# BRAIN BASED LEARNING PRINCIPLES APPLIED TO THE TEACHING OF BASIC CARDIAC CODE TO ASSOCIATE DEGREE NURSING STUDENTS USING THE HUMAN PATIENT SIMULATOR

by

JEAN MARIE MILLER WORTOCK

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
College of Nursing
University of South Florida

Date of Approval:
July 10, 2002

Major Professor: Mary E. Evans, Ph.D., R.N.

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University of South Florida
Tampa, Florida

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CERTIFICATE OF APPROVAL

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This is to certify that the dissertation of

JEAN MARIE MILLER WORTOCK

in the graduate degree program of
Nursing
was approved on July 10, 2002
for the Doctor of Philosophy degree.

Examining Committee:

[redacted]

Major Professor: Mary E. Evans, Ph.D., R.N.

[redacted]

Member: Jason W. Beckstead, Ph.D.

[redacted]

Member: Mary B. Tittle, Ph.D., R.N.

[redacted]

Member: Mary Lou VanCott, Ph.D., R.N.

Committee Verification:

[redacted]

Associate Dean

Dedication

This dissertation is dedicated to my son Jacob. Since his birth April 20, 1979, he has been a constant source of maternal pride and happiness. Much of what I have accomplished in my life has been to provide him with not only the material goods necessary for life, but also to be a role model for him on how to live. He has surpassed all my aspirations for him. Never was his caring and compassion more evident than in the past few weeks as I completed this challenging process. He has been a wonderful support to me especially when I was the most stressed. My son continuously confirms my beliefs in the research on the brain, environmental effects and the learning process. Thank you Jacob for being you, a man I truly admire.

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*An Abstract*

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Neurobiology research has enhanced our knowledge about the brain, and subsequently learning. This perspective is revolutionizing education. New teaching strategies are being developed with learning as the focus. Nurse educators can utilize these strategies to optimize student learning, especially in stressful situations. Few situations are as stressful for health care providers as when a patient goes into cardiac arrest. Improved critical thinking and code proficiency are needed to effectuate better patient outcomes. Skills learned through simulation increase critical thinking both in classroom and laboratory settings and can, ultimately, be transferred to patient situations.

This study examined different strategies for increasing critical thinking necessary for code response proficiency. Up to this point, research had not been conducted utilizing a Web based cardiac code response course and a Human Patient Simulator (HPS). This study used these teaching strategies alone and in combination. The Web based course was developed using brain based learning principles. Two critical thinking measures were selected for use in this study, one general, the California Critical Thinking Skills Test (CCTST), and one nursing specific, the Critical Thinking Process Test (CTPT).

The sample consisted of students (n = 54) enrolled in their last semester of an associate degree nursing program at a central Florida college. An experimental design employing random assignment to 1 of 4 groups was used. Group 1 received only the standard cardiac code response instruction included in the college curriculum; in addition, Group 2 received a HPS code scenario, Group 3 received a Web based cardiac code response course; and Group 4 received a combination of the Web based course and the HPS. All students were tested using both critical thinking measures before and after intervention. Data were analyzed using a four by two (4 X 2) factorial design for mixed

repeated measures. Due to the small sample size with corresponding low power, results of the study were not statistically significant. However the majority of trends were in the direction predicted by the hypotheses. Therefore, Web based instruction when combined with simulators may increase critical thinking, improve skill sets, thereby improving patient outcomes. Continued research is indicated.

Abstract Approved: [redacted]

Major Professor: Mary E. Evans, PhD., R.N.
Professor, College of Nursing

Date Approved: July 10, 2003

# Chapter One

## Introduction

In today's ever changing health care environment nurses are faced with many challenges. Nurses need to be able to use critical thinking strategies to help them solve problems related to critical health care issues with their patients and within an increasingly complex organizational bureaucracy. In order for nurse educators to prepare nurses capable of functioning effectively in their complex role, new innovative teaching strategies are being sought. These teaching strategies are needed to assist students to learn more effectively and to concurrently incorporate critical thinking skills into their clinical practice.

One of the most difficult clinical situations a nurse encounters when critical thinking skills are essential and when second-to-second decisions could determine if a patient will live or die is the cardiac code. When a patient experiences a cardiopulmonary arrest, the correct decision and appropriate intervention need to occur promptly and simultaneously. However, few situations are as stressful as when a patient experiences a heart attack, cardiac arrest, cardiopulmonary arrest, or code (Ehrhardt & Glanker, 1996; Timmermans, 1999). For nursing students, anticipating their first code and wondering if they will be prepared to handle the situation produces significant anxiety, that can impair judgment, performance and client outcomes (Badger, 1996; Owen, 1991). Knowledge and first hand experience can allay caregiver anxiety and improve patient outcomes following cardiopulmonary resuscitation (Chaplik & Neafsey, 1998; Cole, Slocumb, & Mastey, 2001; Cuda, Doerr & Gonzalez 1999; Hallstrom, Cobb, Johnson & Copass, 2000; Moser, Dracup, & Doering, 2000; Pottle & Brant, 2000; Rajacihic, Khasawneh, Cameron, & Al-Ma'aitah, 2001). Nurse educators have long struggled with methods of educating students and nurses on how to cope with and prepare for this critical situation that can occur in a variety of clinical settings. For purposes of this study it is projected that knowledge and first hand experience will also increase critical thinking.

Simulations have been used for over 30 years to assist in learning. Barrows and Abrahamson (1964) were the first to use a simulated patient to evaluate clinical performance. In the past, students practiced skill sets on each other, paid volunteers, or manikins. With the recent advent of the computerized Medical Education Technologies Incorporated (METI) Human Patient Simulator (HPS), much more sophisticated simulations are possible. According to Ironside, (1999) simulations are "thought to be effective in teaching critical thinking in classroom and laboratory situations" (p 238). However, she further states that "little research has been conducted to evaluate the relationship between specific teaching strategies and students' ability to think critically in specific situations" (p 238).

Advances in neurobiology have enhanced our knowledge about the brain and how it functions, and subsequently how we learn. Further, this research has begun to revolutionize education. New teaching strategies using the principles from brain based research are being developed with learning as the central focus. It is now known that students need to construct foundational brain structures, or dendrites, before higher level thought processes, or critical thinking, can occur. Research on how the brain learns best has indicated that students learn in an environment that is comfortable, relaxed, and with minimal stress, which makes learning at home an option needing exploration. Alternate teaching environments are now available to nurse educators with the advent of the internet. Students can take courses in their home environment via distance learning using on line courses in the Web Computer Technology format. Using brain based principles, this research study examined the effects of four teaching methods or conditions on the development of critical thinking in nursing students, using cardiac code response as the focal content area.

*Theoretical Framework*

Multiple theoretical or conceptual frameworks were cited in the studies reviewed related to this research study. The most frequently cited framework in simulation and simulator studies was cognitive learning theory (Bareford, 2001; Byrne & Jones, 1997; DeAnda & Gaba, 1991; Gonzalez & Schaefer, 1996; Johnson, Zerwic & Theis. 1999; Lamond, Crow, Chase, Doggen, & Swinkels, 1996; Russell, Miller & Czerwinska, 1994; Schwid & O'Donnell, 1990; Yoder, 1993). Hensley (1996) used Schon's reflective practicum, which assumes that practice professionals synthesize solutions to clinical problems by both cognitive and behavioral processes. Further, these processes occur while in the midst of interaction with the environment (e. g., clinical settings), which would include simulated clinical settings. Goolsby (2001) also mentioned the environment in her study derived from ecological psychology theory. Thede, Taft and Coeling (1994) and Yoder (1993) cited transfer of learning or knowledge theory. Brooks and Shepard (1990) also cited the concept of lateral transference of general knowledge to specific situations in their study using the Nursing Performance Simulation Instrument but did not link the concept within the study. Gilbart, Hutchison, Cusimano, and Regehr (2000) had one brief reference to knowledge transfer theory in their trauma based simulator study. Both Henry (1991a) and Tschikota (1993) used information-processing theory, a theory of "problem solving on artificial intelligence" (p. 390) to examine clinical decision-making in a simulated client situation. An additional study by Henry (1991b) mentioned the Dreyfus model of skill acquision where skilled nursing practice includes both intervention and clinical judgment. Weis and Guyton-Simmons (1998) briefly discussed Conger and Mezza's (1996) model for critical thinking and Benner's (1984) novice to expert theory in their study based on computer simulation to stimulate critical thinking. The remaining theories mentioned are as follows: human computer interaction theory (Jones & McCormac, 1992); change theory (Donabedian & Donabedian, 1993); Eysenck's theory of anxiety, learning and memory (Eler & Rudman, 1993); Gagne's pairing of instructional events (Gilbert & Kolacz, 1993); King's interacting systems framework (Brooks & Thomas, 1997); Bandura's theory of self-efficacy (Madorin & Iwasiw, 1999); Bandura's social learning theory in combination with Knowles' adult learning theory (Saucier, Stevens & Williams, 2001), and good practices in education theory (Jefferies, 2000). As demonstrated above, there has not been any consistent, unifying learning theory in the studies reviewed. As a result, current learning theoretical frameworks were explored.

In the latter part of the 20th century the dominant theory of learning was behaviorally based from the doctrines of B. F. Skinner (Gazda & Corsini, 1980). As we move into the new millennium, advances in brain research have enabled improved understanding of both brain functioning and learning. Brain based learning theory, founded on Brain Based

Learning (BBL) principles has been postulated with subsequent implications for education (Caine & Caine, 1997; Cross, 1999; Jensen, 1998a; Jensen,1998b; Leamnson, 2000; Smilkstein, 1999). Since learning is partly physiological, educators can focus student learning to facilitate growth of new organic brain structures or dendrites, and enhance new synaptic connections and neural pathways. Practice with directed, specific content, in a setting that encourages the making and correcting of mistakes would result in learning.

Thus, it is postulated that learning and critical thinking would be fostered with the use of a Web based course, in the content specific area of cardiac code response, employing a human patient simulator. This is the conceptual model for this study.

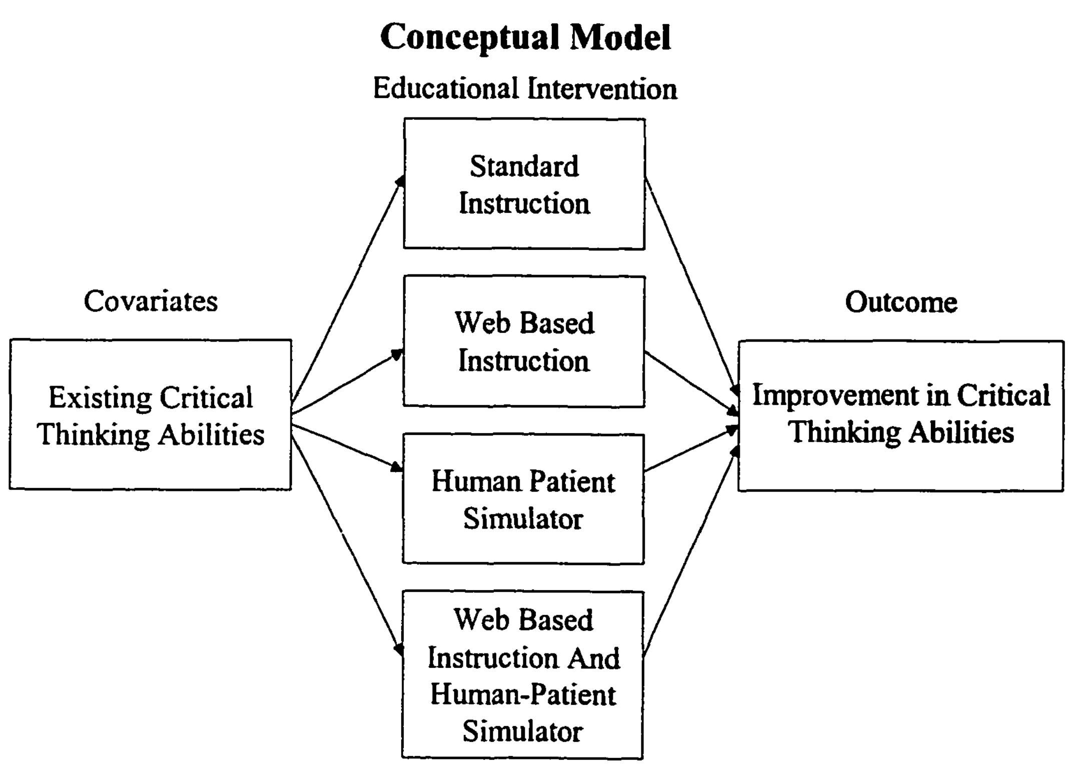


*Figure 1. Diagram of Conceptual Model*

*Purpose of the Study*

The purpose of this study was to determine the effect of different methods of teaching cardiac code on the critical thinking of nursing students. Comparisons were made using four methods of teaching cardiac code response to nursing students with the outcome variable of improved critical thinking, as illustrated in the conceptual model diagram. The covariates for this study were the students' existing critical thinking abilities. The educational interventions were standard instruction, Web based instruction, a Human Patient Simulator (HPS) and a combination of the Web based instruction and the HPS. The projected outcome was an improvement in critical thinking abilities. The four methods will be discussed in detail in Chapter Three.

*Hypotheses*

The following hypotheses were tested.

1) All students will show a significant increase (pre test - post test) on the critical thinking measures.
2) Students in the web based cardiac code response course will show a significant increase in critical thinking compared to students who did not receive the web based cardiac code response course.
3) Students who complete the simulator condition will show a significant increase in critical thinking compared to students who did not complete the simulator condition.
4) The increase in critical thinking will be larger for students with both the web based cardiac code response course and the simulator condition than the simulator condition alone.

5) Students who received either the web based cardiac code response course or the simulator condition will show more improvement on the critical thinking measures than students who received the standard education.

6) Students who received both the web based cardiac code response course and simulator condition will show more improvement on the critical thinking measures than students received either of these conditions alone.

7) Students who received any high technology condition will show more improvement on the critical thinking measures than students receiving the standard education.

8) Students who received both the web based cardiac code response course and the simulator condition will require fewer prompts, and will experience fewer simulator "deaths" compared to the simulator only condition.

*Definition of Terms*

*Brain Based Learning (BBL).* Learning that results from brain based principles

*Brain Based Teaching Principles (BBTP).* Educational strategies that employ or build upon the biochemical understanding of the living brain to promote learning

*Cardiac Code (CC).* Clinical pattern of signs and symptoms indicating the need for cardiopulmonary resuscitation (CPR)

*Cardiac Code Scenario.* Scripted programming for the simulator from stable to pulsatile ventricular tachycardia, pulseless ventricular tachycardia, ventricular fibrillation, and asystole

*Critical Thinking.* Using the nursing process employing the cognitive skills of analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting and transforming knowledge to make decisions that solve patient problems

*California Critical Thinking Skills Test (CCTST) 2000.* A secure 34-item non discipline specific test; measures the skills dimension of critical thinking

*Computer Assisted Instruction (CAI).* Computers or computer software used to facilitate learning

*Computer Based Instruction (CBI).* Any instruction involving computer technology used to facilitate learning inclusive of CAI

*Critical Thinking Process Test (CTPT).* A secure 50-item nursing based critical thinking test sold by Educational Resources, Incorporated (ERI)

*Human Patient Simulator (HPS).* Refers specifically to a manikin developed to physiologically model a human being, for purposes of this study, the HPS manufactured by Medical Education Technologies, Incorporated (METI)

*Simulation.* A process whereby real life situations are demonstrated in a laboratory; simulation of a cardiac code is provided through the use of a HPS

*Simulator.* A general term used to denote something that mimics something else; examples could include a flight simulator, an anesthesia simulator, generic brands of human patient simulators

*Student.* Any one enrolled in the last semester of the associate degree nursing program at a south central Florida college

*Summary*

Promoting student learning is the focus of nursing education. It is important that the benefit of HPSs in nursing education be explored empirically, especially as clinical experiences that are essential for skill development are becoming less available. Further, the combination of a web based didactic component used in conjunction with the HPS has been hypothesized to enhance critical thinking in this study. A more detailed discussion of these issues is presented in Chapter Two.

# Chapter Two

## Review of Literature

*Introduction*

Nurse educators are challenged to foster student learning. Part of that challenge is to use teaching strategies that will encourage learning. Research findings may offer new methods or teaching strategies that enhance learning. Technological advances are continuing at a rapid rate. Therefore, nurse educators must stay abreast of these technological advances. Further, research using these new technologies must conducted, and prior research must be evaluated. In this chapter advances in research in the areas of learning, brain based learning, computer assisted or based instruction, web based learning, cardiac codes, simulations, simulators, and critical thinking will be presented.

