

2004

The Impact of Utilizing High-Fidelity Computer Simulation on Critical Thinking Abilities and Learning Outcomes in Undergraduate Nursing Students

Lori Schumacher

Follow this and additional works at: <https://dsc.duq.edu/etd>

Recommended Citation

Schumacher, L. (2004). The Impact of Utilizing High-Fidelity Computer Simulation on Critical Thinking Abilities and Learning Outcomes in Undergraduate Nursing Students (Doctoral dissertation, Duquesne University). Retrieved from <https://dsc.duq.edu/etd/1161>

This Immediate Access is brought to you for free and open access by Duquesne Scholarship Collection. It has been accepted for inclusion in Electronic Theses and Dissertations by an authorized administrator of Duquesne Scholarship Collection. For more information, please contact phillipsg@duq.edu.

THE IMPACT OF UTILIZING HIGH-FIDELITY COMPUTER SIMULATION ON
CRITICAL THINKING ABILITIES AND LEARNING OUTCOMES IN
UNDERGRADUATE NURSING STUDENTS

by

Lori Beth Schumacher

BSN, Creighton University, 1988

MS, University of Minnesota, 1996

Submitted to the Doctoral Program Faculty
of the School of Nursing in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy

Duquesne University

2004

© Copyright by Lori B. Schumacher

2004

THE IMPACT OF UTILIZING HIGH-FIDELITY COMPUTER SIMULATION ON
CRITICAL THINKING ABILITIES AND LEARNING OUTCOMES IN
UNDERGRADUATE NURSING STUDENTS

Lori B. Schumacher, PhD

Duquesne University, 2004

Critical thinking abilities and learning outcomes are major components of nursing education. Initial critical thinking skills are often gained while the nursing student is learning the theoretical nursing principles in the classroom and is further enhanced in the clinical setting where learned knowledge is applied. A variety of instructional strategies are utilized to facilitate learning and promote critical thinking. Through the utilization of three complex and dynamic conceptual models, this study compared critical thinking abilities and learning outcomes of beginning baccalaureate undergraduate nursing students when three instructional strategies were used (classroom, simulation, and a combination of classroom and simulation).

A descriptive, quasi-experimental research design was utilized for this study that compared critical thinking abilities and learning outcomes of three groups of students utilizing three instructional strategies. Thirty-six nursing students completed the study. A 60-item customized HESI exam was administered as a pretest to all study participants and used to randomize the subjects into three treatment groups. Randomization occurred through a block rank ordering technique based on the initial critical thinking scores. Using one of the three instructional strategies, each group rotated through three learning activities, which illustrated the nursing care of clients experiencing an emergent

cardiovascular or respiratory event: myocardial infarction, deep vein thrombosis leading to pulmonary embolism, and shock (anaphylactic and hypovolemic). After the completion of each learning activity, critical thinking abilities and learning outcomes were measured through the administration of a 20-item customized HESI exam which served as the posttest. One-way ANOVA calculations were conducted to determine the effect of instructional strategies on critical thinking ability and learning outcomes. Bonferroni post hoc comparisons were employed to evaluate significant ($p < 0.05$) differences between groups.

There were no statistically significant differences between critical thinking abilities ($p > 0.08$) or learning outcomes ($p > 0.12$) of nursing students when classroom instruction was utilized to deliver a learning activity. HESI exam scores were higher and statistically significant differences were detected between critical thinking abilities ($p \leq 0.002$) and learning outcomes ($p \leq 0.001$) of nursing students when simulation or a combination of classroom and simulation was utilized to deliver a learning activity.

Dissertation Advisor: Joan Such Lockhart, PhD, RN, CORN, AOCN[®], FAAN

ACKNOWLEDGEMENTS

I would like to extend grateful appreciation to numerous individuals who have continuously provided me with support and encouragement through this endeavor. First of all, I wish to thank my students and colleagues, especially Dr. Alfred Lupien, Dr. Katherine Nugent, Dr. Martha Bradshaw, Dr. Lucy Marion, and Jane Smith. Without them, my exploration, involvement and growth with high-fidelity human patient computer simulation would not have been possible.

I also want to express special thanks to the doctoral faculty at Duquesne University. I appreciate and wish to thank Dr. Joan Lockhart, the chairperson of my dissertation committee, as well as committee members Dr. Gladys Husted and Dr. Alfred Lupien, and Dr. Ainslie Nibert from HESI, for their advice, guidance and encouragement. I especially wish to extend my deepest gratitude to my family. To my father and mother, Stan and Sandy, who have continually inspired me in all my nursing endeavors and I wish to dedicate this dissertation to them. I appreciate and will never forget all the encouragement that dad gave me through my doctoral studies even though he was ill and not feeling his best. Through his illness, he always strived and was determined to make life better and live to the best of his abilities. Dad, it is your determination, strength, love, wisdom, and encouragement that I will always cherish and will attempt to foster in my nursing endeavors and those of my students.

TABLE OF CONTENTS

	Page
List of Tables.....	xi
List of Figures.....	xiii
I. Introduction.....	1
A. Background of the Study.....	2
B. Purpose of the Study.....	8
C. Research Questions.....	8
D. Definition of Terms.....	9
1. Critical Thinking.....	9
2. Learning Outcomes.....	11
3. Instructional Strategies.....	12
a. Traditional Didactic Classroom.....	13
b. High-fidelity Human Patient Computer Simulation.....	13
c. Didactic and Simulation Combination.....	14
4. Undergraduate Nursing Students.....	14
E. Assumptions.....	15
F. Limitations.....	15
G. Significance to Nursing.....	16
a. Academic.....	16
b. Professional Practice.....	17
II. Review of the Literature.....	19

A.	Introduction.....	19
1.	Critical Thinking.....	19
a.	Critical Thinking and Teaching Methods.....	21
b.	Critical Thinking and Decision-Making.....	22
c.	Watson-Glaser Critical Thinking Appraisal.....	24
d.	California Critical Thinking Skills Test and the Disposition Inventory.....	27
2.	Learning Outcomes.....	32
3.	High-fidelity Computer Simulation.....	35
4.	Review of the Literature Summary.....	46
B.	Conceptual Framework.....	46
1.	Complexity Integration Nursing Theory.....	49
a.	Theory of Nursing Knowledge and Practice.....	51
b.	The Theory of Human Being.....	53
c.	The Nursing Theory of Social Entirety.....	54
d.	Self Observation Methodology.....	54
2.	Novice-to-Expert and Thinking-in-Action and Reasoning-in- Training.....	56
3.	Crisis Resource Management.....	61
C.	Summary.....	65
III.	Methods.....	67
A.	Design.....	67
B.	Subjects.....	69

1.	Assessment of the Learner/Study Subject.....	70
C.	Setting.....	71
1.	Framework of Study Site’s Nursing Curriculum.....	72
2.	Curriculum Design.....	74
D.	Instructional Strategies.....	75
1.	Learning Activity Plans.....	76
2.	Instructional Strategies Utilized.....	77
a.	Traditional Didactic Classroom.....	77
b.	High-Fidelity Human Patient Computer Simulation.....	77
c.	Combined Didactic and HHPCS.....	81
E.	Instruments.....	81
1.	Reliability.....	83
2.	Validity.....	84
F.	Procedure.....	85
G.	Procedure for Protection of Human Subjects.....	86
H.	Procedure for Data Analysis.....	88
IV.	Results and Discussion.....	90
A.	Introduction.....	90
B.	Formation of Study Groups.....	90
C.	Description of Groups.....	91
D.	Findings.....	93
1.	Question 1.....	97
2.	Question 2.....	98

