	290	240	(3 out of 4)
Oncology	1162	312	262	(3 out of 3)
Operative	1434	584	534	(5 out of 5)
Physical Assessment	1297	447	397	(4 out of 4)
Renal	1584	734	684	(4 out of 4)
Respiratory	1237	387	337	(6 out of 6)
Trauma/Emergency	1559	709	659	(3 out of 3)

Scores Compared to Acceptable and Recommended Levels



Delivery ID 53207

Health Education Systems, INC. (HESI)

SP MS V-2 - RETEST 1 Results

Scoring Information

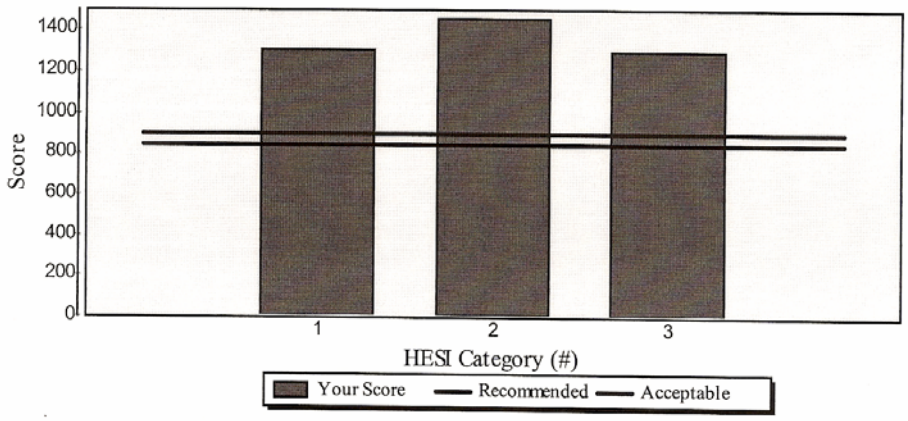
Name: [redacted]
School: FACULTY REVIEW - FACULTY REVIEW
HESIScore: 1306.00%

Date: 3/13/2006
Duration: 58 Minutes 52 Seconds.

NLNAC Accreditation Categories

Subject Area	HESI Score	Deviation From Acceptable	Deviation From Recommended	Number of Questions Answered Correctly
Critical Thinking	1306	456	406	(48 out of 50)
Therp Communications	1462	612	562	(2 out of 2)
Therp Nsg Intvn	1299	449	399	(46 out of 48)

Scores Compared to Acceptable and Recommended Levels



Delivery ID 53207

Health Education Systems, INC. (HESI)
SP MS V-2 - RETEST 1 Results
Scoring Information

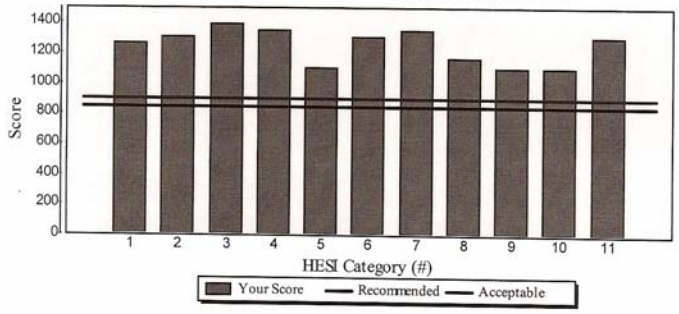
Name: [redacted]
School: FACULTY REVIEW - FACULTY REVIEW
HESIScore: 1306.00%

Date: 3/13/2006
Duration: 58 Minutes 52 Seconds.