*Learning*

The educational focus in community colleges has shifted from teaching to learning as we enter the new millennium (Cross, 2000; O'Banion, 1997; O'Banion & Milliron, 1998; Skiba, 1997). O'Banion, in O'Banion and Milliron (1998), states that in order to survive in the 21$^{st}$ century, community colleges must become less focused on teaching and more focused on learning. Further, O'Banion states that a "Learning Revolution is sweeping across the higher education landscape . . . as institutions strive to remove the time-bound, place-bound, role-bound, and bureaucracy-bound models of education that shackle innovation and transformation" (1998, p. 1).

A major impetus for this learning revolution has been significant advances in the field of neurobiology, specifically in the area of brain research that has enabled a better understanding of how the brain works and subsequently, how we learn. Educators, working with neurobiologists have taken this new information and applied it to learning principles (Cross, 1999). Thus, these new learning principles are brain based. Therefore, the belief is that students will learn more effectively if brain-compatible methods are utilized. This is the premise for this study.

O'Banion's (1998) comment regarding removing time-bound and place-bound restrictions on education supports the concept of brain based learning that is student focused, whether in the class room or via distance learning. Subsequently, educators should develop strategies that center on expanding student learning, and adapting educational systems to facilitate the learning process. The assumptions and implications for education presented in Table 1 were presented by Dr. David H. Ponitz at a roundtable discussion: Focus on learning: Planning the Community College of the twenty first century (November 5, 1998). If these assumptions and implications are implemented, it is postulated that there will be improvement in educational processes, with an end result of increased student learning.

In addition, educational systems, and specifically educators, have a responsibility to their students to prepare them for the workplace of tomorrow. Trends have shown that America's workforce has changed significantly since 1970's with a move toward a more technically based work force (see Table 2, ibid).

Table 1

Assumptions and Implications for Learning and Educational Systems

| Assumption | Implication |
|---|---|
| Learning is life-long and continuous. | The system is seamless. |
| Learning is developmental, building on levels of attainment. | The system is integrated, removes duplication and facilitates progress. |
| Learning opportunities are available when and where needed. | The system is open to ease of access. |
| Learners are increasingly autonomous. | The system allows individualized service, responding to intellectual, social, psychomotor and affective aspects. |
| Meeting the needs of learners is paramount. | Educators must determine system functions; technology is an enabler. |
| Learner progress through the system is administratively facilitated. | Administrative systems are nonduplicative across the system. |

Table 2

Changes in America's Workforce

| | Four Year Degree | Semi Skilled | Technical |
|---|---|---|---|
| 1970 | 20% | 65% | 15% |
| 1990 | 20% | 15% | 65% |

With the significant changes in the workforce and the phenomenal increases in knowledge and information available, what do students really need to learn - the acquisition of facts or the skills to locate and utilize information? Certainly, a strong theoretical knowledge base is essential as an educational foundation, especially in a complex content area such as nursing. To focus solely on the acquisition of facts, however, is inadequate to provide the critical thinking skills needed by nurses today and in the future. Nurse educators need to utilize the best and most current teaching/learning strategies to facilitate student learning.

One such strategy is brain based learning which is part of the impetus driving the learning revolution. Owing to significant advances in the fields of anthropology, chemistry, cognitive science, psychology, neuroscience, and especially neurobiology, all studying specific areas of brain research, there is a better understanding of how the brain works and subsequently, how we learn (Jensen, 2000).

*The Brain*

Understanding the human brain is challenging. "If the brain were so simple we could understand it, we would be so simple, we couldn't," –Lyall Watson in Jensen (1998a, p. 82). This profound statement on the complexity of the human brain illuminates the inherent challenges in research and understanding.

In the 1970's the concept of split-brain or "right-brain, left-brain" was postulated (See Appendix A for Right Brain, Left Brain functions). The current emphasis is on analyzing the functions of both hemispheres to facilitate synthesis, or whole brain learning (Gazzaniga, 1998).

Some researchers suggest that studying any individual brain structure results in a better understanding of the entire brain. The biocomplexity model of the 1990s espouses that every structure in the brain is connected either by physical, chemical, or electrical properties (Ferguson, 1992; Jensen, 1998a). Through these multiple connections the brain exchanges information with the rest of the human body. The brain is the organ system in our bodies responsible for learning, thinking, and remembering.

These brain abilities are present in utero; as the fetus develops, or does not develop, so does the brain. The mind/body connection begins in utero, as does the positive or negative influences of environment. At birth, the human brain is incomplete. The brain, even though immature, contains approximately 100 billion cells, which compares with the number of stars in a galaxy. However, similar to the stars, these cells are not connected into functioning networks. By the time the child is three the brain has formed about one thousand trillion connections between these brain cells (Epstein, 1998), thus the emphasis on early childhood environment and education. Connections are either kept or lost dependent on use or environment or both.

Whatever knowledge, skills or concepts the brain learns is individual, based on individual experiences and personal environment. These influences are central to shaping the brain, and subsequently what the brain learns (Smilkstein, 1998). The process of learning requires connections and unless significant connections are made, little effective learning takes place (Parnell, 1995). It is the responsibility of educators to utilize these principles to effectuate the most learning possible. Educators, working with neurobiologists have taken this new information and applied it to learning principles (Cross, 1999). Thus, these new learning principles are brain based. Therefore, the assumption is that students will succeed as learners if brain-compatible methods are utilized. Parents and educators can assist in improving and facilitating both the environment and the content in which the brain learns.

*Learning Environment*

In addition, when learning opportunities occur in a setting that is compatible with the way the brain learns best, learning is both spontaneous and pleasurable. On-line educational opportunities provide the potential for such a setting. The pleasure occurs, in part, as a result of the endorphins that are produced during a relaxed, positive learning experience. Endorphins, our body's natural opiates, are produced in the brain during pleasant experiences, in this case, learning; but endorphins are also produced with other activities such as exercise or keyboarding, which would also increase a natural sense of well being (Hanneford, 1995; Katz & Rubin, 1999). By combining these two processes learning becomes both active and pleasurable. This type of learning experience reinforces the concept that learning is fun.

*Brain Based Learning*

By definition, brain based learning is a learning theory based on the structure and function of the human brain; this theory is foundational to this study. "Brain-compatible learning is a research-based, multidisciplinary approach to the question of how our brain learns best," (Jensen, 1998b, Introduction, non paginated). Both the synapses in the brain and the peptides (amino acids) found throughout the body are essential to the transmission of information to and from the brain. It is the neuron, through its dendrites, that enable the synapses in the brain to connect. One neuron could connect to as many as

50,000 other cells. The more connections that are made the more learning can occur (Smilkstein, 1999).

Expressed very simply, if the brain is allowed, or encouraged to fulfill its normal processes, learning will occur. Under this theory everyone can and does learn. Learning is growing new dendrites or new brain structures. Teaching using brain based learning principles is facilitating the growth of dendrites, synapses, and neural networks (Smilkstein, 1999).

*Brain Based Learning Principles*

There are theorists specializing in brain-based learning, each reporting multiple principles. According to both Caine and Caine (1990, 1994, 1997, 1998a, 1998b) and Jensen (1998a, 1998b), there are twelve core principles of brain-based learning. These principles are summarized as follows. Every human brain is unique. The brain or mind is a complex, dynamic and social system. Intelligence is defined as the ability to collect and utilize data through patterning, and is valued by our society. Meaning, which is more important than information, occurs through patterning, and emotions are critical to the patterning process. Emotions drive our attention, health, learning, meaning, memory, and survival. Complex learning is both enhanced by challenge, resulting in higher level learning, and inhibited by threat, which causes the brain to revert to a survival mode. Complex, challenging experiences with positive feedback are the best enhancers of learning. Cognitive skills are most enhanced when the learning is combined with music and motor skills. The brain can process both "parts and wholes," as well as focus attention and peripheral perception all simultaneously. Learning is conscious, unconscious, and developmental. People's learning will progress at their individual developmental level, but fortunately the brain's ability to develop continues throughout the life span. Memory is a combination of spatial connections and systems of rote learning. Memory experiences are stored in a variety of neural pathways. All memory is both in the mind and body therefore, movement, foods, attention cycles, drugs, and chemicals all may have a powerful effect on learning (Caine & Caine,1990, 1994, 1997, 1998a, 1998b) and (Jensen,1998a, 1998b). These principles were used in the development of both the web based cardiac code response course and the HPS scenario used in this study.

*Brain Based Learning Implications for Education*

Caine and Caine (1990, 1994, 1997, 1998a, 1998b), and Smilkstein (1993a, 1993b, 1998, 1999) have postulated brain based learning principles with subsequent implications for education. Since learning is partly physiological, educators can focus student learning to facilitate growth of new organic brain structures or dendrites and enhance new synaptic connections and neural pathways. These structures grow by making and correcting mistakes. Encouraging the making of mistakes and increasing practice will reinforce learning. Such repeated practice is possible with a HPS. Practice with directed, specific content would result in specific neural pathways or connections for that content area. The cardiac code response course provided the specific content for this study. Further, each student needs to make a personal connection with the new content so that they can relate new learning to previous learning to establish increased neural pathways for memory retrieval (VanTassell, 1998). Students will need to construct basic brain structures about each concept "before they can construct the dendrite/synapse/neural network-rich, higher structures needed for critical/creative thinking" (Smilkstein, 1999).

Students with prior knowledge or experience in a content area will have a brain structure advantage and therefore, higher level abilities than students without this advantage. Thus, structuring individualized curriculum from simple to complex will facilitate all levels of learning (Nunley, 1998). As activity and stimulation promote neural growth, activity levels should be as high as reasonably possible (Hanneford, 1995; Katz & Rubin, 1999). If the learning environment is positive, supportive, and encouraging, students will be more likely to learn (Caine & Caine, 1997; Nkongho, 1994; Smilkstein, 1999).

Unfortunately, our traditional teaching methodology often thwarts the brain-based process. Research, combining what we know about the human brain with current classroom research studies, is enabling us to better understand how the brain learns. Further, research has supported the development of teaching strategies that are not only compatible with the way the brain learns, but actually enhance the brain's ability to learn.

In essence, every area of the educational process will be affected. Thus, such research could have a significant impact on the educational process. Curriculum could be developmentally and culturally appropriate, integrated, interdisciplinary, relevant, inclusive of gender differences, social and emotional literacy, nutrition, music, physical activity, and metacognition strategies (Jensen, 1998b). Brain-based curricula will also incorporate the concepts of "multiple intelligences" postulated by Howard Gardner (1983) and supported by educational research (Armstrong, 1994; Haggerty, 1995). Educators will assist learners in procuring the most effective individual learning experiences, in an environment conducive to learning.

*Computer Assisted Instruction (CAI) or Computer Based Instruction (CBI)*

An environment conducive to learning may be a student's home, office, or on campus computer laboratory. Kulik and Kulik (1987, 1991) reported the effectiveness of computer-based instruction in both elementary schools and colleges. A meta-analysis of 11 Computer Assisted Instruction (CAI) studies found that "nursing students who used computer assisted instruction learned more than those who had traditional instruction and did so in less time" (Belfry & Winne, 1988, p. 77).

In 1993, Jelovsek and Adelbonojo reviewed 49 studies reported in the medical literature from January 1966 through June 1992 using CAI. In their integrated review, CAI instruction improved learning in approximately 61% of the studies.

Further, a meta-analysis by Cohen and Dacanay (1994) based on 29 Computer Based Instruction (CBI) studies, 10 of which used simulation, dated between 1966 and 1991, found higher achievement test averages with CBI compared to conventional instruction. Positive effects were reported with computer-driven interactive videos that simulated real-life scenarios thus providing students with "clinical" experiences in non-threatening settings. While these analyses report positive findings overall, the need for increased research with detailed descriptions was stressed. Increased technological advances will provide continued opportunities for computer linked, nursing based research.

*Web based learning*

On-line or web based learning has increased dramatically in the past few years (DeBourgh, 2001; Gray, 1998; Levine, 2002). More and more classes, including nursing classes, are being offered on-line or via a distance format (Glacken & Baylen, 2001). Research into the effectiveness of this learning method is in the initial stages (Malloy &

DeNatale, 2001; Polichar & Bagwell, 2000; Scollin, 2001; Sery-Ble, Taffe, Clarke, & Dorman, 2001). However, the attributes of learners that are successful have been postulated (DeBourgh, 2001; Effken & Doyle, 2001; Washenberger, 2001). Those attributes coincide with the brain based learning principles discussed earlier and used for this study.

*Cardiac Code*

In the field of nursing, few situations are as stressful to health care providers as when a patient experiences a heart attack, cardiac arrest, or code (Ehrhardt & Glanker, 1996; Timmermans, 1999). For nursing students, anticipating their first code and wondering if they will be prepared to handle the situation produces significant anxiety, which can impair judgment, performance and client outcomes (Badger, 1996; Linnard-Palmer, 1995; Owen, 1991). Health care professionals were first given formal instruction on CPR in 1966 after the National Academy of Sciences/National Research Council conference (Campbell & Swan, 1993). The standards of cardiopulmonary resuscitation (CPR) have been updated and revised since that time (American Heart Association, 2000). Research has shown that the competence level of a cohort trained in cardiopulmonary resuscitation significantly departed from the teaching module, and resulted in potentially injurious behaviors (Graham & Scollon, 1996; Meischke, Finnegan, & Eisenberg, 1999; Morgan & Donnelly, 1996). In a 1998 research study, medical students completed an alternate instruction video on CPR and displayed overall superior performance when compared with traditional trainees (Todd, et al., 1998). A poll conducted in 1993 revealed that the American Heart Association's standards for the conduction of codes were not being followed (Green, 1993). Further, nursing research has indicated that continuing education in handling codes or potential codes is indicated (Brown, Latimer-Heeter, Marinelli, Rex, & Reynolds, 1995; Chaplik & Neafsey, 1998; Schueler & Moser, 1999; Stewart, 1993). Multiple researchers report that mock code programs have resulted in improved nurses' comfort and skill during actual codes (Linnard-Palmer, 1995; Mishkin, Holloran, & Burge, 1982; Robinson, Shiling, Ackles, & Brooke, 1989; Whitcome, et al., 1990). Participants indicated that the opportunity to practice their skills in a nonthreatening situation with immediate feedback was very beneficial (Cuda, et al., 1999; Wadas, 1998). Smith and Crnkovic (1994) instituted weekly mock codes to deal with multiple deficiencies in code management. Again, participants' reported improved knowledge levels and less anxiety. Further, actual resuscitations ran more smoothly. These research studies indicate continued educational efforts need to be focused on improving cardiac code proficiencies using a variety of teaching/learning strategies. Due to the weight of evidence in support of computer-based web instruction, and the need for cardiac code knowledge and experience, the current study used a technologically sophisticated web based on-line computer course to provide the cardiac code response content in an interactive format.

*Simulations*

Additional examples of computer-based technology are simulations. Real world simulations have been used since ancient times to promote learning. However the skill sets then were survival based hunting for food and self-protection. The simulations would involve throwing a spear at an animal skin draped over a bush or mock self-protection simulations. Actual simulations, such as real people pretending to be patients, have been used for over 30 years in health care fields (Barrows & Abrahamson, 1964). Such simulations assist in learning, and have afforded nurses and other health care providers experiences with which to build essential skills.

As a cardiac code simulation was an integral part of this research study, current research in the area of simulations was located and reviewed. No two studies used the same techniques or the same simulation. The twenty-five individual studies are presented chronologically in a technical table in Appendix B. The following topics are included in the technical table: study design, subjects, instruments, analysis and findings.

Studies that contained topics related to the current research were examined for application to the current study. In two related research studies, Henry (1991a, 1991b) discovered that when cardiac dysrhymthia content was included in critical care courses decision-making was enhanced. This finding supported the inclusion of the cardiac code response content in the current study. In 1993, Henry and Holzemer found a modest relationship between proficiency scores on a computer based clinical simulation, self-evaluation and cognitive knowledge test. Registered Nurses evaluated their own proficiency using the Cardiac Self-Assessment Tool.

In another study employing cardiac content, a nine step skills algorithm with adjunctive supportive information was effective in decreasing student response time when used with a code blue simulation (Linnard-Palmer, 1996). This finding further strengthened the use of the cardiac code simulation in the current research study.

A number of studies explored critical thinking, decision-making, and judgment. In their qualitative, CAI based study, Weis and Guyton-Simmons (1998) found increased thinking and prioritization skills in the associate degree nursing (ADN) students' responses to the six patient situation simulations. Further, content mastery and implementation were better when an instructor offered guidance and assistance. This supports the use of an instructor with simulation experiences to guide and enhance learning.

Lev (1998) reported prioritizing, decision-making, knowledge building and retention, as well as time utilization skills were enhanced through a simulation experience based on student self report. When compared to students in the lecture sections of the same course, the students in the simulation demonstrated increased knowledge.

The study by Aronson, Rosa, Anfinson, and Light (1997) cited overwhelmingly positive comments. The opportunity to practice judgment skills in a nonthreatening environment was a frequent evaluative comment made by the participants.

In another study, increased perception of self reportedly enabled the nursing student to shift the decision making focus to the client (Brooks & Thomas, 1997). This qualitative study used a structured interview with a simulated clinical vignette to assess students' decision-making process.