3.	Question 3.....	99
4.	Critical Thinking Score Comparisons for Learning Activities.....	101
	a. CAD/MI Learning Activity.....	102
	b. DVT/Pulmonary Embolism Learning Activity.....	103
	c. Shock Learning Activity.....	104
5.	Question 4.....	105
6.	Question 5.....	106
7.	Question 6.....	108
8.	Learning Outcome Score Comparisons for Learning Activities....	110
	a. CAD/MI Learning Activity.....	110
	b. DVT/Pulmonary Embolism Learning Activity.....	112
	c. Shock Learning Activity.....	112
	E. Discussion.....	114
V.	Summary.....	120
	A. Limitations.....	121
	B. Recommendations.....	122
	C. Implications for Nursing Academia.....	122
	D. Implications for Professional Nursing Practice.....	124
	E. Recommendations for Future Study.....	125
	APPENDIX A. School of Nursing Course Descriptions.....	128
	APPENDIX B. Learning Activity Teaching Plans.....	131
	APPENDIX C. HESI Test Blueprints.....	137
	APPENDIX D. Sample HESI Scoring Report.....	140

APPENDIX E. HESI Confidentiality Statement.....	145
APPENDIX F. Demographic Data Questionnaire.....	146
APPENDIX G. Protection of Human Subjects Committee Materials.....	147
APPENDIX H. Permission to Use Figures and Illustrations.....	152
REFERENCES.....	155

List of Tables

Table 1	Characteristics of Critical Thinking.....	5
Table 2	Novice-to-Expert Learning Behaviors and Attributes.....	57
Table 3	Thinking-in-Action Habits of Thought and Action and Characteristics of Domains of Practice.....	60
Table 4	Pretest HESI Critical Thinking Scores (N = 60).....	91
Table 5	Subject Demographic Data by Group (N = 48).....	92
Table 6	Study Attrition.....	93
Table 7	Comparison of HESI Posttest Mean Critical Thinking Scores and Instructional Strategy.....	95
Table 8	Comparison of Posttest Mean HESI Total Scores and Instructional Strategy.....	96
Table 9	HESI Critical Thinking Scores for Traditional Didactic Classroom Instruction.....	97
Table 10	HESI Critical Thinking Scores for High-Fidelity Human Patient Computer Simulation.....	99
Table 11	Bonferroni Post Hoc Comparison of Critical Thinking Scores and HHPCS Utilization.....	99
Table 12	HESI Critical Thinking Scores for Combination Instruction.....	100
Table 13	Bonferroni Post Hoc Comparison of Critical Thinking Scores and Combination Instruction.....	101
Table 14	Group Comparison for CAD/MI Learning Activity.....	103
Table 15	Bonferroni Post Hoc Comparison of CAD/MI Learning Activity.....	103
Table 16	Group Comparisons for DVT/PE Learning Activity.....	104
Table 17	Group Comparisons for Shock Learning Activity.....	105
Table 18	HESI Scores for Traditional Didactic Classroom Instruction.....	106

Table 19	HESI Scores for High-Fidelity Human Patient Computer Simulation Instruction.....	107
Table 20	Bonferroni Post Hoc Comparison of HESI Scores and HHPCS Utilization.....	108
Table 21	HESI Scores for Combination Instruction.....	109
Table 22	Bonferroni Post Hoc Comparison of HESI Scores and Combination Instruction.....	110
Table 23	Group Comparisons for HESI Scores and the CAD/MI Learning Activity.....	111
Table 24	Bonferroni Post Hoc Comparisons of CAD/MI Instructional Strategies and HESI Scores.....	112
Table 25	Group Comparisons for HESI Scores and DVT/PE Learning Activity.....	113
Table 26	Group Comparisons for HESI Scores and Shock Learning Activity.....	113

List of Figures

Figure 1	Model of Metatheory.....	50
Figure 2	Four Factors of the Theory of Nursing Knowledge and Practice.....	52
Figure 3	Self Observation Methodology and Continuous Energy Flow.....	55
Figure 4	Crisis Resource Management Model.....	63
Figure 5	Diagram of Study Design.....	69
Figure 6	School of Nursing Curriculum Schema.....	75
Figure 7	Programmed Simulation Case Study.....	78
Figure 8	HESI Style Question.....	83
Figure 9	Comparison of HESI Posttest Mean Critical Thinking Scores and Instructional Method.....	94
Figure 10	Comparison of Posttest Mean Total HESI Scores And Instructional Method.....	96

CHAPTER 1

INTRODUCTION

Critical thinking is a key component of clinical nursing practice (Alfaro-LeFevre, 2004; Sedlak, 1997). Initial critical thinking skills are often gained while the nursing student is learning the theoretical nursing principles in the classroom and is further enhanced in the clinical setting where learned knowledge is applied. A considerable amount of time and effort in planning and facilitating critical thinking in the learning process of students is occurring with the desire to enhance and encourage clinical and decision-making skills in the novice nurse (Maynard, 1996). A variety of instructional strategies is usually sought and utilized since individuals possess different learning styles and preferences for learning. One such instructional modality for enhancing critical thinking is the use of full-body, high-fidelity human patient computer simulation (HHPCS). HHPCS provides a controlled environment while allowing the student to exercise basic nursing and decision-making skills.

HHPCS provides realistic, whole-body patient simulators that were introduced to the health care industry in the early 1990s for use in anesthesiology in order to study human performance and improve education (Lupien & George-Gay, 2001). High-fidelity human patient computer simulators contain numerous features that assist in making them realistic such as palpable pulses, measurable blood pressure, heart sounds, hemodynamic monitoring capabilities, spontaneous ventilation, breath sounds, reactive pupils, production of output drainage (urine, chest tube) and a pharmacologic system that enables medications to be delivered and the action of the medication to be experienced (Euliano, 2001a, 2001b; Kozlowski, 2004; Lupien & George-Gay, 2001).

Utilizing HHPCS provides a link to critical thinking abilities and their development and should be used concomitantly with clinical practice (Rauen, 2004). HHPCS provides access to realistic problems that require active participation in problem-solving and also facilitates learning the effects of harmful actions without jeopardizing an actual patient (Weis & Guyton-Simmons, 1998). From HHPCS, students are able to receive feedback on their critical thinking and decision-making processes as they occur which assists in their understanding and clarifying the urgency of the underlying problem and possible choices and consequences of the entire simulated situation. Most of the research involving simulation has been done in the fields of aviation, anesthesia, military, medicine, and graduate nursing (nursing anesthesia). If simulation is going to be used in the entry-level education of nurses, its implication as it relates to undergraduate nursing education, must be studied.