AACN Curriculum* Categories

Subject Area	HESI Score	Deviation From Acceptable	Deviation From Recommended	Number of Questions Answered Correctly
Core Categories				
Assessment	1264	414	364	(23 out of 24)
Critical Thinking	1306	456	406	(48 out of 50)
Communication	1389	539	489	(4 out of 4)
Technical Skills	1345	495	445	(21 out of 22)
Core Knowledge				
Ethics	1103	253	203	(1 out of 1)
Hlth Promo/Risk/Prvnt	1309	459	409	(26 out of 27)
Illness & Disease Mgmt	1347	497	447	(37 out of 38)
Info & Hlth Care Tech	1165	315	265	(2 out of 2)
Role Development				
Manager of Care	1104	254	204	(3 out of 3)
Member of Profession	1103	253	203	(1 out of 1)
Provider of Care	1311	461	411	(46 out of 48)

Scores Compared to Acceptable and Recommended Levels



Delivery ID 53207

APPENDIX F

STUDENT EVALUATION SURVEYS FOR HPS AND CASE STUDIES

Simulation Evaluation

Please circle the best response to each of the following questions:

1. What is your age range?

   18-24
   25-31
   32-38
   39-45
   46 and over

2. In which curricular track are you currently enrolled?

   Traditional Baccalaureate Track
   Second-degree Accelerated BaccalaureateTrack
   Hospital Based Diploma Program

3. What is your gender?
   Male
   Female

Please circle the response that best describes how you feel about the simulation experience:

	Strongly Disagree	Disagree	Agree	Strongly Agree
4. The simulation experience helped me to better understand nursing concepts.	**1**	**2**	**3**	**4**
5. The simulations were a valuable learning experience.	**1**	**2**	**3**	**4**
6. The simulations helped to stimulate critical thinking abilities.	**1**	**2**	**3**	**4**
7. The simulation was realistic.	**1**	**2**	**3**	**4**
8. The knowledge gained through the simulation experiences can be transferred to the clinical setting.	**1**	**2**	**3**	**4**
9. I was nervous during the simulation experience.	**1**	**2**	**3**	**4**
10. Because of the simulation experience, I will be less nervous in the clinical setting when providing care for similar patients.	**1**	**2**	**3**	**4**
11. Simulation experiences can be a substitute for clinical experiences in the hospital.	**1**	**2**	**3**	**4**
12. Simulation experiences should be included in our undergraduate education.	**1**	**2**	**3**	**4**

Now, please add any additional comments regarding the simulation experience:

Thank you for completing this survey!

Case Study Evaluation

Please circle the best response to each of the following questions:

1. What is your age range?

   18-24
   25-31
   32-38
   39-45
   46 and over

2. In which curricular track are you currently enrolled?

   Traditional Baccalaureate Track
   Second-degree Accelerated BaccalaureateTrack
   Hospital Based Diploma Nursing Program

3. What is your gender?
   Male
   Female

Please circle the response that best describes how you feel about the case study experience:

	Strongly Disagree	Disagree	Agree	Strongly Agree
4. The case study experience helped me to better understand nursing concepts.	**1**	**2**	**3**	**4**
5. The case studies were a valuable learning experience.	**1**	**2**	**3**	**4**
6. The case studies helped to stimulate critical thinking abilities.	**1**	**2**	**3**	**4**
7. The case studies were realistic.	**1**	**2**	**3**	**4**
8. The knowledge gained through the case study experiences can be transferred to the clinical setting.	**1**	**2**	**3**	**4**
9. I was nervous during the case study experience.	**1**	**2**	**3**	**4**
10. Because of the case study experience, I will be less nervous in the clinical setting when providing care for similar patients.	**1**	**2**	**3**	**4**
11. Case study experiences can be a substitute for clinical experiences in the hospital.	**1**	**2**	**3**	**4**
12. Case study experiences should be included in our undergraduate education.	**1**	**2**	**3**	**4**

Now, please add any additional comments regarding the case study experience:

Thank you for completing this survey!