Novice clinical decision-making skills were compared after students were grouped by either internal or external locus of control as measured by the Rotter Internal-External Locus of Control Scale in Tschikota's study (1993). Further, the study indicated that complex decision-making skills were found in participants with internal locus of control when simulation transcripts were content analyzed ($z = 3.48$; $p < .01$).

Johnson, et al. (1999) compared telephone vs. videotaped simulations. In the study, 48 of 51 students reported enhanced use of critical thinking skills as measured by a six-point Likert type rating scale.

Whether or not simulated learning will be transferred to clinical situations is of interest in deciding to use simulation teaching strategies. Only three studies were located that mentioned this content area. In Yoder's (1993) pilot study, the computer assisted interactive video (CAVI) group scored 12.3% higher on the clinical performance exam than the linear group. Both groups viewed the same asepsis video; however, the linear group did not experience the interactivity portion. The CAVI group demonstrated a greater transfer of learning of the cognitive principles when evaluated by their clinical performance. In the second study, based on post simulation interviews, Goolsby (2001) found that participants reported there would be realistic, transferable learning to clinical settings. In the third study, it was found that computer based learning simulations may serve to develop a common set of skills that could be applied in using computers in the clinical setting (Sittig, et al., 1995).

Simulations may be used in place of clinical experiences. Hensley (1996) concluded that a maternity simulation was as effective as a four-week clinical rotation in maternity.

Simulations have additional features that make them valuable learning experiences. Simulations, while not real life, were cited as a positive learning experience in Thede, et al. (1994). In an observational study by Bareford (2001) students spent more time on task due to increased student interest with a resulting learning. Lamond, et al. (1996) deduced through content analysis that verbal interactions were essential in forming judgments. Therefore, voice or speech should be included in all simulations, if possible. Voice was provided for the HPS in this research study.

As the current study used an experimental pretest post test design, simulation studies that employed a similar design were sought. Three studies reviewed used a pre test post test design. Jefferies' (2000) oral medication simulation study resulted in higher post test scores in the technology group, as well as higher satisfaction survey ratings (Cronbach's alpha = 0. 87). No significant differences were noted in skills ratings.

In Rouse's (2000) study, a CAI simulation on congenital heart disease was compared to traditional classroom lecture, and a combination of the two. The investigator developed 20 question multiple-choice test with a Kuder-Richardson of 0.665 was used pre and post intervention. The entire time commitment was 90 minutes for the pre test, intervention, and post test. All three groups improved, but the results were not statistically significant. Post test scores were the highest in the third group, which included both CAI and traditional classroom lecture, indicating the combination of the two methods was most effective.

Saucier, et al. (2000) used the CCTST, an instrument used in the current study. Results determined that while critical thinking scores as measured by the CCTST did not increase significantly, there were advantages to CAI instruction in terms of student satisfaction and time efficiency. Further, the findings also concluded that CAI was at least equivalent to the nursing process in promoting critical thinking, indicating that further research is needed.

The remaining studies, (Blenner, 1991; Donabedian & Donabedian, 1993; Erler & Rudman, 1993; Gilbert & Kolacz, 1993; Haak, 1993; Jones & McCormac, 1992; Madorin & Iwasiw,1999; Russell, et al.1994) covered a variety of simulation topics. Refer to Appendix B for study details.

While each study was unique, the researchers reached essentially the same conclusions. Anecdotally researchers state that simulations were effective, based more on participant response than statistical significance. Simulation studies cite varying levels of success. Whatever form of simulation was used all were reported to be effective teaching/learning strategies when either compared to or combined with traditional teaching methodologies. These results indicate the need for further research.

*Simulators*

As the simulation used in this study employed a simulator, current research studies were located and reviewed regarding simulators. Denson and Abrahamson (1969) and Abrahamson, Denson & Wolf (1969) were the first to use a computer-controlled anthropometric manikin called Sim One. In the past, students practiced skill sets on each other, paid human beings that acted as patients, their actual patients, or used manikins. With the advent of computer driven simulators such as Harvey the Cardiology Patient Simulator (CPS), the full-body simulators by MedSim (Rauen, 2001), Laerdal SimMan Universal Patient Simulator (Laerdal, 2001), and the Medical Education Technologies Incorporated (METI, 2001) HPS, and other technique specific simulators, much more sophisticated simulations are possible. The METI HPS is physiologically modeled and therefore, can realistically simulate literally hundreds of responses to stimuli, mimicking a real patient without the inherent danger of death, although the HPS can simulate death. The HPS appears to breathe, have a heart beat and peripheral pulses, corneal reflexes (blinks its eyes), occulomotor reflexes (constricts and dilates its pupils), and responds like a human would to various treatments such as CPR and the administration of drugs, including oxygen. The scenario developed for this study used these features of the HPS.

Most research to date using HPS has been in the following areas: anesthesia cardiology, surgery, and trauma (Monti, Wren, Haas, & Lupien, 1998; Weiger, 1998).

The University of Miami Center for Research in Medical Education has developed cardiac simulations using "Harvey". Their simulator-based research has shown that caregiver skills learned through cardiac simulation can be effectively transferred to real patients (Ewy, Felner, & Juul, 1987; Gordon & Issenberg, 1999; Issenberg, et al. 1998; Issenberg, et al.1999; Petrusa, Issenberg, Mayer, & Feltner, 1999; Waugh, et al., 1995).

Twenty-eight simulator based research studies were reviewed. A variety of simulators were used in a cross section of educational settings. The studies were in the following areas: anesthesiology (n = 19), medical students (n = 7), nurses and medical students (n = 1) and critical care nurses (n = 1). Refer to the technical tables in Appendix C for study details including design, subjects, simulator, analysis and findings.

In 1990, DeAnda and Gaba conducted a qualitative study using videotaped anesthesia simulations with the Comprehensive Anesthesia Simulation Environment. Results revealed 132 unplanned errors, indicating the potential use of simulators to investigate critical incidents, including cardiac code. In a follow up study by the same researchers in 1991, detectable response time differences between the original cohort of residents when compared with anesthesiologists were not statistically significant (DeAnda & Gaba). In another study using Comprehensive Anesthesia Simulation Environment, Botney, Gaba, and Howard (1993) qualitatively studied a surgical setting where the simulation was a loss of pipeline oxygen to the patient. The times to correct response or action were extremely varied in the study.

Harvey, the cardiac sound simulator mentioned earlier, enabled efficient and effective development of cardiovascular assessment skills with an alpha = 0.79 (Harrell, Champagne, Jarr & Miyaya, 1990). Further, another Harvey based study revealed that participating interns had difficulty diagnosing common valvular heart diseases (St. Clair, Oddone, Waugh, Corey, & Feussner, 1992).

In 1995, Waugh et al. found the UMedic system, a combination of Harvey, a multimedia computer and video graphics, real-time digitized video and audio technology easy to use and reliable; further, participants (96%) felt their bedside skills improved. In another study, an analysis of a 77 item randomized test taken by senior medical students using the UMedic system yielded a 0.94 reliability coefficient (Issenberg et al., 1998). Petrusa et al., (1999) reported the UMedic system was favorably rated compared to other learning materials resulting in curriculum inclusion.

When evaluated using a one equals poor to ten equals outstanding Likert type questionnaire, the Anesthesia Simulator-Recorder (ASR) was labeled a good evaluation device ($6.6 \pm 2.0$) (Schwid & O'Donnell, 1990). In an additional study (1992) the same researchers documented the following findings: a team approach to simulation was desirable, 92 % of participants stated the simulator was realistic, and advanced cardiac life support (ACLS) should be reviewed every 6 months. Their research study documented the need for realistic cardiopulmonary resuscitation techniques on a twice a year basis employing a team approach, providing support for the current study.

Residents gave the simulator higher ratings than did anesthesiologists in a study (Holzman, Cooper, Small & Gaba, 1993) using an Anesthesia Crisis Resource Management (ACRM). In the study both residents and anesthesiologists used the simulator in a real operating room. Participants were involved in simulated cardiopulmonary resuscitation. Post experience, 75% of the respondents felt that the course should be taken every 12 to 24 months.

Also using ACRM, Kurrek and Fish (1996) experienced similar results. In their study when asked to rate the anesthesia simulator using a 10 point scale the residents rated the simulator higher 9.2 ± 1.1 compared to the anesthesiologists 8.3 ± 2.0; over all perceived benefit rated high.

An observational guide instrument evaluation study based on analysis of videotapes of their earlier ACRM study revealed poor interrater reliability for the behavioral markers and technical scores (Gaba, Botney, Howard, Fish, & Flanagan, 1994). The researchers concluded that their observational guide needed further instrument refinement. Acting on their own recommendation, the results of instrument refinement were presented in a follow up study where interrater reliability on two of the ACRM scenarios varied from 0.70 to 0.89 with fair to excellent agreement (Gaba, Howard, Flanagan, Smith, & Botney, 1998). In the study an observational guide was used during the mock codes with the HPS scenario and interrater reliability was assessed. This technique was used in the current research study addressed in this paper as well.

An additional study using ACRM (Byrick, et al., 1996) focused on error prevention in anesthesia. Seminars focused on managing critical events. Post seminar simulations were conducted. A five point questionnaire was completed. All residents rated the simulator experience either four or five. Anxiety during the simulation videotaping, as well as requests for feedback regarding the simulator experience, were reported, raising these issues for consideration when conducting simulator research.

The Leiden Anesthesia simulator was used in an experimental anesthesiology test/retest study. Those participants repeating the same scenario (Group B) performed significantly better on the retest indicating that exposure to the same scenario improves performance (Chopra, et al., 1994).

DeVitt, et al., (1996) using an Anesthesia Simulator, conducted an instrument evaluation for internal consistency. The alpha equaling 0.27-0.28 indicates poor internal consistency. Further, reliability and validity data is needed to ascertain the benefit of an Anesthesia Simulator for use in evaluating performance. A subsequent study in 1997, by the same group of researchers, revealed a Kappa statistic of agreement = 0.96, $p < 0.001$, with agreement on 29 of 30 items. The validity of both the scenarios and the scoring system had not been determined.

Devitt, et al. (1998) found that patient simulator hemodynamic data obtained from the computer database of the Eagle Simulation Manikin, when used adjunctively with two human raters was an effective and reliable evaluation method of anesthesiologist proficiency. The basis for this finding was that faculty were consistently rated higher than students in the simulation study. In the study, a scenario based rating instrument was adjusted and items with poor internal consistency were eliminated. The remaining six items on the rating guide had a Cronbach's coefficient alpha of 0.66. Faculty consistently scored higher than residents on these six remaining items. The researchers reported instrument discriminant validity.

Gonzalez and Schaefer (1996) identified the Computer Assisted Electronic Human Simulator Training System (CAE Corporation) as a valuable educational tool for difficult airway management. In their study they devised various airway management scenarios. Simulator sessions were videotaped and reviewed by both students and instructors. Based on exit surveys the experiences were rated highly by the students.

Gilbart, et al. (2000) also used the CAE System in their experimental study. Medical students were randomly assigned to either a seminar based trauma class or a computer based trauma simulator. While the researchers did not find statistical significance, they reported a tendency toward improvement in the simulator group on the Objective Structured Clinical Examination. (The Objective Structured Clinical Examination is an evaluation instrument frequently used by anesthesiologists with simulated patients according to Ladyshewsky, 1999). Anecdotally, a post-exam questionnaire revealed that 92% of the students indicated that the human patient simulator should be part of each student's educational experience.

In a study that used the University of Washington Medical Center (UWMC) patient simulator to train surgical team members, Bower (1997) reported unanimously positive student feedback. Cardiac arrest was found to be the most common critical event eliciting positive student responses. The students felt the simulator training prepared them well for their anesthesia rotations. This study reinforces the need for cardiac arrest simulations.

The Anaesthetic Computer Controlled Emergency Situation Simulator was used in Byrne and Jones' (1997) study conducted at Cambridge and Addenbrooke's hospital. A simulator effectively evaluated anaesthetists at different levels of clinical experience. The simulator functioned as expected, however, the anaesthetists made serious errors and had frequent delays in taking effective action to correct the problems encountered.

The METI HPS was determined to be effective for skill updating of anesthesiologists at a large-scale continuing education conference (Lampotang, Good, Westhorpe, Hardcastle & Carovano, 1997). In a follow-up study, utilizing the data collected at the same conference, the researchers conducted an experimental study where 91 anesthesiologists were randomly assigned simulated critical incident scenarios with and without pulse oximetry and capnography (Lampotang, et al.,1998). Each HPS session had been videotaped. A computer-generated recording of the Human Patient Simulator's responses during the simulation was captured on disc and analyzed in conjunction with the videotape. Only a projected trend toward significance was found. Log ranking, a non-parametric test, was used to determine the speed with which the anesthesiologists reached a critical incident diagnosis, and diagnosis speed was statistically significant for only one scenario. Further, performance anxiety was reported, as were unanimously positive responses to the simulator experience.

In an exploratory study (Doerr, Quinones, Dipboye & Dunbar, 2000), also using the METI HPS, conducted a three-day training course for six anesthesia residents. The topics covered included operating room safety, machine function, pre-operative assessment, and anesthetic management. The researchers reported these results: increased confidence, knowledge, reaction times, critical decisions and recognition skills, with fewer medical errors. Replication was recommended with a larger sample size.

Fourth year medical students utilized a linear analog scale with scores ranging from 0 (disagree) to 100 (agree) to rate the METI HPS experience in an acute care skills acquisition study by Schweiger, Jackson, and Preece, (2000). When asked to rate the degree to which the objectives were met by the simulator scenario, ratings were between $86 \pm 14$ and $93 \pm 7$. The authenticity of the simulator scenarios was rated between $84 \pm 12$ and $90 \pm 10$ with cardiopulmonary resuscitation receiving highest rating. The following two comments are representative of the numerous positive responses:

"excellent teaching device," and "should be used earlier in our education." These comments support continuing use of, and research with, the HPS.

NeoSim (Medical Plastics Laboratory, Inc.) was used in a qualitative study of neonatal resuscitation in a simulated delivery room environment (Halamek, et al., 2000). The maternal manikin is a HPS (MedSim-Eagle, Inc) and the neonate is a life-like neonatal manikin, but not a HPS. Participants completed an intensive evaluation. All subjects expressed high levels of satisfaction except in evaluating the interactivity of the neonatal manikin. Participants were especially enthusiastic in describing the realistic nature of the simulation.

*Critical Thinking*

According to numerous authors, a variety of teaching strategies, simulations included, are effective in teaching critical thinking in both the classroom and laboratory settings, however, the relationship between teaching strategy and students' critical thinking has not been researched adequately (Aronson, et al., 1997; Burt & Goepfert, 1998; deTornyay, 1968; Fletcher, 1999; Hanna, 1991; Ironside, 1999; Lunney, 1992; Mallow & Gilje, 1999; Mislevy, Steinberg, Breyer, Almond & Johnson, 1999; Morton, 1996; Morton, 1997; Rauen, 2001; Small, et al., 1999; Whitis, 1985).

Appreciating the value of simulations, the National Council of State Boards of Nursing has investigated the use of computerized clinical simulation testing to evaluate the clinical decision-making skills for new graduates as well as periodic evaluation of continuing practitioners (Bersky, 1997; Bersky, Krawczak & Kumar, 1998; Bersky & Yocom, 1994; Krawczak & Bersky, 1995).

The definition of critical thinking varies among scholars (Adams, 1999;

Alexander & Giguere, 1996; Duchscher, 1999; Elder & Paul, 2001; Facione & Facione, 1996; Gordon, 2000; Jacobs, Ott, Sullivan, Ulrich, & Short, 1997; Jones & Brown, 1993; Kramer, 1993; Morrison, Smith, & Britt, 1996; Parse, 1996; Paul, 1995; Pless & Clayton, 1993). As reported in Alexander and Giguere, nurse educators generally evolved the definition of critical thinking to mean:" . . . an intellectually disciplined process of conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from or generated by observation, experience, reflection, or communication as a guide to belief or action . . . manifested in reading, listening, writing, and/or speaking." (1996, page 16).

However, a Delphi study by Scheffer and Rubenfeld (2000) resulted in the following consensus definition of critical thinking in nursing:

> 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. Critical thinkers in nursing practice the cognitive skills of analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting and transforming knowledge (p. 357).

In 1992, the National League for Nursing's (NLN) accreditation guidelines listed critical thinking as a mandatory criterion and continues to support this inclusion (NLN, 1999 & 2000). Nurse educators and nursing education programs continue to stress critical thinking skills (Brown & Sorrel, 2000; Daly, 1998; Dexter, et al., 1997; Haffer &

Raingruber, 1998; May, Edell, Butell, Doughty, & Langford, 1999; McGovern & Valiga, 1997; Miller & Babcock, 1996; Rubenfeld & Scheffer, 1995; Sedlak, 1997; Shell & King, 2000; Tanner, 1993; Tanner, 2000; Videbeck, 1997; Youngblood & Beitz, 2001).