Background of the Study

Critical thinking is an essential component of nursing curricula and is a highly valued outcome (Alfaro-LeFevre, 2004; Cook, 2001; Daly, 2001; Sedlak, 1997). In nursing, critical thinking is a purposeful, dynamic process that has varied perspectives and has been described many ways depending upon its intention and implication. Critical thinking is the application of inquiry, which involves analyzing, evaluating, and critiquing issues, interactions, and information through a metacognitive activity (Beeken, 1997; Boychuck, 1999). Theories of critical thinking can be traced back to the early Greek philosophers including Socrates, Plato, and Aristotle. The early philosophers used techniques of purposeful thinking through inquiry, examination, and reflection, which assisted students in clarifying their ideas and positions (Daly, 1998; DiVito-Thomas,

2000). Facione (1990) conducted a Delphi study involving a panel of experts in critical thinking and critical thinking assessment research. The panel concluded with a consensus statement for critical thinking:

We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based...Critical thinking is a pervasive and self-rectifying human phenomenon. The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused on inquiry, and persistent in seeking results which are precise as the subject and the circumstances of inquiry permit (p. 3).

Another definition of critical thinking frequently used by nursing schools is by Watson and Glaser (1980) who viewed critical thinking as:

...a composite of attitudes, knowledge, and skills which includes: (1) attitudes of inquiry that involve an ability to recognize the existence of problems and an acceptance of the general need for evidence in support of what is asserted to be true; (2) knowledge of the nature of valid inferences, abstractions, and generalizations in which the weight or accuracy of different kinds of evidence are logically determined; and (3) skills in employing and applying the above attitudes and knowledge (p. 1).

Critical thinking is also utilized in education as Browne and Freeman (2000) state:

...critical thinking comes in many forms, but all possess a single core feature.

They presume that human arguments require evaluation if they are to be worthy of widespread respect. Hence, critical thinking focuses on a set of skills and attributes that enable a listener or reader to apply rational criteria to the reasoning of speakers and writer. These attitudes and skills are the substance of critical thinking texts and curriculum materials (¶ 4).

Throughout the various realms of nursing, critical thinking is a highly valued outcome and tends to be based upon the nursing process (Saucier, Stevens, & Williams, 2000). Critical thinking is also considered by the National League of Nursing (NLN) and the American Association of the Colleges of Nursing (AACN) to be an essential curriculum component and have listed the assessment of critical thinking as a mandatory criteria for accreditation (AACN, 1998; Rubenfeld & Scheffer, 1999; Scheffer & Rubenfeld, 2000). Unfortunately, even with all this emphasis on the importance of critical thinking, a consensual definition does not exist. In an attempt to form a consensus statement on critical thinking for the nursing profession, research was conducted utilizing a panel of international nurses, which defined critical thinking as:

...an essential component of professional accountability and quality nursing care.

Critical thinkers in nursing exhibit these habits of 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 (Rubenfeld & Scheffer, 1999, p. 5).

According to Rubenfeld and Scheffer (1999), the essential characteristics for critical thinking are dependent upon three types of attributes: innate qualities, cognitive processes and decision-making. Innate qualities of critical thinking are characteristics that an individual possesses and requires a cognitive process to occur with the ultimate end-point of a decision being made (Rubenfeld & Scheffer, 1999; Scheffer & Rubenfeld, 2000; Schumacher, 2004). Table 1 lists characteristics present in each of the three essential attributes of critical thinking.

Table 1

Characteristics of Critical Thinking

Innate Qualities	Cognitive Processes	Decision Making
Open-minded	Knowledge recognition	Purposeful
Honest	Information seeking	Pervasive
Prudent	Explaining	Reasoning
Flexible	Application	Well-informed
Trustful	Discriminating	Information seeking
Accountable	Logical reasoning	Contextual perspective
Creative	Analysis	Self-regulatory
Clear	Inference	Judgment
Orderly	Synthesis	Transforming
Diligent	Interpretation	Reflection
Reasonable	Evaluation	
Persistent	Predicting	
Confident		
Intuitive		
Inquisitive		
Persevering		

Note. From "Simulation In Critical Care Nursing Education: Conceptual and Practical Perspectives", by L. B. Schumacher, 2004, W.F. Dunn (Ed), *Simulators in Critical Care and Beyond*, p. 115. Copyright 2004 by the Society of Critical Care Medicine. Adapted with permission of the author.

Critical thinking is also described by the National Council for Excellence in Critical Thinking (Scriven & Paul, 2004) as “ the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief or action” (p.1).

All of the above definitions have similar characteristics of cognitive learning theory, which incorporates an active process that is cumulative and goal oriented (Johnson, Zerwic, & Theis, 1999). During the process of critical thinking, the learner assumes a very active role and faculty become the facilitators of the learning process (Johnson et al., 1999; Rowles & Brigham, 1998).

In nursing, critical thinking is a necessary and sophisticated skill that is needed to make decisions and solve problems, which is essential when caring for acutely ill patients. Critical thinking possesses similar characteristics of cognitive learning theory, which incorporates an active process that is cumulative and goal oriented (Johnson et al., 1999). Throughout the nursing education process, it is thought that a student’s critical thinking ability should increase as the student encounters more complex issues. It is fundamental that faculty understand how the selection of learning activities and instructional strategies assist in the development and empowerment of critical thinking. Having implemented a critical thinking activity, the next step is to evaluate its effectiveness (Ali, Cohen, Gana, & Al-Bedah, 1998). Even though it has been determined that critical thinking is an essential component of the curriculum and is criteria for accreditation, the process of evaluating critical thinking is still being examined (Alfaro-LeFevre, 2004; Cook, 2001; Videbeck, 1997).

Preliminary work using HHPCS and studies of its effectiveness in improving performance and retention of clinical skills has been limited. Chopra, Gesnik, DeJong, Bovill, Spierdik, and Brand (1994) evaluated the efficacy of HHPCS as a training tool and found that anesthetists who use HHPCS “respond more quickly, deviate less from accepted guidelines and perform better in handling crisis situations” (p. 295). Recent work by Schwid, Rooke, Carline, Steadman, Murray, Olympio, Tarver, Steckner, and Westone (2002) studied the performance of anesthesia residents’ clinical management skills and identified clinical management problems with residents through errors that were made in the simulation scenarios and demonstrated the need to evaluate critical thinking and decision-making skills.

As a nurse educator, this researcher has had the opportunity to utilize HHPCS in various capacities and observe nursing students’ abilities to learn and make decisions in scenarios that were presented. Through the experience of inquiring and observing nursing students experiencing simulation, this researcher noticed that the students enjoyed working with HHPCS and that they evaluated the experience as one that enabled them to use their critical thinking skills and increase their nursing knowledge. HHPCS may effectively bridge the gap between conventional learning and the unpredictable clinical environment. The use of HHPCS allows the learner to be an active participant in the learning process as well as practice skills and interventions in a safe, repeatable environment while providing reinforcement to the learning acquired and being manifested (Dunn, 2004; Loyd, Lake, & Greenberg, 2004). Thus, the question “How do nursing students acquire nursing knowledge and the ability to critically think?” evolved. Reflection on this question along with thoughts about learning led to the general research

question: Is there a difference in critical thinking abilities and learning outcomes in students exposed to different instructional strategies?