APPENDIX G

SCRIPTS FOR THE GRADUATE STUDENT AND RESEARCHER

Script for the Graduate Student Assistant

Hello! My name is Susan Lucot and I am currently a graduate student at the Robert Morris School of Nursing and Allied Health. I am assisting Professor Valerie Howard who is conducting research in order to obtain her Doctoral Degree in Higher Education Administration from the University of Pittsburgh School of Education. I have no evaluation responsibilities related to your course. I am here today to ask for your permission to participate in her research study which examines the use of simulation in nursing education to enhance knowledge gain and critical thinking abilities of nursing students. She is recruiting nursing students form Robert Morris University and Sharon Regional Hospital School of Nursing. Your participation is very valuable to Professor Howard. As part of your course requirements, you are required to participate in a "Simulation Day" on July 10, which includes both the use of the human patient simulator and case studies as educational strategies to enhance your knowledge of medical-surgical nursing. To participate in this study, Professor Howard is asking to complete a HESI developed pretest and posttest consisting of 35 questions, which will take approximately one hour of your time on the same day as the simulation experience. In addition, she is asking you to complete a 12 item Simulation Evaluation form upon completion of the activity in order to assess your perspective of the simulation experience. She is hoping to get 50 nursing students to participate in this study, which will run until December, 2005. There are no foreseeable risks associated with this project. By taking the HESI pretest and posttest, you may receive an educational benefit through the practice of taking these critical thinking exams. You do not have to participate if you do not want to, and your grade will not be affected if you choose not to participate. In fact, Professor Howard will not know who has chosen to participate until after she posts the final grades at the end of July. You may choose to withdraw from this study at any time without incurring any penalty. All answers and data will be kept strictly confidential and will be kept in a locked file. I will give you two copies of this script. Does anyone have any questions?

If you choose to participate, please complete the second page of this script and return this to me now. I will collect these forms and use this information to notify you regarding the time and location of the pretest and posttest. If you have further questions, you can contact Valerie Howard at 412-397-3846 or via email at howardv@rmu.edu. My contact information is:

Susan Lucot: sllst4@rmu.edu; 412-559-4650 (c) ; 412-835-3252 (h).

Thank you for your time and consideration given to participating in this study!

Script for the Researcher

Hello! My name is Valerie Howard and I am currently a Doctoral student at the University of Pittsburgh School of Education in the Higher Education Administration Program. I am here today to ask for your permission to participate in my research study which examines the use of simulation in nursing education to enhance knowledge gain and critical thinking abilities of nursing students. I am recruiting nursing students from Robert Morris University and Sharon Regional Hospital School of Nursing. Your participation is very valuable to me. As part of your course requirements, you are required to participate in a "Simulation Day", which includes both the use of the human patient simulator and case studies as educational strategies to enhance your knowledge of medical-surgical nursing. To participate in this research study, I am asking you to complete a HESI developed pretest and posttest consisting of 35 questions, which will take approximately one hour of your time on the same day as the simulation experience. In addition, I am asking you to complete a 12 item Simulation Evaluation form upon completion of the activity in order to assess your perspective of the simulation experience. I am hoping to get 50 nursing students to participate in this study, which will run until December, 2006. There are no foreseeable risks associated with this project. By taking the HESI pretest and posttest, you may receive an educational benefit through the practice of taking these critical thinking exams. You do not have to participate if you do not want to, and your grade will not be affected if you choose not to participate. In addition, you may withdraw from the study at any time without incurring any penalty. All answers and data will be kept strictly confidential and kept in a locked file. I have two copies of this script which I will pass out to you now. Does anyone have any questions?

If you choose to participate, please complete the second page of this script and return this to me now. I will collect these forms and use this information to notify you regarding the time and location of the pretest and posttest. If you have any further questions, you can contact me, Valerie Howard, at 412-397-3846 or via email at howardv@rmu.edu. Thank you for your time and consideration given to participating in this study!

Research Study Contact Information

(Page 2 of Script)

I, _____, agree to participate in Valerie Howard's research study and agree to be contacted at the following email address regarding the time and location of the pretest and posttest:

_____

APPENDIX H

CONFIDENTIALITY FORM AND PERMISSION FOR VIDEOTAPING

Robert Morris University
School of Nursing and Allied Health
Confidentiality Statement and
Permission for Simulation Videotaping

I, _____, agree to keep the information derived from this scenario confidential. I will not share the scenario details with other students, and I will not discuss the performance of my classmates during the scenario with others.

I also give permission to be videotaped during the simulation scenario. I understand that this videotape will be used for educational purposes only, and that other classmates and instructors may view this. Following the simulation activity, the videotapes will be erased. By critically evaluating my performance through the viewing of videotapes, I understand that my learning can be maximized.

_____ _____

(Student Signature) (Date)

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