It is certain that nurses need critical thinking skills so that their professional judgments are soundly based, resulting in positive patient outcomes (Adams, Whitlow, Stover, & Johnson, 1996; Di Vito-Thomas, 2000; Genrich, Banks, Bufton, Savage, & Owens, 2001; Lauri, et al., 2001; Siktberg & Dillard, 1999; Walsh & Hardy, 1999; Zimmerman & Phillips, 2000). Thus nurses' decisions will truly reflect concern for the health and welfare of the clients and communities served (Alfaro-Lefevre, 1995; Facione & Facione, 1996; Youngblood & Beitz, 2001). Adams (1999) reviewed 20 research studies from 1977-1995 focusing on critical thinking abilities of professional nursing students. The Watson-Glaser Critical Thinking Analysis was used in 18 of the 20 studies. The other two studies did not specify instruments for assessing critical thinking. The Watson-Glaser Critical Thinking Analysis continues to be frequently selected to measure critical thinking in nursing ( Fry, Alfred, & Campbell, 1999; Magnussen, Ishida, & Itano, 2000; Vaughan-Wrobel, O'Sullivan, & Smith, 1997). The California Critical Thinking Disposition Inventory and California Critical Thinking Skills Test (CCTST) are also frequently used instruments (Beeken, 1997; Bowles, 2000; Facione, Facione, & Sanchez, 1994; Facione & Facione, 1996; Thompson & Rebeschi, 1999; Turner & Nelson, 2000). The CCTST 2000 was selected for use in this research due to definitional agreement based on the 1990 American Philosophical Association Delphi consensus that "critical thinking is the process of purposeful, self-regulatory judgment. This process gives reasoned consideration to evidence, context, conceptualizations, methods and criteria"

(Facione & Facione, 1998). The instrument will be discussed further in the next chapter.

Critical thinking is frequently assessed upon entry and exit from nursing programs (Bandman & Bandman, 1996; Oermann, Truesdell, & Ziolkowski, 2000; Rane-Szoskak & Robertson, 1996; Thompson & Rebesschi, 1999). In a survey of Bachelor's in Nursing programs, O'Sullivan, Blevins-Stephens, Smith, & Vaughan-Wrobel (1997) found that all of the 237 responding BSN programs assessed critical thinking using standardized or locally developed instruments to measure the critical thinking criterion set by the NLN; similar use is projected for ADN programs.

*Summary*

Advances in technology are exerting major influences on health care delivery and educational processes worldwide. Technology has the potential to have a positive impact on nursing care and patient outcomes by accelerating the identification of clinical problems as well as enhancing communication through the electronic documentation process. Technology has affected how and where nursing education processes are conducted. These technological changes have also affected how and where nursing students learn. Students can attend classes in their own home via on-line distance learning delivery systems.

The changing clinical environment is adding to the challenge of preparing nurses. The decline in the number of hospitalized patients, with an increase in the severity of illness for those patients who are hospitalized, increasing numbers of home bound clients, fewer and less experienced preceptors or role models due to the nursing shortage, and increasing numbers of students seeking the same learning experiences require faculty to be innovative in developing and implementing learning strategies.

Based on the studies reviewed, the findings support the continued use of simulation as a teaching tool in nursing education. While these methods are beneficial, researchers agree they are not meant to replace other methods of instruction, but to enhance them. With the current focus in education on learning, rather than teaching, success depends on nursing faculty ability to combine computer-based technology with the requisite knowledge and skills nurses of the future will need.

Students respond favorably and enthusiastically to simulated forms of learning, which may increase motivation and learning. Simulation features that will yield the best results are those that actively involve the student, are realistic, and provide immediate feedback (Cohen & Dacanay, 1994). Based on research findings, HPSs promote active learning but have only been tested in a few health care settings. Additional research is needed across all areas of nursing.

Students' ability to think critically has been studied extensively. However, a direct causal effect between specific educational strategies and increased critical thinking has not been established. Thus, while there has been research in the area of critical thinking there is a need to explore new teaching strategies and their effects on learning and subsequent critical thinking development. The next chapter reviews the research methods used in this study.

# Chapter Three

## Methods

The purpose of this study was to determine the effect of different methods of teaching cardiac code on the critical thinking of nursing students. Comparisons were made using four methods of teaching cardiac code response to nursing students with the outcome variable of improved critical thinking, as illustrated in the conceptual model diagram presented in Chapter One. Nursing students were tested using two critical thinking measures. The two measures were administered before and after the intervention. A detailed description of the design and procedures follows.

### *Research Design*

This study used a four by two (4 X 2) mixed repeated measures factorial design. There were four conditions or groups; each was assessed on critical thinking at two points in time. The first teaching condition was the standard code response instruction utilized in Nursing IV. The nursing content in Nursing IV is primarily advanced medical-surgical concepts. The course occurs in the last semester of the associate degree nursing program (see Appendix D for the Standard Cardiac Code Unit from the Nursing IV Syllabus). The second condition involved a cardiac code scenario developed for use with the HPS. The third condition was a web based on-line cardiac code response course. The fourth condition was a combination of the web based on-line cardiac code response course and the cardiac code scenario utilizing the HPS. Students were randomly assigned to one of the four conditions. The design is illustrated in Figure 2.

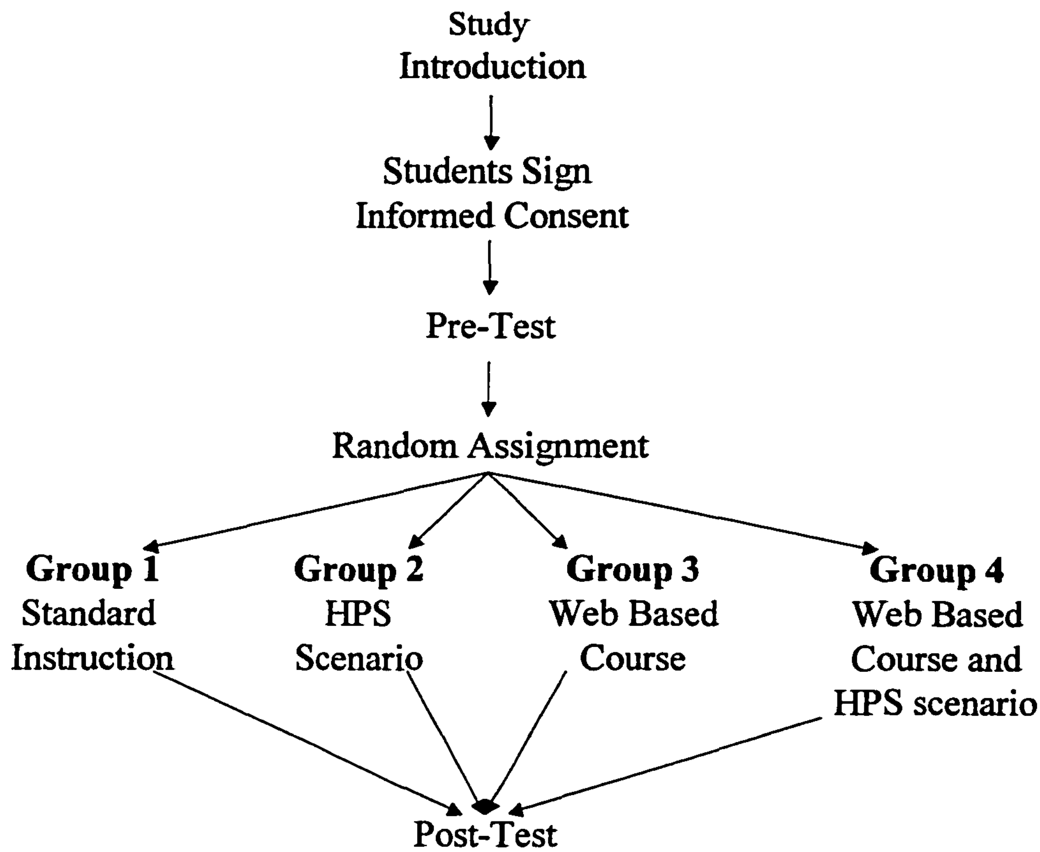


*Figure 2 Methods Model*

*Participants*

Students enrolled in Nursing IV, their fourth and last semester, in the associate degree nursing program both fall 2001 and spring 2002 were asked to volunteer for the research study. All nursing students enrolled in Nursing IV the two semesters were eligible to participate. However, the student had to successfully complete the semester's course work to remain in the study. A demographic information form was developed to collect background information on the student's age, gender, ethnicity, education, level of nursing experience and years at each level, CPR experience, Cardiac Code experience and experience with the HPS. Refer to Appendix E for the Demographic Information form.

*Instruments*

All students were given two standardized tests, the California Critical Thinking Skills Test (CCTST) 2000, from California Academic Press, and the Critical Thinking Process Test (CTPT), an Advanced Concept Test, from Educational Resources, Inc. (ERI) Testing Bureau, before and after the intervention. Both instruments were purchased for use. In addition, the instruments are secure, and therefore could not be included in the appendix. Each company scored their instruments. These instruments are described below.

*CCTST.* The California Critical Thinking Skills Test (CCTST) 2000 was selected for this study as it is specifically designed to measure the skills dimension of critical thinking. As critical thinking combines both skill and mental ability, individuals must be disposed to think critically and have the skills to do so (Facione & Facione, 1998). The CCTST targets the foundational critical thinking skills of analysis, interpretation, inference, evaluation and explanation (the five subscales on the instrument); all of these are skills nursing students are taught to use based on tenets of the nursing process. The items in the CCTST were developed through over twenty years of research. Items have been reported to possess high item-total correlations (exact numbers were not stated) (Facione & Facione, 1998). The items are general and do not provide preference to any one academic specialization. Cultural, social and gender bias have been avoided according to the authors. All of the 34 multiple choice items in the instrument are arranged from simple to complex critical thinking skills. Internal consistency estimates (Kuder Richardson - 20) range from .70 to .71 based on pre test post test computations (Facione & Facione, 1998). The results were shown to vary slightly from sample to sample. The CCTST was normed using nursing programs in the United States; 50 schools volunteered between 1992 and 1997. The mean score on the exam was 16.24 (Facione, 1997). When the test was normed on nursing students obtaining masters' degrees the mean was 19.01 ± 5.087. Content, construct, and criterion validity were established for the instrument. Further, the CCTST was shown to be valid and reliable when used to evaluate learning outcomes involving critical thinking (Facione & Facione, 1998). As this is a secure test a sample was not placed in the Appendix.

*CTPT.* The CTPT was selected for use in this study as it was developed specifically for nursing populations. The CTPT is a secure 50 item, multiple-choice diagnostic instrument that evaluates critical thinking within a nursing environment, and which stresses intellectual processing skills over nursing content mastery. Educational Resources, Inc. (ERI) affirms that critical thinking, in nursing, is a process ideally measured using a holistic nursing perspective comprising both abstract thinking and process skills. The instrument measures five levels of abstract thinking: prioritizing, inferential reasoning, goal setting, application of knowledge, and evaluation of predicted outcomes. It also measures four critical processing skills: listening, writing, speaking and reading. These nine topics comprise the subscales of the CTPT. Further, ERI has shown that the CTPT is a reliable (.93) and valid (content and diagnostic) assessment instrument for evaluating mastery by students of critical thinking skills (Frost, 2000). However, the validity and reliability of any instrument must be continually re-evaluated. Users of the Critical Thinking Process Test are encouraged to submit studies that pertain to the validity of this assessment tool (Frost, 2000). The test information, funding to support the study, and permission to utilize the CTPT for this study was all provided by ERI.

*Experimental Conditions*

*Standard Instruction.* For this research study, standard instruction references the cardiac code content that is included in the Nursing IV course module in the Unit on Oxygenation. The actual course pages are included in Appendix D. All the nursing students in Nursing IV have a scheduled three-hour seminar on the Oxygenation unit. The entire unit is extensive and includes advanced nursing based health problems in both the cardiac and respiratory systems, with two pages of the unit devoted to cardiac code response.

*Web Based Course Design.* Numerous web based on-line courses were developed at the study college as part of the nursing curriculum. The electrocardiogram (ECG) course was modified for use in the present study. The content and technology template developed from the ECG course was used as a starting point to create the on-line course employed in this study. Refer to Appendix F for the cardiac code response course learning objectives. The entire on-line course contains in-depth information to address each of the learning objectives. The units are Cardiac Anatomy and Physiology, Electrophysiology, Sinus Rhythms, Ventricular Rhythms, Cardioversion and Defibrillation, Code Blue, and Case Studies. There is a sample page from the web based cardiac code response course in Appendix G. Wherever feasible the content was dynamic and interactive; for example the blood flow through the heart and the electrical conduction system were animated. The password-protected course is available in Web CT via the study college on line web site.

*Cardiac Code Scenario for the Human Patient Simulator.* The students in the Associate Degree Nursing program are required to be CPR certified. Basic CPR content was used to develop the scenario for the HPS. A preexisting ACLS scenario was also used to program the HPS. Steady states and transitions were added so that the HPS would progress from stable status to cardiac arrest in manner that was consistent for every student team unless the team took corrective action to change the HPS response. The HPS would "live" or "die" based on the student's actions or non-actions. The transitions were spaced every five minutes to allow for processing time by the students. If the students processed the change in HPS status information faster, the scenario was advanced appropriately. Appendix H is the HPS scenario. Student teams were based on both group assignment and student availability. Students in Group 2 were scheduled together, as were students in Group 4. Students scheduled an appointment with the HPS when they had time to do so.

An observational guide based on the cardiac code learning objectives was developed for use in the study (see Appendix I for the Observational Guide). The guide was based on the requisite skills needed for cardiac code response. Initially the guide had three categories, "yes," "no," and "prompt needed." Estimates of interrater reliability were obtained by having both observers watch the two students in the pilot group complete the HPS scenario twice. As stated earlier, there was a time interval between the two ratings. Observers recorded their independent observations on the guide using check marks. The number of agreements was divided by the number of agreements and disagreements totaled (Polit & Hungler, 1999). After the first run of the scenario, the interrater reliability was only .76. It was determined that the guide needed another category. The category of "No, despite prompt" was added. On the second run of the scenario, using the improved guide, the estimate of interrater reliability improved to .96.

A power analysis was performed prior to beginning the study using an estimated effect size of 0.06 ($\omega^2$) and a conventional level of significance (alpha = .05) and power (.80), a sample size (n) of 45 students per treatment condition was projected for this study (Keppel, 1991).

*Procedure*

The proposed study was reviewed by the University of South Florida (USF) Social and Behavioral Studies Institutional Review Board (IRB) and approved under expedited review. Recruitment flyers were placed in prominent places throughout the college during the first few weeks of class fall and spring semesters describing the research study (see Appendix J). Information sessions were held at a variety of times to accommodate both day and evening students. Pizza and sodas were provided. After consent was obtained (see Appendix K for the Informed Consent Form), students then signed up for testing times for the two critical thinking instruments. All materials related to student identification were kept in a locked file drawer. In the fall, group assignment was randomly initiated after informed consent was obtained. As many students that signed informed consent did not take the pre-tests, and therefore did not participate in the study, the procedure was changed for spring and only after initial testing was completed were students randomly assigned treatment groups.

The actual participation time in the study varied depending on the treatment group and the individual student's time commitment. All of the students were scheduled for the same amount of seminar time in Nursing IV, three hours per week for 12 weeks. One three-hour seminar was devoted to the concept of oxygenation, which included the cardiac code response, or standard information (see Appendix D). One third of the seminar time was used for achievement tests. Study time was student specific.

The students assigned to the standard condition, Group 1 had the least time commitment, only completing the standard cardiac code unit in the Nursing IV module. The students in Group 1 did not complete *either* the web based on-line basic cardiac code response course or the scenario with HPS. The standard group's total time commitment for the study, in addition to seminar time and individual study time, was approximately one half hour for the lunch and introduction and two hours for the CTPT and the CCTST at the beginning and end of the semester for a total of four and one half hours.

Group 2 was the Human Patient Simulator (HPS) only group. Students in Group 2 scheduled an appointment with the two trained faculty for their session with the HPS. Students were asked to sign up in teams if possible. The HPS scenario was completed prior to taking the post tests. Time spent with the simulator was approximately one hour to one hour and fifteen minutes. Total time commitment for this group was one half hour for the lunch and introduction, one to one and one fourth hours of simulator laboratory time, and four hours for the testing for a total of five and one half to five and three fourths hours.

The students assigned to Group 3 completed the web based on line basic cardiac code response course. Anticipated course completion time would be four to six hours, however this time would vary based on the students' prior learning, familiarity with computers, reading ability etc. Total time commitment was one half hour for lunch and introduction, four to six hours for module completion, and four hours of testing time for a total of eight and one half to ten and one half hours. The students in Group 4 had the greatest time commitment as they completed both the cardiac code unit and simulation scenario (approximately 11 hours). All students received a $40.00 honorarium after completing the post tests.