Purpose of the Study

The purpose of this study is to compare critical thinking abilities and learning outcomes of beginning undergraduate nursing students when three instructional strategies (traditional didactic classroom, HHPCS, and a combination of didactic classroom and HHPCS instruction) are used to illustrate the nursing care of the clients experiencing an emergent cardiovascular or respiratory event during three learning activities. The three emergent cardiovascular or respiratory events that the beginning undergraduate nursing student will be exposed to in this study are myocardial infarction, deep vein thrombosis leading to pulmonary embolism, and shock (anaphylactic and hypovolemic).

Research Questions

Utilizing three instructional strategies to illustrate the nursing care of clients experiencing an emergent cardiovascular or respiratory event, the following research questions will be addressed:

1. Is there a difference between critical thinking abilities of beginning baccalaureate nursing students after being exposed to traditional didactic classroom instruction when learning nursing care of a client experiencing an emergent cardiovascular or respiratory event?
2. Is there a difference between critical thinking abilities of beginning baccalaureate nursing students after being exposed to HHPCS instruction when learning nursing care of a client experiencing an emergent cardiovascular or respiratory event?

3. Is there a difference between critical thinking abilities of beginning baccalaureate nursing students after being exposed to a combination of traditional didactic classroom and HHPCS when learning nursing care of a client experiencing an emergent cardiovascular or respiratory event?
4. Is there a difference in learning outcomes of beginning baccalaureate nursing students after being exposed to traditional didactic classroom instruction when learning nursing care of a client experiencing an emergent cardiovascular or respiratory event?
5. Is there a difference in learning outcomes of beginning baccalaureate nursing students after being exposed to HHPCS instruction when learning nursing care of a client experiencing an emergent cardiovascular or respiratory event?
6. Is there a difference in learning outcomes of beginning baccalaureate nursing students after being exposed to a combination of traditional didactic classroom and HHPCS instruction when learning nursing care of a client experiencing an emergent cardiovascular or respiratory event?

Definition of Terms

Several definitions are useful to understanding the research being proposed.

Critical Thinking

Due to the complexities and vastness of the definition of critical thinking, difficulty arises when attempting to operationalize and measure the concept of critical thinking. For the purposes of this study and since the university at which this study will be conducted utilizes the Core Competencies of the American Association of Colleges of

Nursing (AACN), the definition of critical thinking that will be used is taken from *The Essentials of Baccalaureate Education for Professional Nursing Practice* (AACN, 1998):

Critical thinking underlies independent and interdependent decision making.

Critical thinking includes questioning, analysis, synthesis, interpretation, inference, inductive and deductive reasoning, intuition, application, and creativity.

Course work or clinical experiences should provide the graduate with the knowledge and skills to:

- use nursing and other appropriate theories and models, and an appropriate ethical framework;
- apply research-based knowledge from nursing and the sciences as the basis for practice;
- use clinical judgment and decision-making skills;
- engage in self reflection and collegial dialogue about professional practice;
- evaluate nursing care outcomes through the acquisition of data and the questioning of inconsistencies, allowing for the revision of actions and goals;
- engage in creative problem solving (p. 9).

In most instances, critical thinking is measured by utilizing a commercially developed educational assessment instrument (Rane-Szostak & Robertson, 1996). In this study, critical thinking will be operationalized utilizing a custom-made, computerized exam created for the researcher by Health Education Systems, Inc (HESI). The custom-made examination will provide a critical thinking score that is based upon the AACN

(1998) definition of critical thinking, which is also the definition that is being used for the purposes of this study. Test items on the custom exam were written based on a critical thinking model, which requires nursing judgment to be applied in order to determine the correct answer (Morrison, Smith, & Britt, 1996). Even though the customized HESI measures other variables, the exam contains a separate critical thinking category and composite score which indicates critical thinking ability and will be described in complete detail in Chapter 3.

Learning Outcomes

Learning outcomes will be defined according to the Bloom's Taxonomy of Educational Objectives for Cognitive Domain (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956). In the taxonomy, there are six different hierarchical cognitive levels of learning outcomes ranging from knowledge, which is the lowest and most basic level, to evaluation, which is the highest and most sophisticated outcome. The taxonomy categorizes the learning outcomes according to a particular cognitive level and assists in determining the achievement of the described objective (Mager, 1997). The first level is knowledge, which is defined as remembering previously learned material through recalling information and material from specific facts. The second level, comprehension, and is defined as the ability to grasp the meaning of material through translating, interpreting, explaining, or summarizing. The next step is application, which refers to the ability to apply and utilize learned material. The fourth level, analysis, refers to the ability to examine the material by separating the material into elemental parts and so the organizational structure might be understood. The next level is synthesis, which formulates a new whole from parts of learned material. The last and highest level of

learning is evaluation, which contains all elements from the five previous categories, plus the ability to evaluate and judge the value of the material (Bloom et al., 1956).

When selecting an instrument to be utilized in this study to measure learning outcomes, a customized HESI exam was chosen for several reasons. First, the customized HESI exam focuses on content specific to what is being presented in the learning activities conducted in this study. Second, the exam items contain application and analysis level questions, which measure a higher cognitive level than the knowledge or comprehension levels. The purpose of using higher cognitive level items requires multilogical thinking which is “thinking that requires knowledge of more than one fact to logically and systematically apply concepts to a clinical problem” (Morrison et al, 1996, p. 28). Third, the HESI custom-made exam will be an efficient strategy for this study since multiple operational (critical thinking abilities and learning outcomes) measurements may be obtained from the one instrument. The custom-made HESI exam will be described in complete detail in Chapter 3.

Instructional Strategies

Instructional strategies are specific educational approaches used by educators and individuals to learn and retain information (Dyer, Riley, & Yekovich, 1979). Learning is an individualized phenomenon and each individual possesses different learning styles and preferences for processing and learning information (Dyer, Riley, & Yekovich, 1979). One student might prefer to learn information through a particular method such as traditional didactic classroom instruction, while another student might learn the same information by actively participating through an active or kinesthetic method such as HHPCS. For the purpose of this study, three instructional strategies will be used for

instruction when illustrating the nursing care of a client experiencing an emergent cardiovascular or respiratory event during three separate learning activities in this study: traditional didactic classroom, HHPCS, and a combination of didactic classroom and HHPCS. All instructional strategies utilized in this study will follow a specified teaching plan of the specific event being presented during the specified learning activity.

Traditional Didactic Classroom. Traditional didactic classroom instruction is defined as classroom lectures with PowerPoint slide presentations of the emergent cardiovascular or respiratory event. A case study of a client will also be utilized in the slide presentation to assist in incorporating and linking the concepts that were presented during the learning activity.

High-fidelity Human Patient Computer Simulation. HHPCS is described as a full-body, realistic mannequin that features a realistic airway and functioning respiratory system (i.e., self-regulating spontaneous ventilation, breath sounds, and measurable exhaled gases) and a functioning cardiovascular system (ie. heart sounds, palpable pulses, blood pressure measurement) (Dunn, 2004; Egan, 2004; Euliano, 2001a; Kozlowski, 2004; Lampotang et al., 1998; Loyd, Lake, & Greenberg, 2004; Lupien & George-Gay, 2001; Ravert, 2002). A HHPCS is also composed of sophisticated computer technology that utilizes mathematical models of pharmacology (pharmacokinetics and pharmacodynamics) and human physiology (Carovano, 1997; Euliano, 2001b; Euliano, Caton, van Muers, & Good, 1997; Lampotang et al., 1998; Murray, Good, Gravenstein, van Oostrom, & Brasfield, 2002). Combining the physical attributes of the mannequin with the sophisticated computer technology allows for the simulator to respond physiologically to interventions performed on the simulator, specifically those

interventions that affect the cardiovascular and respiratory system (Euliano, 2001b; Euliano et al., 1997; Kozlowski, 2004; Lupien & George-Gay, 2001; Murray et al., 2002).

In this study, the high-fidelity human patient computer simulator that will be utilized as an instructional strategy is the Human Patient Simulator[®] from Medical Education Technologies, Inc., Sarasota, Florida. The same concepts and cognitive objectives that were covered in the traditional didactic presentation will be included and incorporated in instruction utilizing HHPCS instead of a slide presentation. A case study of a client, which is the same as the traditional didactic strategy, will also be presented utilizing HHPCS.

Didactic and Simulation Combination. For the purpose of this study, the third instructional strategy to be utilized in this study is a combination of both previously presented strategies: traditional didactic classroom and HHPCS instruction. A combination of these two instructional strategies incorporates both the didactic slide presentation and the utilization of HHPCS with the same case study that was used during the learning activity.

Undergraduate Nursing Students

Undergraduate nursing students are defined as third year (junior) nursing students enrolled in a four year baccalaureate nursing program. Students will have completed one semester of basic fundamental nursing skills and are enrolled in their first adult health clinical nursing course. These students have not been previously exposed to the content being presented in the three learning activities nor HHPCS as an instructional strategy.

Assumptions

The following assumptions are identified for this study:

1. Participants will respond honestly to test questions.
2. Participant responses to test questions will be a true reflection of their critical thinking abilities and knowledge (cognitive outcome).
3. The assignment of participant groups and sequence of testing will not be contaminated.
4. The content presented for each learning activity module will have equal difficulty.
5. The HHPCS is a reliable working piece of equipment that will perform and react physiologically with each use.
6. The participant performance on the exercises conducted during the study can be generalized to clinical nursing practice.

Limitations

Certain research methodology and analytic techniques must be considered as potential limitations of this study when reviewing the findings of this study and include:

1. The sample size of students could be self-limiting due to geographic location of the study and the number of nursing students available.
2. The sample size could decrease due to failure of study participants to continue with study.
3. The sample in this study is a convenience sample (non-probability sampling technique) and may not be an accurate and representative sample of the variables being measured.

4. The reliability values of the HESI custom-made exam items will be determined at each testing opportunity.
5. The study cannot control for life experiences that might be similar to the learning activities presented during the study and hence, critical thinking and learning outcomes might be influenced inadvertently.
6. The ability to critically think takes time to evolve and this study is time-limited and not longitudinal and therefore, a change in one's critical thinking ability might not occur.

Significance to Nursing

Learning is an individualized phenomenon that is based on awareness and acquiring relevant information. It is important and beneficial for nurse educators, in the academic and clinical settings, to recognize and incorporate effective and various instructional strategies into the learning objectives. Learning is a dynamic life-long process that does not conclude at the completion of an academic degree, but continues throughout one's professional career and impacts the quality of nursing care that is delivered and patient outcomes. One's critical thinking abilities also continue to develop as they gain experience in delivering nursing care. HHPCS as an instructional strategy and link to one's critical thinking abilities, may have a tremendous impact on the discipline of nursing which significance is two-fold: academic and professional practice.

Academic

In the academic setting, HHPCS is a unique, technological instrument that impacts student learning and serves as a bridge between theory and practice. HHPCS assists the student to comprehend and experience the various nursing concepts and

principles that are being taught and learned. For example, the student can actually observe the cardiovascular effects following the administration of a medication, such as epinephrine, in a controlled learning environment without having to deal with all the complexities of taking care of an actual patient who would require the medication. Also, the student might be exposed to HHPCS in a case presentation that requires the student to recall, grasp, comprehend, and apply learned concepts in order to effectively intervene on the simulated patient.

HHPCS may also be economically beneficial when attempting to balance the ratio of nursing students to faculty in the clinical setting. Clinical learning is a major component of nursing education and with the faculty shortage, the proportion of students to faculty is staggering. One of the main issues is clinical safety for the patient and the student. An option of a HHPCS clinical experience assists faculty and the student in attaining a beneficial experience without jeopardizing a patient in the clinical setting where there is possibly not enough staff on the unit to assist or the faculty member is strewn and inaccessible to the student in their time of need. Also, a HHPCS experience allows the student to rehearse a crisis situation prior to experiencing it in real life on an actual patient. All of these measures mentioned have a potential to prevent errors at the bedside which would put the patient in harms way.

Professional Practice

In professional practice, HHPCS may serve as an instructional strategy as in academia, however, the cognitive learning objectives of the experience will probably differ and be at a higher level. For instance, in academia the a cognitive objective might be to identify abnormal lung sounds (crackles) on a client with congestive heart failure,

whereas in professional practice the objective might be to prioritize the care of the client with congestive heart failure after assessing and collecting pertinent clinical data.

With the much publicized results and encounters of human errors made in healthcare, HHPCS also has the potential to serve as an instructional strategy that could assist in preventing such harmful errors. For instance, when a professional nurse is learning and adapting to a new role, such as orienting to the critical care area, HHPCS can serve as an adjunct between theory and practice and expose the nurse to critical care concepts and principles (i.e., hemodynamic monitoring and ventilator management) prior to actually experiencing such things at the bedside with actual patients. Another example of the effective use of HHPCS would be team communication during a crisis situation and observing how the team actually communicates and intervenes. Finally, professional staff development could be facilitated through the use of HHPCS where nursing clinical competencies could be assessed and validated during a prearranged time rather than waiting for the right patient to happen along in order for the professional nurse to be assessed.

Even with all of the potential positive aspects for utilizing HHPCS in academia and professional practice, there is one major drawback. High-fidelity human patient computer simulators are expensive (average cost approximately \$225,000) and institutions may not be able to purchase such an item due to budget constraints. Also, the day-to-day operation and maintenance of the simulator could be a financial drain to an existing fixed budget. Therefore, it is essential to determine the effectiveness and conduct a cost analysis of the benefits and limitations of adopting, purchasing, or rejecting any piece of equipment.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

A preliminary review of the literature indicated that numerous studies on critical thinking in nursing education have been conducted, but to date, no study has specifically investigated the three major variables of concern in this study: nursing students' critical thinking ability, high-fidelity computer simulation, and learning. The medical research literature is limited in the field of medical education utilizing high-fidelity computer simulation, but is quite limited in the nursing literature. Therefore, for the purposes of this literature review, critical thinking and high-fidelity computer simulation will be examined.