*Hypotheses*

This design allowed testing of multiple hypotheses. The specifics as to group and the method of testing were:

1) All students will show a significant increase (pre test - post test) on the critical thinking measures. This hypothesis examined the main effect of time.
2) Students in the web based cardiac code response course (Groups 3, 4) will show a significant increase in critical thinking compared to students who did not receive the web based cardiac code response course (Groups 1, 2). Interaction contrasts were reviewed comparing the change pre test to post test in Groups 3 and 4 to the change pre test to post test in Groups 1 and 2.
3) Students who complete the simulator condition (Groups 2, 4) will show a significant increase in critical thinking compared to students who did not complete the simulator condition (Groups 1, 3). Interaction contrasts were reviewed comparing the change pre test to post test in Groups 2 and 4 to the change pre test to post test in Groups 1 and 3.

4) The increase in critical thinking will be larger for students with both the web based cardiac code response course and the simulator condition (Group 4) than simulator condition alone (Group 2). Interaction contrasts were reviewed comparing the change pre test to post test in Group 4 to the change pre test to post test in Group 2.
5) Students who received either the web based cardiac code response course (Group 3) or the simulator condition (Group 2) will show more improvement on the critical thinking measures than students who received the standard education (Group 1). Interaction contrasts were reviewed comparing the change pre test to post test in Group 3 and the change pre test to post test in Group 2 compared to Group 1.
6) Students who received both the web based cardiac code response course and simulator condition (Group 4) will show more improvement on the critical thinking measures than students who received either of these conditions alone (Groups 2 and 3). Interaction contrasts were reviewed comparing the change pre test to post test in Group 4 to the change pre test to post test in Groups 2 and 3.
7) Students who received any high technology condition will show more improvement on the critical thinking measures (Groups 2, 3, 4) than students receiving the standard treatment (Group 1). Interaction contrasts were reviewed comparing the change pre test to post test in Groups 2, 3 and 4 to the change pre test to post test in Group 1.
8) Students who received both the web based cardiac code response course and the simulator condition (Group 4) will require fewer prompts, and will experience

fewer simulator "deaths" compared to the simulator only condition (Group 2). The number of prompts on both interrater guides for each team in Groups 2 and 4 were totaled and t tests were conducted comparing the average scores. The number of deaths in Groups 2 and 4 were compared using a chi square distribution.

*Data Analysis*

This quantitative study used a pre-test-post-test experimental design employing random assignment. Data were analyzed using a four by two (4 X 2) factorial analysis of variance (ANOVA) for mixed repeated measures. Analysis of variance permits the investigation of both the separate and joint effects of two independent variables on a dependent variable. The two independent variables are the web based on-line basic cardiac code response course and the HPS scenario. These two variables were hypothesized to act in conjunction with one another to exert a joint influence. The dependent variable was critical thinking. The joint effects of the two independent variables on the dependent variable were studied through the analysis of main effects and interaction effects in the context of factorial design. Calculating F tests on the main effects and interaction tested the hypotheses stated earlier. Interaction effects were further examined using a simple main effects analysis (Jaccard & Becker, 1990; Munro, 1997; Nieswiadomy, 1998; Polit, 1996). All data were analyzed using a statistical package for social studies (SPSS) 10.0 (SPSS, 1999).

*Summary*

This chapter has discussed the design, methods and procedures employed in this study. In Chapter Four the results of the data analysis are presented.

# Chapter Four

## Results

A sample of 55 nursing students voluntarily participated in this experimental mixed repeated measures study. This chapter presents descriptive information on the participants and inferential tests of significance that address each hypothesis.

### *Descriptive Information*

The total number of volunteer students signing the informed consents fall semester was 37, and there were 38 spring semester, totaling 75. However, only 17 students began the study fall semester. Spring semester all the students signing informed consents began the study, bringing the total student participants to 55. The final number completing the study, however, was only 54 as one student was ineligible to continue due to dropping the Nursing IV course. As a result, each treatment group only contained 13 to 15 students

A total of 54 students, 29.5 % of the students enrolled in Nursing IV, completed the study. Demographic profiles of the sample and student body are shown in Table 3. The majority of the participants were women (92%). Based on the data in Table 3 the sample was representative of the students enrolled in the course.

Additional demographic information obtained from the participating students included age, education, health care experience, CPR experience, code experience, and experience with the HPS. This information is presented in Tables 4 (age, mean = 31.2) and 5 (remaining demographics).

Table 3

Race and Gender Demographics for Sample compared to Students Enrolled in Nursing IV

| Variable | | Sample<br>n = 54 | Students Enrolled in Nursing IV<br>n = 184 |
|---|---|---|---|
| Gender | Male | 7.4% | 7.6% |
| | Female | 92.6% | 92.4% |
| Race | African American | 11.1% | 17.9% |
| | Asian | 7.4% | 3.3% |
| | Caucasian | 83.3% | 74.5% |

Table 4

Age Demographic

| Variable | Sample<br>n = 54 | |
|---|---|---|
| Age | Range | Percentage |
| | 20-29 | 51.8% |
| | 30-39 | 33.3% |
| | 40-49 | 11.1% |
| | >50 | 3.7% |

Table 5

Education; Health Care, CPR, Code, and HPS Experience

| | | |
|---|---|---|
| Education | No Prior Education | 51.9% |
| | AA | 25.9% |
| | AS | 16.7% |
| | BS | 5.6% |
| | BA | 1.9% |
| Health Care Experience | No Prior Experience | 14.8% |
| | Nursing School | 1.3% |
| | CNA | 70.4% |
| | LPN | 11.1% |
| | Paramedic | 3.7% |
| | Other | 9.2% |
| CPR Experience | Yes | 37% |
| | No | 63% |
| Code Experience | Yes | 35.2% |
| | No | 64.8% |
| HPS Experience | Yes | 85.2% |
| | No | 14.8% |

The percentage of students who volunteered for the study was lower than anticipated. Rather than the projected 45 students per treatment condition, there were only 13-15 students per group. Maintaining the same level of significance (alpha = .05) and an effect size of 0.06 the power for this study was reduced to 0.30 (Keppel, 1991). Therefore due to insufficient power, the results of this study are being reported as initial or preliminary. The focus will be on predicted trends and effect sizes, rather than significance levels.

Insight Assessment calculated the reliability estimate for the CCTST specific to this study. The Kuder-Richardson (KR) 20, the Cronbach alpha for instruments that are scored dichotomously, meaning the answers are right or wrong, was .79 for the combined pre test post test data. When the data were split into pre test and post test the KR-20s were .81 and .76 respectively. The Cronbach alpha for the CTPT was .74 for the total data, .80 for just the pre test and .66 for just the post test.

*Hypotheses Testing*

Prior to beginning the analysis the data were scrutinized for data entry errors. Accuracy was first verified by proofreading the data file. Frequency distributions were also examined. Syntax adjustments were made for unequal group size, rather than omitting subjects since the sample was already small. Analysis of variance tests were conducted using SPSS's multiple analysis of variance (MANOVA) procedure. Post hoc comparisons were used to explore differences. The results of the data analysis follow.

*Hypothesis One.* All students will show a significant increase (post test - pre test) on the critical thinking measures. This was tested on the main effect of time. Group means are displayed in Table 6.

The results of this analysis were not statistically significant, however, the marginal means show a trend in the direction predicted from the hypothesis on the

CCTST and the CTPT. Effect size was calculated. The $\eta^2$ for the main effects on CCTST and CTPT were .008 and .003 respectively. The level of power was only .076 for the test of Hypothesis One. Insight Assessment, the scoring center for the CCTST reported that the Mean Score of 17.4 for the entire group placed the study population as a whole between the 76th and 82nd percentiles as compared to a sample set of two-year college students (Roberts, 2002).

Table 6

Group Means Compared for Testing Hypothesis One

| Group | 1<br>n = 15 | 2<br>n = 13 | 3<br>n = 13 | 4<br>n = 13 | Marginal<br>Means |
|---|---|---|---|---|---|
| CCTST | | | | | |
| Pretest | 17.53 | 16.46 | 16.76 | 18.15 | 17.24 |
| Post test | 18.47 | 16.39 | 16.85 | 18.15 | 17.4 |
| *Difference* | *0.94* | *-0.07* | *0.09* | *0* | *0.26* |
| CTPT | | | | | |
| Pretest | 55.20 | 60.31 | 60.15 | 59.08 | 58.56 |
| Post test | 56.80 | 59.23 | 58.92 | 61.54 | 59.04 |
| *Difference* | *1.6* | *-1.08* | *-1.23* | *2.46* | *0.48* |

Note. Group 1 = Standard; Group 2 = HPS; Group 3 = Web Based Course; Group 4 = HPS and Web Based Course.

All of the subscales on the two instruments were also analyzed. Again there were no results that were statistically significant due to low power (average = .182). However, the trend was in the predicted direction. The average $\eta^2$ for the main effect of time was

0.01. According to Cohen (1992) this is a small effect size. Post hoc power analysis indicated that a sample size of n = 944 - 998 would be needed to achieve significance at .05.

*Hypothesis Two.* Students in the web based cardiac code response course (Groups 3, 4) will show a significant increase in critical thinking compared to students who did not receive the web based cardiac code response course (Groups 1, 2). This was examined using interaction contrasts comparing the change pre test to post test. The means are reported in Table 7.

Table 7

Group Means Compared for Testing Hypothesis Two

| Groups | 1 & 2<br>n = 28 | 3 & 4<br>n = 26 | $\eta^2$ |
|---|---|---|---|
| CCTST | | | |
| Pretest | 17.03 | 17.46 | |
| Post test | 17.5 | 17.5 | |
| *Difference* | *0.47* | *0.04* | *.005* |
| CTPT | | | |
| Pretest | 57.57 | 59.62 | |
| Post test | 57.93 | 60.23 | |
| *Difference* | *0.36* | *0.62* | *.001* |

Note. Group 1 = Standard; Group 2 = HPS;

Group 3 = Web Based Course; and Group 4 = HPS and Web Based Course.

Statistical significance was again absent; however, the trends were in the predicted direction with Groups 3 and 4 showing a slightly larger difference than Groups 1 and 2 on the CTPT. This was not observed on the CCTST. The $\eta^2$ were .005 and .001 respectively. The level of power was only .067 for the test of Hypothesis Two. Post hoc power analysis indicated that a sample size of approximately 900 would be needed to achieve significance.

*Hypothesis Three*. Students who complete the simulator condition (Groups 2, 4) will show a significant increase in critical thinking compared to students who did not complete the simulator condition (Groups 1, 3) was tested with another interaction contrast. Refer to Table 8 for the means.

Statistical significance was not present. The trend was in the predicted direction for the CTPT with Groups 2 and 4 showing slightly larger differences than Groups 1 and 3, however this was not the case for the CCTST where Groups 1 and 3 means were slightly higher. The $\eta^2$ were .018 and .001 respectively. The level of power was only .084 for the test of Hypothesis Three.

*Hypothesis Four*. The increase in critical thinking will be larger for students with *both* the web based cardiac code response course and the simulator condition (Group 4) than the simulator condition alone (Group 2). This was tested using an interaction contrast on these two groups (see Table 9).

Again, the test was not significant due to low power (.122) and a negligible to very small effect size (see Table 9). There was no change in test scores in Group 4, while Group 2 mean scores were slightly lower on the CCTST. The Group 4 change was larger than that of Group 2 on the CTPT.

Table 8

Group Means Compared for Testing Hypothesis Three

| Groups | 1 & 3<br>n = 28 | 2 & 4<br>n = 26 | $\eta^2$ |
|---|---|---|---|
| CCTST | | | |
| Pretest | 17.18 | 17.48 | |
| Post test | 17.72 | 17.47 | |
| *Difference* | *0.54* | *-0.02* | *.011* |
| CTPT | | | |
| Pretest | 57.5 | 59.7 | |
| Post test | 57.78 | 60.39 | |
| *Difference* | *0.29* | *0.69* | *.001* |

Note. Group 1 = Standard and Group 3 = Web Based Course Group 2 = HPS; Group 4 = HPS and Web Based Course.

*Hypothesis Five*. Students who experienced *either* the web based cardiac code response course (Group 3) or the simulator condition (Group 2) will show more improvement on the critical thinking measures than students who received the standard education (Group 1). This was tested by the interaction contrasts on the change in Groups 2 and 3 compared to Group 1. These means are shown in Table 10.

Again, there were no statistically significant results with the power only .178. The effect sizes are listed in Table 10. The pattern of means observed was clearly not as predicted by the hypothesis.

Table 9

Group Means Compared for Testing Hypothesis Four

| Groups | 2<br>n = 13 | 4<br>n = 13 | $\eta^2$ |
|---|---|---|---|
| CCTST | | | |
| Pretest | 16.42 | 18.15 | |
| Post test | 16.39 | 18.15 | |
| *Difference* | *-0.03* | *0* | *.000* |
| CTPT | | | |
| Pretest | 60.31 | 59.08 | |
| Post test | 59.23 | 61.54 | |
| *Difference* | *-1.08* | *2.46* | *.001* |

Note. Group 2 = HPS; Group 4 = HPS and Web Based Course.

*Hypothesis Six.* Students who received *both* the web based cardiac code response course and simulator condition (Group 4) will show more improvement on the critical thinking measures than students who received *either* of these conditions alone (Groups 2 and 3). This was tested using interaction contrasts comparing the change pre test to post test in Group 4 to the change pre test to post test in Groups 2 and 3 combined. The means are shown in Table 11.

Again, there were no statistically significant results. The power was only .151. Groups 2 and 3 had a slight increase on the CCTST while Group 4 showed no change at all. Groups 2 and 3 had a decrease in scores while Group 4 experienced a slight increase in pre to post test scores on the CTPT. The confidence interval is so wide that definite conclusions cannot be stated. However, with additional participants the hypothesis may be supported.

Table 10

Group Means Compared for Testing Hypothesis Five

| Groups | One<br>n = 15 | Two and Three<br>n = 26 | $\eta^2$ |
|---|---|---|---|
| CCTST | | | |
| Pretest | 17.53 | 16.62 | |
| Post test | 18.47 | 16.59 | |
| *Difference* | *0.94* | *0.03* | *.022* |
| CTPT | | | |
| Pretest | 55.20 | 60.23 | |
| Post test | 56.8 | 59.08 | |
| *Difference* | *1.6* | *-1.16* | *.021* |

Note. Group 1 = Standard;

Group 2 = HPS; Group 3 = Web Based Course Group

*Hypothesis Seven.* Students who received *any* high technology condition will show more improvement on the critical thinking measures (Groups 2, 3, and 4) than students receiving the standard treatment (Group 1). This was tested using interaction contrasts that compared the change pre test to post test in Groups 2, 3 and 4 combined to the change pre test to post test in Group 1. Refer to Table 12 for the means.

Table 11

Group Means Compared for Testing Hypothesis Six

| Groups | 2 & 3 | 4 | $\eta^2$ |
|---|---|---|---|
| | n = 26 | n = 13 | |
| CCTST | | | |
| Pretest | 16.62 | 18.15 | |
| Post test | 16.59 | 18.15 | |
| *Difference* | *0.03* | *0* | *.000* |
| CTPT | | | |
| Pretest | 60.23 | 59.08 | |
| Post test | 59.08 | 61.54 | |
| *Difference* | *-1.16* | *2.46* | *.033* |

Note. Group 2 = HPS; Group 3 = Web Based Course;

Group 4 = HPS and Web Based Course.

There were no statistically significant results. Based on the slight differences between Group 1 and the other three groups it actually appears that the change was greater in Group 1. This pattern is opposite than predicted by the hypothesis. Again, this difference is so slight and the confidence interval is so wide that definite conclusions cannot be stated. Power is only .146.

*Hypotheses Eight.* Students who received both the web based cardiac code response course and the simulator condition (Group 4) will require fewer prompts, and will experience fewer simulator "deaths" compared to the simulator only condition (Group 2). There were five teams in Group 2. There were seven teams in Group 4. The number of prompts given in Groups 2 and 4 were compared. The average number of prompts for

Group 4 was 15.1 and 17.3 for Group 2 as predicted. However, the *t* test on the average scores was non significant. The $\eta^2$ of .01 indicated a small effect size.

Table 12

Group Means Compared for Testing Hypothesis Seven

| Groups | One<br>n = 15 | Two, Three, & Four<br>n = 39 | $\eta^2$ |
|---|---|---|---|
| CCTST | | | |
| Pretest | 17.53 | 17.13 | |
| Post test | 18.47 | 17.11 | |
| *Difference* | *0.94* | *-0.02* | *.025* |
| CTPT | | | |
| Pretest | 55.20 | 59.85 | |
| Post test | 56.8 | 59.90 | |
| *Difference* | *1.6* | *0.05* | *.008* |

Note. Group 1 = Standard

Group 2 = HPS; Group 3 = Web Based Course;

Group 4 = HPS and Web Based Course.