Critical Thinking

The exploration of critical thinking is evident throughout the nursing literature and encompasses such things as the definition, its relationship to clinical competence, and strategies to measure critical thinking. In nursing education, both qualitative and quantitative research studies regarding critical thinking have been conducted on nursing students at various educational levels. Predominantly, critical thinking has been measured by two commercial instruments: the California Critical Thinking Skills Test (CCTST) and the Watson-Glaser Critical Thinking Appraisal (WGCTA). However, there are currently other instruments that incorporate and examine the aspects of critical thinking.

Sedlak (1997) conducted a qualitative study that described and analyzed the critical thinking processes of seven beginning baccalaureate nursing students. In an

attempt to obtain a variety of ages for the study, phone interviews were done with 26 students from which the seven students were selected to participate in the study. Students who participated were enrolled in their first clinical course. The students kept clinical journals and were asked to describe and reflect on their weekly clinical experiences. Students also participated in three tape-recorded, structured interviews that probed and expanded on issues from the students' journal entries. In an attempt to gather descriptions of student interactions and activities while in the laboratory setting, non-participatory observations of students were gathered by the researcher. All data collected were coded and categories were formed in order to analyze the data. Four themes/perspectives emerged regarding the development of critical thinking through making clinical decisions: professional self, perfectionism, caring, and self-directed learning. The study also concluded that beginning students possessed critical thinking abilities and that students' critical thinking is facilitated and developed by providing a supportive environment and opportunities for dialogue.

In an interpretive phenomenologic investigation, Haffer and Raingruber (1998) attempted to discover experiences of clinical reasoning and development of critical thinking in 15 baccalaureate nursing students. Participants in the study were students enrolled in an elective clinical reasoning course. Data were gathered through student logs, videotapes of clinical scenarios and discussions of scenarios. Narrative themes, exemplars, and paradigm cases in the student logs and videos were identified. Confidence and the development of confidence emerged as being significant in the development of critical thinking.

Critical Thinking and Teaching Methods. Teaching methods and the effect on a students' critical thinking skills were evaluated by Daley, Shaw, Balistrieri, Glasenapp and Piacentine (1999) and Saucier, Stevens, and Williams (2000). The use of concept maps was evaluated by Daley et al. (1999) using 18 randomly selected senior nursing students. The students in the study did not receive a standardized critical thinking test. Instead, the conclusion that there was an increase in conceptual and critical thinking among the students was determined by the improvement between the progress of the concept maps. For this study, a concept map was a schematic representation of linking words to concepts and depicting conceptual relationships. Each student created three concept maps over the semester. The concept maps were used not only to evaluate critical thinking, but they were also used as clinical post-conference topics and discussion of theoretical content in the clinical setting. Using a scoring formula that was derived for the study, each student's first and final concept map was scored. The researchers found that there was a significant ($p = 0.001$) improvement in the development of concept maps, which was indicative of an increase in conceptual and critical thinking.

Another teaching method of computer-assisted instruction and its relationship to critical thinking skills was evaluated by Saucier et al. (2000). The relationship between computer-aided instruction and critical thinking skills among 120 baccalaureate nursing students at an accredited, state-supported academic center in Texas was studied. Students participating were randomly divided into two educational strategy groups: computer-assisted instruction or the traditional written nursing process. In order to measure each student's critical thinking abilities and as a pre and post-test to the course, all students were given the CCTST. Overall mean scores of the CCTST decreased between the pre

(16.10) and the post-test (13.9). Internal consistency reliability was computed and determined to be $KR-20 = 0.62$ for the pretest and $KR-20 = 0.70$ for the post-test which indicated they were not significantly different from the established norms. Upon further examination of the data using a multiple regression model, the effect of the case study strategy on the magnitude of critical thinking ability was found to be statistically significant ($p = 0.0001$), indicating that utilizing computer-assisted instruction as a learning strategy did not have a negative outcome on a student's critical thinking ability.

Critical Thinking and Decision-Making. From the definitions of critical thinking and past research there exists a link to a possible correlation between critical thinking and decision-making. Maynard (1996) conducted a longitudinal study that examined the relationship between critical thinking and professional nursing competence in 30 baccalaureate nursing graduates. A cross-sectional, random sample from two cohorts between 1985 to 1990, who attended a private liberal arts college and lived within a 250-mile radius, were selected to participate in the study. While in the nursing program, the participants had their critical thinking ability measured at the sophomore and senior years using the WGCTA; and again as a practicing nurse. Professional competence was also measured using Schwirian's (1978) the Six Dimension Scale of Nursing Performance (6-D scale) which measured the dimensions of leadership, critical care, collaboration/teaching, planning/evaluation, communication/interpersonal relations, and professional development. The critical thinking ability of the students did not change significantly while they were students, however, there was a statistically significant ($F= 3.84, df = 2, 48, p= 0.05$) increase in critical thinking scores between when the participant was a student and as a practicing nurse.

In another study by May, Edell, Butell, Doughty, and Langford (1999) examined the relationship between critical thinking and clinical competence in 143 baccalaureate senior nursing students. Students were administered the California Critical Thinking Disposition Inventory (CCTDI) and the CCTST. Each instrument was used to evaluate the presence of specific abilities and characteristics. The CCTDI measures the characteristics of the ideal thinker and the CCTST measures one's ability to analyze, evaluate and reason a problem situation. Clinical competence was measured using the institution's standardized competency evaluation tool. One month prior to program completion, the students were administered both critical thinking measures. At the end of the 5-week clinical practicum rotation, clinical competencies were evaluated by the student, clinical instructor, and the clinical preceptor. Findings from the CCTDI revealed that the overall Cronbach's alpha reliability was 0.88, and the reliabilities ranged between 0.55 to 0.76, which were consistent with the use of the instrument. The study also showed that 85% of students scored above 280 on the CCTDI, which implies that there was not a serious deficiency in the critical thinking dispositions. Findings from the CCTST revealed a higher mean score (16.76) than the established mean score (15.89). Pearson product moment correlations were used to compare the CCTDI and CCTST scores with the clinical competency tool findings which revealed no significant relationship ($p < 0.05$) between clinical competence and critical thinking. However, students showed that they were able to think critically and practice according to standards.

The effects of critical thinking abilities of baccalaureate nursing students and their ability to manage different clinical situations were examined by Chau, Chang, Lee, Ip,

Lee, and Wootton (2001). Eighty-three baccalaureate nursing students (first year $n= 38$; second year $n= 45$) were administered the CCTST and an investigator constructed nursing knowledge test prior to and after the students viewed eight videotaped vignettes depicting various clinical situations. The investigators concluded that there was a significant increase between the mean score of the pre (24.37, 25.30, $p= 0.01$) and post (31.51, 28.09, $p> 0.05$) nursing knowledge test. The post test CCTST scores increased slightly, however, the difference was not significant ($p > 0.05$).

Watson-Glaser Critical Thinking Appraisal. Watson and Glaser (1980) developed the WGCTA to measure an individual's critical thinking abilities. Critical thinking was defined by Watson and Glaser (1980) as an amalgamation of an individual's attitudes, knowledge and skills. The WGCTA measures an individual's critical thinking abilities in five subsets: inference, recognition and assumptions, deduction, interpretation, and evaluation of arguments. According to Watson and Glaser (1980), the following are definitions for each of the five subset abilities:

1. Inference was defined as the degree of discrimination between truth and falsity on statements given from the data presented.
2. Recognition of assumptions was based upon the ability to recognize presuppositions presented in the testing statements.
3. Deduction referred to an individual's ability to draw conclusions from information given.
4. Interpretation was the decision-making ability of an individual from the data presented.