In addition, the simulator death rates in Groups 2 and 4 were compared. The number of deaths in each group was two for a 40% death rate in Group 2 and a 29% death rate in Group 4. Further, using a chi square test of independent proportions indicated that these rates were not statistically different.

In addition, the Nursing IV course grades were averaged with the resulting means: Group 1- 91%, Group 2 - 89%, Group 3 - 89%, and Group 4 - 93%. The grades were not significantly different.

*Summary*

While the results of this study were not statistically significant, the majority of trends were in the direction predicted by the hypotheses. The results and implications for education, practice and research will be discussed in Chapter Five.

# Chapter Five

## Introduction

This chapter focuses on the interpretation, implications, limitations, discussion and conclusions related to the results obtained from this study. The multiple limitations of the study are posited with possible solutions for alleviation, or at least minimalization. Conclusions drawn from the study are presented as well as the implications for nursing education, practice and research. Other research studies will be referenced as appropriate for purposes of comparison to the current study.

### *Interpretation*

In most cases, the predicted pattern of mean differences was observed in the data. Assuming these trends were to continue, statistical significance may be obtained with the inclusion of additional participants. Each of the eight hypotheses will be discussed as to whether or not they were supported by the study results.

The first hypothesis postulated that all students would show a significant increase (pre test - post test) on the critical thinking measures. This hypothesis was statistically not supported. The data did indicate that the means were in the direction predicted by the hypothesis with slight increases pre to post test on both measures for the total sample

The second hypothesis proposed that students in the web based cardiac code response course would show a significant increase in critical thinking compared to students who did not receive the web based cardiac code response course. This increase was not significant. However the data did indicate that the means were in the direction predicted by the hypothesis on the CTPT, but not on the CCTST.

Hypothesis three stated that students who completed the simulator condition would show a significant increase in critical thinking compared to students who did not complete the simulator condition. However the data did indicate that the means were in the direction predicted by the hypothesis, again on the CTPT, but not on the CCTST.

The fourth hypothesis stated that the increase in critical thinking would be larger for students with both the web based cardiac code response course and the simulator condition than simulator condition alone. This hypothesis was not supported. However the data did indicate that the means were in the direction predicted by the hypothesis on both instruments.

Hypothesis five suggested that students who experienced *either* the web based cardiac code response course or the simulator condition would show more improvement on the critical thinking measures than students who received the standard education. This hypothesis was not supported. However the data from the CCTST did indicate that the means were in the direction predicted by the hypothesis but the CTPT did not.

Hypothesis six postulated that students who experienced *both* the web based cardiac code response course and simulator conditions would show more improvement on the critical thinking measures than students that received either of these conditions alone. This hypothesis was not supported. Again, the data did indicate that the means were in the direction predicted by the hypothesis on both instruments.

In hypothesis seven it was projected that students who received *any* high technology condition would show more improvement on the critical thinking measures. This hypothesis was not supported. However the data did indicate that the means were in the direction predicted by the hypothesis on the CTPT, but not on the CCTST.

Finally, hypothesis eight postulated that students who received *both* the web based cardiac code response course and the simulator condition would require fewer prompts, and would experience fewer simulator "deaths" compared to the simulator only condition. This hypothesis was not supported. However the data did indicate that the means were in the predicted direction. Despite the non-significance of the means the weight of the evidence indicates that the trends were in the direction predicted by the hypothesis for the majority of the results of the study.

*Discussion*

Based on student comments, as well as general knowledge about the student population, there are multiple factors that may have influenced student enrollment in the study. The first, and very likely the most significant impact in the fall semester was the timing of the first introductory session, September 11, 2001. As the disaster was unfolding, the Nursing IV students were attending class followed by the introductory session. Only seventeen students signed informed consents. That was the total enrollment for the semester, even though another introductory session was held.

The primary focus for the student population fall 2001 was on successful completion of the required course work for the semester, which was made more challenging by a change in the grading scale. The grading scale for the entire nursing program, including the graduating class had been raised from a passing score of 75% to 80%. This resulted in a very stressed and unhappy student population during the fall semester 2001. While the overall departmental atmosphere and student attitude improved by spring 2002, only 38 additional students enrolled in the study. This was a major increase over fall, but still not even close to half the potential enrollment of 184.

The time commitment may have been a factor. Students frequently voiced the comment that they did not "have time" to participate. Further, students often said they would participate if they could be enrolled in Group 1, the group with the least time commitment. When the students were told that random assignment was essential to the study design and therefore group assignment could not be individually, or specifically determined, some students declined to participate. Decreasing the time commitment may result in additional students participating in future studies. The time could be lessened by using just one of the critical thinking instruments, shortening the web based course to just the cardiac code content, and expediting the scenario with the HPS. While these changes could increase student participation the actual learning might be less.

The honorarium for participation was a $40.00 stipend paid at the study's conclusion. Most students commented that the time commitment was too extensive for the amount of money being offered. As students can be employed in health care settings during Nursing IV and as those positions range in salary from $16.00 to $30.00 per hour (as reported by local nurse recruiters), students saw the time commitment needed for the study as a loss of time for work, and subsequently a loss of income. The majority of the student participants possess prior health care experience as indicated by the demographic data. By seeking additional funding, and using the remaining research grant funds for student stipends additional participants will hopefully enroll.

Student reticence with regard to web based on-line instruction has been evident this past year, even with a nursing department wide initiative to offer classes on-line. Students have indicated their hesitancy to take the on-line options by not enrolling in the course sections that are offered in that format. Similarly, students declined to enroll in the study stating the lack of a computer, or of easy access to computers even though multiple sites with computers were available. By increasing computer availability when students are on campus and fostering a nurturing environment supportive of computer use students may be more open to research using this medium. Offering more internet based learning activities in each of the nursing courses could decrease student fears about computer based learning/teaching strategies. Also, decreasing the depth and length of the web based cardiac code responder course may be an option. Increased use of the Web CT email and discussion tools, including the chat room option may increase student comfort and satisfaction. Student evaluations of the on-line course were not formally conducted, only anecdotally received. A brief evaluation component needs to be developed and uploaded into the course.

In their study of critical thinking skills, Thompson and Rebeschi (1999) found a significant increase in the total CCTST score. However, their study was based on measurements taken at the end of the first semester of a BSN program, and at exit, whereas in this study the measurements were both taken within the last semester, and with an ADN sample which may account for the non-significance of the score change. Further, this was a very homogeneous sample, with high initial scores that could be indicative of a ceiling effect.

Due to the non-existence of research at the college before fall 2002, no prior discussions about research, and no opportunities for student participation in research the students did not participate at levels expected. Also, ADN nursing students have had limited exposure to nursing research other than introductory material in the area of evidence-based practice in their curriculum. Their lack of understanding of the research process or the reasons for research was apparent from their questions at the introductory sessions and requests related to group placement. Increasing the student's basic knowledge of the reasons for research, and basic, introductory research curriculum may facilitate increased participation. As the BSN curriculum includes research concepts, the study could be expanded to include that venue. Further, research results from other studies support the need for experimental studies at the Baccalaureate level (Thompson & Rebeschi, 1999; Turner & Nelson, 2000).

*Limitations*

This study was limited by the small sample size. Further, students were not asked to list why they declined to participate so their reasons for not participating are conjecture. As students self selected to participate this may have contributed to the homogeneity of the sample with the more learning oriented students participating.

Another limitation was that the sample was from only one region of the United States (Florida). Therefore the findings should not be considered representative of the entire state, or country. Also, the study was conducted at only one ADN Nursing Program so results could not be generalized to other ADN or Bachelor of Science in Nursing (BSN) Nursing Programs.

A possible limitation may be that the sample was predominantly women, although representative of the nursing student population. Unfortunately, it is not possible to remove this limitation due to the current composition of students in nursing programs.

Another limitation was the lack of a cultural milieu supporting the practice of research at the college. The NLN/METI research grant used to fund the study was the first such grant received at the college where the research study took place.

The instruments used in this study have limitations as well. The CCTST is not a nursing specific instrument, although it has been used in with nursing students (Facione and Facione, 1998). The reliability has been previously reported between .70 and .75. The developers have stated that .65 to .75 is adequate to measure critical thinking (Facione and Facione, 1998). However, Nunnally and Bernstein (1994) state that when making important decisions about individuals, "a reliability of .90 is the bare minimum, and a reliability of .95 should be considered the desirable standard"(p. 264-5). The initial sample size projections were based on the assumption of perfect reliability. Given that the average estimate of reliability was only alpha of .77 the projected sample size would have been 236 with 59 participants per group. Based on the reliability estimates reported earlier, the estimated random error variance in critical thinking scores was approximately 40%. This in conjunction with the small sample size contributed to the lack of statistical significance. If the study is replicated with more reliable measure of critical thinking, i.e., instruments with a Cronbach alpha of .90 or higher, then the sample size originally proposed may prove sufficient. Leppa (1997) in a study with Registered Nurse (RN) to BSN students decided to eliminate the CCTST based on poor test performance and potential psychological burden to the test population.

No published nursing research was located regarding the CTPT. The developers of the exam provided the data included. While the instrument is nursing specific, the lack of published research for comparison data is a limitation. Continued research with this instrument is warranted.

Both exams are 50 minutes long and were administered back to back, so there could have been an element of responder fatigue both during pre and post testing. The exams were scheduled together for student convenience. Further, graduating students' attitudes about assessment testing is less than optimal at the end of the last semester of nursing school (Thompson & Rebeschi, 1999). As the tests were given at the beginning and end of a 15 week semester, as opposed to a few weeks apart, it is unlikely that there was any pre test post test effect, specifically higher test results due to familiarity with the test instrument.

*Implications for Education and Practice*

The research project has generated interest among the faculty at the college where the study took place, with a corresponding increase in HPS use, on line instruction development, and strategies for promoting critical thinking. The faculty that teach Nursing IV, are especially anxious to incorporate both the cardiac code response course and the cardiac code scenario into the Nursing IV curriculum. This may be an obstacle to continuing or expanding the current research at the college. If the two independent variables were incorporated into the Nursing IV curriculum the research design could no longer be implemented.

There are implications for use of the web based on line cardiac code responder course and the HPS scenario in all levels of nursing education, from generic to critical care (Cole, et al., 2001; Vandrey & Whitman, 2001) and all clinical practice arenas, not only for students, but also for graduate and practicing nurses as well (Cuda, et al., 1999; Smith

& Crnkovic, 1994; Wadas, 1998). In the educational arena, students could be introduced to the HPS and the application of basic CPR techniques in their first nursing course. The content could then be leveled and included in every subsequent course until the student graduates. Also, the combination could be offered via refresher courses to nurses returning to the profession. In health care delivery arenas the combination of cardiac code content and HPS could be used when orienting new nurses with repeat exposure every six months to maintain proficiency. The combination could be used to provide a much more realistic way for nurses and other health care professionals to maintain annual CPR certification. The cardiac code responder course and HPS scenario, with slight modification, could be used for ACLS courses as well.

The benefit of the instruction, while not evident in the data, apparently manifested itself in the clinical performance of the study participants. Also, students reported higher confidence in the clinical area after sessions with the HPS. In addition, there were requests from students that were not in the simulator group to have an opportunity, after the final testing was completed, to experience the code scenario.

*Recommendations for Future Research*

While the mean score increases in critical thinking on the two instruments only trended toward significance, the use of both the HPS and web based on line instruction warrant continued study. Even though critical thinking has been discussed, researched, and written about extensively, it is still unclear to what extent technologically sophisticated strategies, such as simulators and web based instruction enhance critical thinking in nurses. Research is needed to answer this question. Continuation and replication of this study, and other experimental studies are needed to further the exploration of these teaching strategies (DeBourgh, 2001; Effken & Doyle, 2001; Glacken & Baylen, 2001; Malloy & DeNatale, 2001; Scollin, 2001; Sery-Ble, et al., 2001). This study could be replicated with a larger sample, as well as with different nursing populations.

Research is also needed to ascertain the extent of transfer of learning from simulated and web based environments to real life situations. Additional research would enable the testing of theoretical and conceptual frameworks in the areas of simulators and web based instruction. Crucial to improvement in patient care, studies are needed to ascertain both the transfer of code response skills from theory to practice, as well as their effect on patient outcomes (Cuda, et al., 1999; Smith & Crnkovic, 1994; Wadas, 1998).

While additional research is needed using these technologies there are barriers to such research. Computers, and especially computer based simulators have been expensive. Initial cost, housing environment, setup, and maintenance are major issues to simulator use. The traditional purchase price of the HPS has varied from $100,000-$200,000, although educational grants are occasionally available. Newer models are being developed at significantly lower prices ($30,000 - 45,000) and these prices may include software updates and maintenance agreements. If purchased separately, maintenance agreements may run from $11,000 - 13,000 annually as is the case at the college where this study was conducted. Access to maintenance and the costs to keep the HPS in optimal operating condition – computer and equipment upgrades, gases to support optimal system functioning, technological support, adjunctive equipment such as cardiac monitors, security to protect the simulator from vandalism, etc. may also limit purchase and access and therefore research (Huddy, McKay, & Culp, 1999; Raabye & Steinov, 1998).

As costs decrease and software becomes increasingly user-friendly valuable simulator learning and research opportunities will become more universally available. Additionally the availability of research grants through NLN/METI will promote the research that is needed with the HPS in a variety of nursing and health care settings. While the HPS and its collateral equipment are costly, so are clinical rotations. In addition to the instructional costs, there are liability issues as well. Clinical sites are not as available as they once were, and the nursing shortage may further limit clinical sites. Also, certain experiences are not available in the clinical setting on a consistent basis. Cardiac code opportunities are a classic example. Simulators provide opportunities for such experiences. Aware of the value of HPS enhanced learning experiences, the Florida Board of Nursing has approved up to 10% of a nursing student's clinical experiences occurring with an HPS. With the advent of pediatric simulators research could be conducted, and replicated in a pediatric environment.

There has been extensive research in the area of critical thinking as mentioned in Chapter Two. The research with the HPS in anesthesia and other areas is considerable. A meta-analysis of current research in both critical thinking and simulator studies is warranted.

Nursing has few discipline specific instruments to assess critical thinking and clinical decision-making. Instrument evaluation of currently available tools and continued development are other areas of needed research. Establishment of the psychometric properties on existing instruments is also important.

*Conclusions*

The preliminary results from this study indicate that the high technology teaching/learning strategies employed may have benefit in assisting nursing students to learn critical thinking skills. The trends indicate an increase in critical thinking by the students. However, the sample did exhibit a high level of critical thinking prior to intervention. Any predictions based on the results are both cautious and tentative. Continuation of the study is indicated to verify the initial results

*Summary*

Although tests of significance did not support any of the study's hypotheses the trends for the hypotheses were in the predicted direction. Continued enrollment of student participants is warranted. Additional funding sources will be explored to increase the student stipend, to hopefully expand the participation rate. Learning strategies that were implemented in this study have the potential to positively impact both student and patient outcomes. Some of the tenets of the brain based learning movement have alienated educators due to the total focus on learning, rather than teaching. The latest trend is to use brain based learning principles to focus on expanding student learning, while maintaining the "nobility of teaching" according to Milliron (2002). It will be essential to provide information about these principles to nurse educators, as well as demonstrate their value in promoting student learning to affect wide scale adoption across nursing programs.

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# Appendices

# Appendix A: Left Brain/Right Brain Theory

| Left Brain | Right Brain |
|---|---|
| Rational, logical | Intuitive, open-ended |
| Verbal | Visual/spatial |
| Planned and structured | Fluid and spontaneous |
| Solves problems through analysis | Solves problems through synthesis |
| Controls feelings | Free with feelings |
| Makes objective judgments | Makes subjective judgments |
| Remembers names | Remembers faces |
| Prefers multiple choice tests | Prefers essay tests |
| Prefers hierarchies in formal structures | Prefers participatory informal structures |
| Sees the trees | Sees the forest |
| Analytical | Visionary |
| Linear | Analogical |
| Logical | Free association |
| Sequential | Simultaneous |
| Vertical | Lateral |
| Convergent | Divergent |
| Deductive | Inductive |

Appendix B: Simulation Studies in Nursing*

| Study | Design & Subjects | Instruments & Analysis | Findings |
|---|---|---|---|
| Blenner (1991) | Descriptive<br>n = 26<br>Graduate Nursing Students | Simulation Research Game<br>Structured Debriefing | Useful adjunct to theory class |
| *Henry (1991) | Descriptive<br>n = 142<br>Critical Care Nurses | Proficiency Scores<br>Data before intervention<br>87% of Simulation deaths due to medical error | Dysrhymthia content needed in critical care courses |
| *Henry (1991) | Investigational<br>Repeated Measures<br>n = 68<br>Critical Care Nurses | Demographic Profile<br>Computerized Clinical Simulations<br>McNemar - experience p = 0. 04<br>ACLS p = 0. 07 | Positive findings between decision making with both experience and ACLS for Atrial Flutter Simulation |
| Jones & McCormac (1992) | Experimental<br>n = 61<br>First year nursing students | Computer Satisfaction Questionnaires<br>2 x 2 mixed design<br>ANOVA p < 0. 001 | Students preferred what ever computer package was presented first |
| Donabedian & Donabedian (1993) | Test-Retest<br>Experimental<br>n = 231<br>BSN students | Computer exercise<br>Essay/short answer test questions | No significant change in performance in either group of students |
| Erler & Rudman (1993) | Quasi-experimental<br>Pretest-Post test<br>n = 50; Control = 24; Experimental = 26<br>Junior BSN | Spielberger State-Trait Anxiety Inventory<br>Control group scores were higher prestate (t = 5.46, p >0. 001) than poststate | No significant difference in anxiety scores between students attending the simulation lab and those who did not. |
| Gilbert & Kolacz (1993) | Comparative<br>n = 123; CAI = 65; Small Group = 58<br>First Semester ADN Nursing Students | Clinical Calculation Skill Exam | No significant differences between CAI and Small Group teaching |

Appendix B: (Continued)

| Study | Design & Subjects | Instruments & Analysis | Findings |
|---|---|---|---|
| * Haak (1993) | Qualitative n = 60 Nurses, students and laypersons | CAI Video Patient Simulation Triangulated evaluation of knowledge, experience & clinical nursing judgment | Participants with more knowledge and experience performed better on the simulation |
| *Henry & Holzemer (1993) | Descriptive n = 68 Critical Care Nurses | Basic Knowledge Assessment Tool Cardiac Self-Assessment Tool | Modest relationship between proficiency score - written simulation, self-evaluation, and cognitive knowledge |
| *Tschikota (1993) | Quantitative Descriptive n =19 Nursing students | Rotter Internal-External Locus of Control Scale | Novice decision making skills Internal subjects used complex decision making skills |
| Yoder (1993) | Experimental Pilot n = 24; CAIVI =13; n = 11 Linear | Linear versus CAI Video Instruction (VI) | CAIVI group scored 12. 3% higher than the linear group indicative of transfer of learning |
| Russell, Miller & Czerwinska (1994) | Descriptive n = 106 BSN nursing students | Observation and Checklist Likert Scale Evaluations CAI positively correlated with improved test grades $p < .01$ | CAI simulation and lecture preferred to text and lecture based on student evaluations |
| Thede, Taft, & Coeling (1994) | Qualitative n = 12 Nursing students | Questionnaire Interview | Simulations while not real life are a positive learning experience. |

Appendix B: (Continued)

| Study | Design & Subjects | Instruments & Analysis | Findings |
|---|---|---|---|
| Sittig, et al. (1995) | Quantitative Pretest/Post-test n = 2200 Nurses | Anonymous written evaluation of simulation experience; Skills improved from 65% to 80% | Computer based learning simulation insured common set of computer acquisition skills |
| Hensley (1996) | Exploratory Quasi-experimental n = 8, Jr. BSN Nursing Students | Criterion measures Perceived self-efficacy, clinical anxiety, state anxiety | Simulations were as effective as a four-week clinical rotation in maternity |
| *Lamond, et al. (1996) | Qualitative Interviews n = 114 Nurses | Content Analysis | Verbal interaction essential to judgment. Add verbal content to simulations |
| Linard-Palmer (1996) | Pre-experimental Single Subject, Repeated Measures, Variable Baseline n = 5 Nursing Students | CPR Simulation Nine step skills algorithm Post Simulation Interviews | Six to thirteen simulations were needed to perform the code with 100% accuracy; supportive information and algorithm effective to decrease response time |
| *Aronson (1997) | Self-report Evaluation n = 90 ADN Nursing Students | Written Evaluation Instrument | Overwhelmingly positive comments; able to practice judgment skills in a nonthreatening environment |
| *Brooks & Thomas (1997) | Qualitative Descriptive Exploratory n = 18 BSN Senior Nursing Students | Written simulated clinical vignette Open-ended interview | Increased perception of self allowing decision making focus to shift to the client |
| *Lev (1998) | Qualitative n = 13 Nursing students n = 1 faculty | Anonymous written evaluation of simulation experience | Simulation assisted with prioritizing decisions, increased knowledge, effective use of time |

Appendix B: (Continued)

| Study | Design & Subjects | Instruments & Analysis | Findings |
|---|---|---|---|
| *Weis & Guyton-Simmons (1998) | Qualitative<br>n = 14 ADN Nursing Students | CAI Test<br>Verbal feedback | Simulation made me think; helped with prioritization; forced decision making |
| * Johnson, Zerwic, & Theis (1999) | Quantitative Observational<br>n = 51 BSN Senior Nursing Students | Likert Scale -6 pt. Compared telephone vs. videotaped simulations. Means ranged from 5.39-5.53 | Students (48 of 51) found simulations helpful in utilizing critical thinking skills Mean = 5. 47 |
| *Madorin & Iwasiw (1999) | Quasi-experimental Pilot; Pretest/Post-test<br>n = 23 BSN Nursing students | Researcher-developed self-efficacy Likert 4 pt. questionnaire; t(10 df) = -3.76 $p < .01$ | Significant differences in self-efficacy scores post simulation. Usefulness of computer simulation - 82% "somewhat helpful" and 19% "very helpful." |
| Jeffries (2000) | Experimental Pretest/Post-test<br>n = 42 BSN<br>n = 23 Technology<br>n = 19 Traditional | CD ROM simulation on oral medication administration Instructor made tests; Skills competency observation schedules Satisfaction survey - Cronbach's alpha 0.87 | Significantly higher post test scores in the technology group and higher satisfaction ratings. No significant differences in skills ratings |
| Rouse (2000) | Experimental Pretest/Post-test<br>n = 72 ADN; 1) 26 = CAI;<br>2) 26 = Traditional Classroom Lecture (TCL);<br>3) 20 = CAI and TCL | CAI simulation - Congenital Heart Disease; Multiple Choice Test with a Kuder - Richardson's = 0.665; Tukey's adjustment for change significant for group 3 $p<0.001$ | Supports the effectiveness of instruction. CAI is best used as a supplement to TCL |

Appendix B: (Continued)

| Study | Design & Subjects | Instruments & Analysis | Findings |
|---|---|---|---|
| Saucier, Stevens & Williams (2000) | Randomized block, two-group, Pretest/Posttest n = 120 BSN Nursing Students | CAI Simulations CCTST Arnold Likert Satisfaction Rating | CAI students were significantly more satisfied; improved time efficiency in the CAI group. |
| *Bareford (2001) | Observational Pilot n = 10 BSN | SimCity© Computer Simulation Game | Usefulness of computer simulation - 82% "somewhat helpful" and 19% "very helpful." |
| Goolsby (2001) | Observational n = 8 ARNP students | Post simulation interviews | Stimulates student interest, increased time on task and overall increased learning Realistic, transferable learning |

*Studies preceded by an asterisk denote research with outcomes addressing critical thinking, thinking, decisions, decision-making, formal reasoning or judgment.

Appendix C: Human Patient Simulator Studies in Anesthesia, Medicine and Nursing

| Study | Design & Subjects | Instruments & Analysis | Findings |
| --- | --- | --- | --- |
| DeAnda & Gaba (1990) | Qualitative<br>n = 19<br>Anesthesiology Residents<br>10 Resident-1<br>9 Resident-2 | Comprehensive Anesthesia Simulation Environment (CASE) Videotaped simulations with "think aloud" then debriefing | Recorded 132 unplanned errors<br>Simulator useful to investigate critical incidents and prevention of fatal errors |
| Harrell, Champagne, Jarr & Miyaya (1990) | Experimental<br>Pretest-Post-test with repeated measures<br>n = 40 Critical Care Nurses | Heart Sound Simulator (Harvey)<br>Two hour teaching program, pretest, review, post-test - repeated three weeks later; exam $\alpha = 0.79$ | Efficient and effective way to improve cardiovascular assessment skills; uses minimal time; provides for individual practice.<br>Device overall rated highly ($8.5 \pm 1.2$) |
| Schwid & O'Donnell (1990) | Survey<br>n = 44<br>n = 23 Residents<br>n = 21 Anesthesiologists | Anesthesia Simulator-Recorder (ASR)<br>Likert Questionnaire<br>10 = outstanding; 1 = poor | Good evaluation device ($6.6 \pm 2.0$) |
| DeAnda & Gaba (1991) | Comparative<br>n = 8<br>Anesthesiologists | Compared to 19 residents from the 1990 study;<br>Response times | Detectable response time differences were not statistically significant; variances were homogeneous |
| St. Clair, et al. (1992) | Cross Sectional Evaluation with two testing sessions<br>n = 63 Interns | Harvey the heart sound simulator; three simulations; Multiple choice test<br>$p \leq 0.05$ | Difficulty noted in diagnosing three common valvular heart diseases |

*Studies preceded by an asterisk denote research with outcomes addressing critical thinking, thinking, decisions, decision-making, formal reasoning or judgment.

Appendix C: (Continued)

| Study | Design & Subjects | Instruments & Analysis | Findings |
|---|---|---|---|
| Schwid & O'Donnel (1992) | Observational<br>n = 30<br>n = 10 anesthesia residents; 10 faculty anesthesiologists; 10 private practice anesthesiologists | Anesthesia Simulator Consultant (ASC)<br>On screen response rates - percent of of correct management 20-100% | ACLS Review every 6 months; Team approach to simulator; Change to a blameless culture; 92% state simulator is realistic |
| Botney, Gaba, Howard (1993) | Qualitative<br>n = 17 anesthesiologist and one Certified Nurse Anesthetist | CASE with loss of oxygen; OR with actors for doctors and nurses;<br>Videotape; think aloud | Time to correct response or action; extremely varied responses |
| Holzman, Cooper, Small & Gaba (1993) | Self Report Survey<br>n = 68 Residents and Anesthesiologists | Anesthesia Crisis Resource Management (ACRM)<br>Rating Scale 1/5 less/more favorable | Participants rated the simulator favorably as a laboratory environment with residents ratings higher than anesthesiologists |
| Chopra, et al. (1994) | Experimental<br>Test retest<br>n = 28 Anesthesiologists and trainees; Group A (13) and B (15) | Leiden Anesthesia Simulator; Simulator Scenarios;<br>Videotapes<br>Evaluated using a standardized scoring scheme | Group B on retest performed significantly better ($p<0.05$). Exposure to the same simulator scenario improves performance |
| Gaba, et al. (1994) | Instrument Evaluation<br>n = 4 Anesthesiologists viewed 8 video tapes of previous participants with the simulator | Performance Assessment Tool - Likert 5 pt. poor to excellent; Performance Markers, ACRM<br>Interrater reliability - Kappa IRR $S_{av}$ for all markers = 0. 09 | Poor Interrater reliability for the behavioral markers and technical scores. Further refinement of instruments indicated. |
| Waugh, et al. (1995) | Experimental<br>Randomized pre test /post test<br>n = 182 Senior Medical students | Harvey<br>Multimedia - computer and video graphics, digitized video, and audio | Overall 96% of the participants felt their bedside skills were improved |

Appendix C: (Continued)

| Study | Design & Subjects | Instruments & Analysis | Findings |
|---|---|---|---|
| DeVitt et al. (1996) | Instrument Evaluation Internal consistency n = 25 | Anesthesia Simulator (AS) Rating Scale $\alpha = 0.27\text{-}0.28$ for the two scenarios | Poor internal consistency; reliability and validity of AS to assess performance needed. |
| Gonzalez & Schaefer (1996) | Anesthesiology Residents and 17 Anesthesiologists | CAE Electronics Human Simulator Training System | Valuable educational tool for difficult airway management |
| Kurrek & Fish (1996) | Qualitative n = unknown Residents, Fellows, Anesthesiologists Survey n = 59 returned anesthesiology survey questionnaires; n = 36 post simulator questionnaires | ACRM; two different Likert Questionnaires - survey (10-1 + to -) and post simulator experience (1-5 + to -) | Indications of support 8. 3/staff; 9. 2/residents. Exit comments 1. 2 to 2. 0 indicating perceived educational benefit. |
| Byrick, et al. (1996) | Anesthesiologists Survey n = 40; 20 faculty and 20 residents | ACRM; videotaped scenarios; Five point visual analogue scale questionnaire | Significantly improved response to questions related to ACRM terminology (6. 2-13. 7); anxiety during taping; request for feedback. |
| Bower (1997) | Qualitative n = 50 Medical Students | Evaluations of Simulator experience | Unanimously positive |
| Byrne & Jones (1997) | Experiential n = 20 Anesthesiologists | ACCESS (Manikin, computer, ventilator) | Simulator functioned as expected; serious errors/delays in action |
| Devitt, et al. (1997) | Observational n = 2 raters n = 30 events Clinical Anesthesiologists | Anesthesia Simulator Interrater Reliability Kappa Statistic of Agreement = 0. 96, $p < 0.001$ | Perfect agreement on 29 of 30 items; validity of scenarios and scoring system yet to be determined. |

Appendix C: (Continued)

| Study | Design & Subjects | Instruments & Analysis | Findings |
|---|---|---|---|
| Lampotang, et al. (1997) | Qualitative n = 113 Anesthesiologists | Human Patient Simulator (HPS) Methodology | HPS is useful for large scale studies and for large group continuing education |
| Devitt, et al. (1998) | Instrument evaluation Experimental n = 8 Anesthesiology Residents n = 17 Clinical Faculty | Eagle Simulation Manikin Multi-item evaluation system; $\alpha = 0.66$ with only six items | Faculty scored > than residents indicating instrument discriminant validity |
| Gaba, et al. (1998) | Instrument evaluation n = 107; 72 anesthesiology residents, 31 faculty; 4 CNA | ACRM (Video tapes from earlier study used); Interrater Reliability; Scenario specific checklists; technical and behavioral ratings; 5 pt. ordinal scale | Interrater variability on the two scenarios varied from 0. 70 to 0. 89; agreement fair to excellent |
| Issenberg, et al. (1998) | Randomized test n = 122 Senior Medical students | Harvey Multimedia - computer and video graphics, digitized video, and audio | Reliability Coefficient of 0.94. |
| Lampotang, et al. (1998) | Experimental n = 91 Anesthesiologists | METI HPS Videotaped sessions Time to correct diagnosis was analyzed in scenarios with and without pulse oximetry and capnography monitoring, using a data recorder | Timed speed of diagnosis was less in only one scenario; monitored groups were more likely to make correct diagnoses though not statistically significant; anxiety as a factor in performance; potential value of simulators |

Appendix C: (Continued)

| Study | Design & Subjects | Instruments & Analysis | Findings |
|---|---|---|---|
| Petrusa, et al. (1999) | Comparative n = 1586 Senior Medical students completed 6131 programs | Harvey Multimedia - computer and video graphics, digitized video, and audio | Positive rating of the value of the system compared to other learning materials; inclusion in curriculum. |
| *Doerr, Quinones, Dipboye, & Dunbar (2000) | Exploratory n = 6 Clinical Anesthesiology - 1 Residents | METI HPS Confidence questionnaire; Multiple choice test; videotaping coded and analyzed | Promising results - increased - confidence, knowledge, reaction time, critical decisions and recognition skills with fewer errors. |
| Gilbart, et al. (2000) | Experimental n = 107; n = 57 simulator; n = 50 seminar Medical Students n = 82 follow up questionnaires | CAE Electronics patient Simulator system | Tendency toward improvement in the simulator group; did not reach statistical significance; equivalence of two teaching procedures; 92% of participants state simulator should be part of 4th year education |
| Halamek, et al. (2000) | Qualitative n = 38 Physicians and Nurses | Objective Structured Clinical Examination Post-encounter Probe Scores | High level of satisfaction with program; appreciation for the realistic nature of the simulation |
| Schweiger, Jackson, & Preece (2000) | Survey Student Rating n = 60 4th Year Medical Students | NeoSim -Maternal HPS; life-like neo-natal manikins used for neonatal resuscitation. Evaluation survey METI HPS Linear Analog Scale 1 - 100 | Objective rating 86-93; Authenticity rating 84-90; numerous positive comments - excellent teaching device; use earlier in our education |

# Appendix D: Standard Cardiac Code Unit from the Nursing IV Syllabus

## CPR – CARDIOPULMONARY RESUSCITATION

Cardiac Arrest – cessation of heartbeat

*Causes:*

1. Fluid, electrolyte, or acid-base imbalances
2. Myocardial infarction
3. Hypoxemia
4. Incorrect administration of medications
5. Mechanical asystole
6. Ventricular fibrillation
7. Ineffective ventricular contraction – i.e., EMD (electro-mechanical dissociation) or PEA (pulseless electrical activity)

Respiratory Arrest – cessation of breathing

*Causes:*

1. Obstructed airway
2. Respiratory depression due to drugs or brain injury
3. Ventilator malfunction
4. Cessation of effective mechanical breathing
5. Ineffective gas exchange

Appendix D: (Continued)

CPR – the ABCD's – initiate CPR within 4-6 minutes of arrest or brain cells will began to die

1. Airway – establish a patient airway
2. Breathing – intubate, initiate ventilations
3. Circulation – cardiac compressions
4. Drugs – initiate appropriate drug therapy (ACLS)
5. Defibrillation

BCLS – basic cardiac life support; external support of circulation and ventilation

ACLS – advanced cardiac life support, includes BCLS plus other therapies such as intubation, oxygen delivery, defibrillation, medication administration

Steps in CPR Technique (review textbook)

ACLS Medications

Please know the following:

1. Oxygen
2. Sodium bicarbonate
3. Epinephrine
4. Atropine
5. Amiodarone
6. Lidocaine
7. Dopamine
8. Dobutamine

Appendix D: (Continued)

Goals of Drug Therapy during ACLS

1. Correct hypoxemia
2. Reestablish spontaneous circulation with adequate B/P
3. Maximize, optimize cardiac function
4. Suppress ventricular ectopy
5. Relieve pain
6. Treat CHF

Appendix E: Demographic Information Form

**Age** Please list your age ___________

Please circle the appropriate categories listed below:

**Gender** Male Female

**Ethnicity** African American Caucasian Hispanic Asian
Other (please write in)

Education **(not including your current enrollment in this Nursing Program)**

**AA AS BA BS MA MS MD DO DC**

**Level of Nursing Experience and Number of Years at each level (you may select all that apply**

| **Level** | **Years** |
|---|---|
| Certified Nurse Assistant | ____ |
| LPN | ____ |
| Paramedic | ____ |
| Respiratory Therapist | ____ |
| Other Write In | ____ |
| Nursing School only | ____ |

**CPR Experience**

Please list the times you have actually applied your CPR skills with a human being, not including class or renewal. __________

Cardiac Code Experience

Please list the number of codes to which you have actively responded. __________

Human Patient Simulator

Have you been oriented to the Human Patient Simulator? Yes No

How many experiences have you had with the Human Patient Simulator? ____

List any specific simulator experiences you can recall.