5. Evaluation of arguments referred to the ability of the individual to distinguish between relevant (strong) and irrelevant (weak) arguments to the issue that is being presented (p. 2).

The WGCTA measures each of these subsets in separate tests (sections), which are identified by the various topic headings on the test.

The WGCTA consists of 80-items are based upon situations that are similar to those that could be encountered at work, school, or topics found in the media (Watson & Glaser, 1980). Items were considered to be neutral or controversial in nature. Neutral items consisted of subject content which there was generally not strong feelings or prejudices toward, such as the weather or scientific facts. On the other hand, controversial items, such as politics, economics, and social issues, may provoke strong feeling affecting how one critically thinks and responds (Watson & Glaser, 1980). There are two variations of the WGCTA: Form A and Form B. Each form contains items and content that are balanced and correlate with the total score which is ideal when administering a pretest and post-test (Adams, Whitlow, Stover, & Johnson, 1996). The reliability of the WGCTA has been assessed in numerous ways using a split-half reliability coefficient according to academic level, major, career, and geographic region (Watson & Glaser, 1980). The content and construct validity of the WGCTA have been examined in various settings and depends upon the extent to which it measures the specified objectives (Watson & Glaser, 1980). The WGCTA has been shown to possess high correlations with other academic measurements such as the Stanford Achievement Tests, the Otis and Otis-Lennon Mental Ability Tests, the California Test of Mental Maturity, Wechsler Adult Intelligence Scale, Miller Analogies Test, College Entrance

Examination Board, Scholastic Aptitude Test, and the American College Test (Adams et al., 1996; Watson & Glaser, 1980).

A longitudinal study by Vaughan-Wrobel, O'Sullivan, and Smith (1997) evaluated the critical thinking skills of baccalaureate nursing students of four classes enrolled between 1993 and 1996. A total of 391 students from a large metropolitan, southern city academic center participated in the study. Form A of the WGCTA was administered to each student prior to entering the junior year, at the completion of the junior year, and at completion of the senior year. There was a statistically significant difference ($p= 0.03$) in critical thinking ability if the student possessed previous nursing experience, and a positive correlation between the older student (age) and critical thinking ability ($r= 0.2$, $p< 0.001$). However, the study also concluded that the mean score attained on the WGCTA at each point in time did not differ significantly.

The differences of critical thinking ability and perception of decision-making ability in practice were evaluated by Girot (2000). In this study, 82 undergraduate nursing students with varying experiences (academic and clinical) from an academic center in the United Kingdom were divided into four groups. Group 1 consisted of 32 first year undergraduate nursing students. Group 2 consisted of 19 senior nursing students. Group 3 was comprised of 17 graduate practitioners who were experienced and held senior nursing positions. Group 4 consisted of 15 experienced practitioners who were entering into academia studies. All study participants in each of the four groups were given the WGCTA. Analysis of the data utilizing a one-way ANOVA found that there was no statistically significant difference ($F_{3,78}= 1.377$, $Mse= 2.24$, $p> 0.02$) in critical thinking skills across the four groups.

Daly (2001) conducted a descriptive-illuminative study that explored student nurses' critical thinking and reasoning processes. Forty-three undergraduate nursing students in the United Kingdom participated in this longitudinal study. The WGCTA was administered to each student at two different time intervals in the nursing program: 1 month and 18 months. Pre and post-test scores from the WGCTA were analyzed. Differences in mean scores and paired t-tests were not statistically significant ($df= 42, t=-0.265, p= 0.7920$). Results from this study suggested that there was no change in critical thinking abilities.

California Critical Thinking Skills Test and the Disposition Inventory. The CCTST was developed from the work of Facione (1990) which became the framework for the instrument. From the initial work, Facione was joined by his wife, Nancy Facione in the investigation of critical thinking in nursing (Facione, 1997). By profession, Peter Facione is a professor of philosophy and Nancy Facione is a nurse and nursing faculty member. The CCTST defines critical thinking as “the process of purposeful, self-regulatory judgment. This process gives reasoned consideration to evidence, context, conceptualizations, methods, and criteria” (Facione, Facione, Blohm, & Giancarlo, 2002, p. 2). The CCTST has three different variations: CCTST Form A (developed in 1990), CCTST Form B (developed in 1992), and CCTST 2000 (developed in 2000). The most current form is the CCTST 2000 which combined some of the established formats from Form A and Form B but also added new items in order to make the CCTST improved for evaluating a participant's critical thinking skills (Facione et al., 2002). The CCTST consists of 34-items that measure the participant's ability to draw conclusions in the areas of analysis, evaluation, inference, deductive reasoning, and inductive reasoning (Facione

et al., 2002). According to Facione et al. (2002), the following are the definitions of each of the five core areas:

1. Analysis is the ability to identify, examine, categorize, decode, clarify, and analyze inferential relationships.
2. Evaluation refers to an individual's ability to credibly assess statements and justify the reasoning.
3. Inference is the ability of an individual to identify elements, form conjectures and draw conclusion.
4. Deductive Reasoning means "the assumed truth of the premises purportedly necessitates the truth of conclusion" (Facione et al., 2002, p.6).
5. Inductive Reasoning means that the conclusion is supposedly justifiable by the assumed truths of the premises presented.

Each item is assigned to one of three subscales: analysis, inference, and evaluation. The subscales of deductive and inductive reasoning are derived from reclassification of 30 items. The items in the CCTST are considered neutral and are based on common situations, topics or issues encountered in daily living (Adams et al., 1996).

The reliability of the CCTST 2000 has been determined to be 0.78 to 0.80 using the Kuder-Richardson- 20 internal reliability coefficient which has significantly increased from 0.68 to 0.70 for CCTST Form A and 0.71 to 0.75 for CCTST Form B (Facione et al., 2002). Content, construct, and criterion validity have been established for the CCTST. The items on the CCTST are linked to the Delphi research and

conceptualization on critical thinking and have been shown to correlate positively to college level grade point average, Scholastic Aptitude math and verbal scores, and Nelson-Denny Reading scores (Adams et al., 1996; Facione et al., 2002).

According to Facione (1997), the CCTDI is an instrument that measures the habits (or dispositions) of the mind during the critical thinking process. The CCTDI is conceptually grounded in the results of the Delphi study and the consensus statement for critical thinking. The instrument consists of 75 items that require the participant to rate each item using a Likert scale, which assesses the amount of seven manifestations the participant possesses. The seven manifestations, or subscales, that are measured include “truth-seeking, open-mindedness, analyticity, systematicity, critical thinking self-confidence, inquisitiveness, and maturity of judgment” (Facione, 1997, p.1). The instrument is scored according to each subscale and also an overall score. Subscale scores range from 10 to 60 with an established standard score set at 40 (Facione, 1997; May et al., 1999). Subscale scores that are below the set standard of 40 indicates a weakness in the manifestation, whereas a score greater than 50 indicates a strength. An overall score is also computed. If the total score is less than 280, then the participant is considered to possess a serious deficiency in critical thinking dispositions. The reliability of the CCTDI is divided and reported as 0.90 overall and 0.72-0.80 for subscale Cronbach alpha coefficients. According to Facione (1997), there is a possibility that the seven manifestations of the CCTDI may or may not correlate with the five scales of the CCTST and is currently under further investigation.