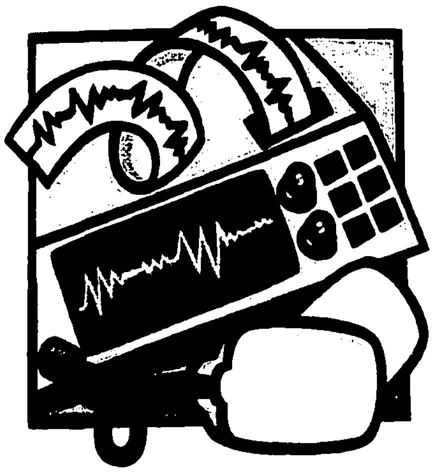
# Appendix F: Cardiac code response course learning objectives

Cardiac code response course objectives

1. Review A & P of the Heart and circulatory system
2. Focus on the circulation through the heart and then to the body; identify major pulse assessment points.
3. Focus on the electrical conduction in the heart
4. Consider the effects of circulatory or conduction abnormalities
5. Explore the possible causes of a cardiac code.
6. Anticipate the skills needed for a successful code.
7. Review Basic CPR skills focusing on the current American Heart Association Guidelines.
8. Review items located on a typical crash cart.
9. Examine a defibrillator.
10. Review the information available from the Cardiac Monitor.
11. Review Airway adjunctive equipment.
12. Learn the code medications.
13. Identify the responsibilities of each Code team member.
14. Explore the role of the RN Primary Care Nurse in a code.
15. Read the CPR documentation forms.
16. Consider your feelings about participating in a code.

Appendix G: Cardiac code response course sample page

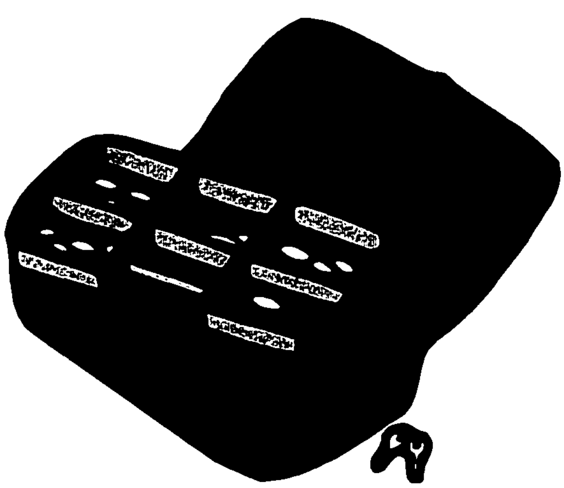
# The Code Cart



**Top of Cart:** Datascope EKG monitor with defibulator/recorder. EKG cables. Orange Airway Box.

**Side of Cart:** Suction canister and tubing. Code Blue record sheets. Ambu bag.

**Back of Cart:** Backboard.



## Orange Airway Box:

Inside- Top:
**1 "C" battery laryngoscope handle**
**1 #3 Macintosh**
**1 #4 Macintosh**
**1 #2 Miller**
**1 #3 Miller**

**First drawer- Medications:**
1 Amiodarone HCL 50 mg syringe (50/mg/ml)
3 Atropine sulfate 1mg syringes (0.1mg/ml)
1 Calcium Chloride 1gm syringe (100mg/ml)
1 Dextrose 50% 50ml syringe (500mg/ml)
2 Dobutamine HCL 250mg vials (250mg/20ml)
2 Dopamine HCL 400mg vial (400mg/5ml)
9 Epinephrine 1:10,000 syringes (0.1mg/ml) 1 with intracardiac needles
Propranolol HCL 1mg ampule (1mg/ml)
1 Heparin Flush 100u/ml 10ml vial

Appendix H: Human Patient Simulator (HPS) Scenario

| State<br><br>(Name) | Patient Status<br><br>(include VS, ABG, etc)<br>Baseline client: Truck Driver awake | Student Learning Outcomes or actions desired | Faculty Actions |
|---|---|---|---|
| Baseline | T-37 , P-76, R-14, BP-180/97, SaO2-95%<br>Eyes open and blinking | Baseline assessment<br><br>Recheck P, R & BP and do a symptom analysis | This is the state the scenario will start in. Students are to begin head to toe assessment including vital signs. After 5 minutes transition to PVCs or if nearing completion of assessment go to next state. Toward end of 5 minutes or end of assessment have client c/o chest pain. |
| PVCs 10% | T-37, P-75, R-14, BP 183/99, SaO2 -95<br>Eyes blinking | Recognize change in cardiac rhythm from regular to irregular. Continue to monitor client. | Time in state 150 seconds go to PVCs 25%. Do not manually advance. |
| PVCs 25% | T-37, P-75 **120?**, R-20 , BP 162/118 labile, **SaO2 90%**<br>Eyes blinking | Must get code cart and place the Life Pack leads. *APPLY O2*<br><br>**SHOULD THIS BE DONE IN PREVIOUS STATE WITH STUDENTS MONITORING CLIENT AT THIS POINT, WHILE AWAITING TRANSFER TO CCU** | Students should determine the need to get code cart into room and notify __________. Place Life Pack leads, HPS facilitator will manually move to next state. If time in state reaches 150 seconds without appropriate action of students HPS will automatically go to next state per time transition. |

Appendix H: (Continued)

| | | | |
|---|---|---|---|
| Pulsatile V Tach | T-37, P-151 v-tach, R-20, BP 127/96, SaO2-95<br>Eyes blinking | Assess ABCs.<br>Recognize V Tach and check for pulses and perfusion.<br>Continue to monitor. | As soon as students carry out appropriate actions, manually move to next state. If time in state reaches 150 seconds without appropriate action of students HPS will automatically go to next state per time transition. |
| Pulseless V Tach | Eyes closed | ABCDs<br>A-Establish airway<br>B-Administer positive pressure ventilations<br>C-do chest compressions<br>D-defibrillate up to 3 times<br>(200J, 300J, 360J) | As soon as students carry out appropriate actions, manually move to next state. If time in state reaches 150 seconds without appropriate action of students HPS will automatically go to next state per time transition. |
| Pulseless V Tach | Eyes closed | Administer Epinephrine 1 mg (1:10,000) IVP, repeat every 3 to 5 minutes or<br>Administer Vasopressin 40 U IVP 1 time only. | As soon as students carry out appropriate actions, manually move to next state. If time in state reaches 150 seconds without appropriate action of students HPS will automatically go to next state per time transition. |

Appendix H: (Continued)

| | | | |
|---|---|---|---|
| V Fib | Eyes closed | Resume attempts to defibrillate at 360 J Administer antiarrhythmics: Lidocaine, amiodarone, procainamide. If hypomagnesemic, administer magnesium as antiarrhythmics may be less effective. | As soon as students carry out appropriate actions, manually move to next sinus tachycardia. If time in state reaches 150 seconds without appropriate action of students HPS will automatically go Asystole. |
| Sinus Tach | Eyes blinked | Recognize that sinus tachycardia is probably due to administration of epinephrine and will resolve in approximately 5 minutes, so no intervention needed. | Continue to monitor until stable. Instructor will call code a success. |
| Asystole | Eyes closed | | Call code and note time of death. |

## Appendix I: Observational Guide

NLN/METI Research Grant

Brain Based Learning Principles Applied to the Teaching of Basic Cardiac Code to

Associate Degree Nursing Students Using the Human Patient Simulator

SIMULATED CODE RATER SHEET

| **Expected students actions:** | **Carried out:** |
|---|---|
| 1. Students review client's chart and kardex prior to entering room. | Yes________ No__________<br>Prompt needed __<br>No, despite prompt_________ |
| 2. Students identify client before beginning assessment | Yes________ No__________<br>Prompt needed __<br>No, despite prompt_________ |
| 3. Students assess client including vital signs. | Yes________ No__________<br>Prompt needed __<br>No, despite prompt_________ |
| 4. When client complains of chest pain, students reassess vital signs including P, R, BP, & $O_2$ sat. | Yes________ No__________<br>Prompt needed __<br>No, despite prompt_________ |
| 5. Administer Nitroglycerin sublingual per physician's order (q 5 min X 3). | 1st Dose Yes____No_______<br>2nd Dose Yes____No_______<br>3rd Dose Yes____No_______<br>Prompt needed ___________<br>No, despite prompt_________ |
| Initiate $O_2$ per nasal cannula. | Yes________ No__________<br>Prompt needed __<br>No, despite prompt_________ |
| 6. Students assess client's pain (symptom analysis). | Yes________ No__________<br>Prompt needed __<br>No, despite prompt_________ |

Appendix I: (Continued)

| | |
|---|---|
| 7. Students recognize change in cardiac rhythm and continue to monitor client. | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| 8. Students recognize increasing irregularity of pulse and notify primary care nurse. | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| 9. Students bring code cart to room. | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| Places lifepack leads to monitor cardiac rhythm. | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| 10. Students recognize change in client's rhythm | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| lower the bed | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| assess peripheral pulses and perfusion. | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| 11. Students assess $O_2$ Sat (arterial blood gases [ABGs]). | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| 12. Students recognize when client begins pulseless ventricular tachycardia and begin Pulseless V-Tach algorithm. | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |

Appendix I: (Continued)

| | |
|---|---|
| 13. Students initiate ABCDs by assuming various code team roles | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| A – establish airway | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| B – administer positive pressure ventilations | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| C – places backboard | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| performs chest compressions | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| D – defibrillate up to 3 times<br>200 joules | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| 300 joules | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| 360 joules | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| 14. Students administer Epinephrine 1 mg IVP or administer vasopressin 40 IU IVP 1 time only. | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |
| 15. Students repeat epinephrine 1 mg every 3 to 5 minutes. | Yes________ No__________<br>Prompt needed __<br>No, despite prompt__________ |

Appendix I: (Continued)

| | |
|---|---|
| 16. Students recognize ventricular fibrillation and resume attempts to defibrillate at 360 J | Yes________ No_________<br>Prompt needed __<br>No, despite prompt_________ |
| 17. Students administer antiarrhythmics: lidocaine, amiodarone, procainamide. | Yes________ No_________<br>Prompt needed __<br>No, despite prompt_________ |
| 18. Mention laboratory data that could affect cardiac response to drugs administered during code. | Yes________ No_________<br>Prompt needed __<br>No, despite prompt_________ |
| 19. Recognize that client is in Sinus Tachycardia and monitor as inceased rate is probably due to administration of epinephrine. | Yes________ No_________<br>Prompt needed __<br>No, despite prompt_________ |
| OR | |
| Recognize asystole and continue CPR. | Yes___________ No______<br>Prompt needed ___________<br>No, despite prompt_________ |
| 20. Completes code documentation forms. | Yes___________ No______<br>Prompt needed ___________<br>No, despite prompt_________ |

Appendix J: Recruitment Flyer

# Nursing IV Students Needed for Research Study

The study is exploring different strategies to help nurses learn about Cardiac Codes

Each participant will receive $40 at the end of the study.

Introduction Meeting
September 11, 2001 - 12:15 or 4:15
Room 212
Pizza Provided

APPROVED THRU
JUN 30 2002
USF IRB INSTITUTIONAL REVIEW BOARD M1294-02XM

IRB # 99.158

# Appendix K: Informed Consent Form

**University of South Florida**
**Participant Consent Form**

**Principal Investigator:** Jean Wortock
**Study Location:** St. Petersburg College (SPC)

**Research Study:** Brain Based Learning Principles Applied to Teaching of Basic Cardiac Code to Associate Degree Nursing Students Using the Human Patient Simulator

**Purpose of Study:** To investigate various methods of instruction for teaching nurses about basic cardiac codes. You are being asked to participate because you are a nursing student interested in this topic.

**Procedure:** You will be randomly assigned to one of four different groups. People in group one receive the standard cardiac code education. People in group two will complete the cardiac code scenario with the Human Patient Simulator lasting about one hour. People in group three will complete the basic cardiac code module on-line taking approximately two - four hours over the course of the semester. Group four will complete both the basic cardiac code module on-line and the cardiac code scenario with the simulator, which will take a total of three - five hours. The study will involve completing two questionnaires that assess your knowledge once at the beginning of the semester and again at the end. The first half of each questionnaire will be pencil and paper and the second half will be on a computer. Each assessment will take approximately one and one-half hours.

**Duration of the Study:** The study will last this semester.

**Confidentiality:** The information you provide will be strictly confidential. You will be assigned an identification number. Your name will not be connected with any of the information you provide. All research reporting will be done in aggregate or group form to protect your confidentiality. "Authorized research Investigators, agents of the Department of Health and Human Services and the USF Institutional Review Board may inspect your records from this research project."

**Risks and Benefits:** There is no risk of physical, mental or social harm to you by participating in this study. The only possible benefits are the opportunity to participate in a research study, and a possible increase in learning in some groups.

**Payment for Participation:** If you volunteer to participate you will be paid a total of $40.00 at the end of the study.

**Volunteering to Participate in this study:** Your participation in this study is voluntary. You may withdraw from the study at any time. Your grade will not be affected by participation or withdrawal.

**Questions and Contacts:** Addition information may be obtained my contacting Jean Wortock, Nursing Program Director, Office [redacted] the Division of Research Compliance at the University of South Florida at [redacted]

**Investigator's Statement:** I have carefully explained to the participant the nature of the study. I hereby certify that to the best of my knowledge the participant signing this form understands the nature, demands, risks, benefits and time commitment involved by participating in this study.

| Jean M. Wortock<br>Investigator | ______________________<br>Signature | __________<br>Date |
|---|---|---|

**Institutional Approval of Study & Informed Consent:** This research and informed consent were reviewed and approved by the University of South Florida Institutional Review Board for the protection of human subjects. This approval is valid until the date provided in the seal below. The board may be contacted [redacted]

**Participant's Consent** - by signing this form I agree that: I have fully read the above information. I have had the opportunity to ask questions and receive answers. I understand that there are no risks and limited, if any benefits to participating. I freely give my consent to participate in the research project. I have been given a signed copy of this form to keep.

| __________<br>Participant | ______________________<br>Signature | __________<br>Date |
|---|---|---|

IRB#99.158
Page 1 of 1

APPROVED THRU
JUN 30 2002
USF INSTITUTIONAL REVIEW BOARD

## About the Author

Jean Marie Miller Wortock received a Bachelor's Degree in Nursing from the College of Saint Scholastica, Duluth, MN. She earned her Master's Degree in Nursing at the University of South Florida. Nursing employment has included: community health, industry, hospitals, and nursing education.

Ms. Wortock has had a 26-year commitment to excellence in nursing education at St. Petersburg College, St. Petersburg, FL. In 2001 she was appointed the Director of the Nursing Program and was recently selected to be the first Dean of the College of Nursing.

Ms. Wortock was included in Who's Who Among America's Teachers. She has been an active member of the Florida Nurses' Association receiving the following honors: District #13 1995 Nurse of the Year, appointment to the Florida Nurses Foundation, and honorary lifetime membership in the Florida Student Nurses Association. Other professional memberships include the National and Florida Leagues for Nursing and Sigma Theta Tau.