Walsh and Hardy (1999) examined dispositional differences among third year college students at a mid-Atlantic public university. Three hundred thirty-four

baccalaureate undergraduate students in varying majors participated in the study and were divided into nonpractice and practice disciplines. Nonpractice disciplines included the following majors: English (n= 26), History (n= 23), Psychology (n= 66). Practice disciplines included five majors: Education (n= 54), English-Secondary Education (n= 17), History-Secondary Education (n= 18), Business (n= 82), and Nursing (n= 48). Each student completed the CCTDI during donated class time. Data were analyzed using the Cronbach alpha and a 2x6 factorial MANCOVA. Results reported Cronbach's alpha coefficients to be 0.9 for the overall score, and 0.56 to 0.77 for the subscale scores, which were consistent with the instrument's established norms. Results also reported a significant main effect on the overall score and subscale scores when compared to the student's major (Wilks $F_{40,1372} = 2.26, p \leq 0.01$). The study found that scores were highest in students majoring in English, Psychology and Nursing. Also, there was a significant main effect revealed when comparing genders, which revealed that female students scored higher on the subscale scores for open-mindedness and maturity (Wilks $F_{8,1372} = 3.16, p \leq 0.001$). However, when comparing majors and gender, no significant interactions were detected.

In a descriptive, longitudinal study, Thompson and Rebeschi (1999) compared entry and program completion critical thinking scores of 38 junior baccalaureate nursing students. Students were administered the CCTST and CCTDI at the end of the first semester of the junior year and again at the completion of the program. Data analysis of the CCTST scores demonstrated a statistically significant ($p = 0.006$) increase of mean scores from a mean of 15.97 at entry to a mean of 17.68 at program completion. In addition, the comparison of all five subscale scores demonstrated an increased, but none

were statistically significant. Data analysis of the CCTDI indicated a statistically significant ($p= 0.015$) increase between entry and program completion overall mean scores (323.9 vs 332.5). Also, the comparison of entry and program completion scores on the analyticity ($p= 0.009$) and truthseeking ($p= 0.002$) subscales were found to be significantly higher. The relationship between demographic variables (age, gender, ethnicity, GPA) and the scores from the CCTST and CCTDI were analyzed using the Pearson product-moment correlation. The only statistically significant relationship was a weak correlation between ethnicity and CCTST program completion scores ($r= 0.33$, $p= 0.04$).

Spelic, Parsons, Hereinger, and Andrews (2001) evaluated the development of critical thinking skills of 136 baccalaureate nursing students in varying tracks (accelerated $n= 68$, education and practice $n= 17$, traditional $n= 51$). The CCTST was administered to all subjects upon entry and completion of the nursing program. The investigators concluded that there was a statistically significant ($p\leq 0.01$) improvement of critical thinking on all subscale measurements and overall scores. However, the only exception was found with the accelerated nursing students analysis subscale score increased but did not reach significance ($p= 0.058$).

Evaluating one's critical thinking ability is important especially when the skill is an essential competency or outcome quality that should be possessed. In an attempt to measure the critical thinking skills of students before and after a baccalaureate nursing program curriculum revision, Beckie, Lowry, and Barnett (2001) measured the critical thinking of 3 groups of students. Group 1 consisted of 55 students who served as the baseline measurement of the class before any curriculum revisions. Groups 2 ($n= 55$) and

3 (n= 73) were the two classes who experienced the curriculum revisions. All students were given the CCTST at three points in the program: entry, midpoint, and exit. Repeated ANOVA measures were utilized to analyze the data. Investigators concluded that the total CCTST scores and each of the subscores were statistically significant: total CCTST score ($F= 10.04$, $p< 0.001$), analysis ($F= 7.96$, $p< 0.001$), inductive reasoning ($F= 9.28$, $p< 0.001$), deductive reasoning ($F= 6.20$, $p< 0.003$), inference ($F= 7.96$, $p< 0.001$), and evaluation ($F= 8.06$, $p< 0.001$). The conclusions of this study indicate the importance of assessing critical thinking abilities and the type of environment the student encounters as educators attempt to foster critical thinking skills.

Rapps, Riegal, and Glaser (2001) tested a model of cognitive development using knowledge base, critical thinking skills, critical thinking dispositions, and experience. In an attempt to account for the influence of education on cognitive development, a total of 232 practicing registered nurses participated in the study. All study participants were graduates from a Southern California nursing program between 1981 and 1994. Participants completed the CCTST and CCTDI. Data were analyzed examining the three levels of cognitive development: dualism, relativism, and commitment. Results indicated that critical thinking was only significant ($F_{2,228}= 19.375$, $p< 0.05$, r' change= 0.14) to the dualistic level of cognitive development. Results also revealed that the seven critical thinking dispositions contributed to the three levels of cognitive development suggesting that critical thinking develops with time and experience.

Learning Outcomes

In education, learning outcomes have been measured utilizing numerous methods. Determining whether learning outcomes have been achieved is an area that learners and

educators struggle with, especially when attempting to accurately evaluate the learning process. Particularly, Health Education Systems, Inc (HESI) is known for their comprehensive nursing examinations that predict one's potential for success on nursing licensure examinations. Items on the HESI exams were developed to test and measure the application and analysis levels on the cognitive levels of Bloom's Taxonomy (Launcher, Newman, & Britt, 1999; Morrison & Free, 2001). Morrison and Free (2001) discuss that there is a relationship that exists between test items written at these higher cognitive levels and the one's ability to critically think and make the judgment to answer the question. Therefore, through the use of the HESI exams, learning outcomes and critical thinking abilities can be assessed and measured.

Numerous studies have been conducted that examine the accuracy and predictability of the HESI exams among nursing students. Evaluating the effectiveness of a comprehensive nursing exam is vital in determining whether the exam and the exam items are actually testing and measuring the outcomes it was developed for. Launcher, Newman, and Britt (1999) examined the accuracy of the computerized HESI Exit Exam to predict licensure success of 2613 registered nursing students and 196 practical nursing students among 62 nursing schools. Students were administered the computerized HESI Exit Exam within 1 to 4 months of graduation. A questionnaire was sent to each participating school that assisted in determining the predictive accuracy of the exam, most specifically inquiring about the number of students who had been predicted to successfully pass, but actually failed the licensure exam. Data analysis revealed that the HESI Exit Exam was highly predictive ($p < 0.001$) in determining a students' success on their licensing exam.

Newman, Britt, and Launcher (2000) conducted a follow-up study on the predictive accuracy of the HESI Exit Exam. The study design was designed to replicate the previous study that was conducted by Launcher, Newman, and Britt (1999). However, during this study, 3,752 nursing (3,296 registered nurse and 456 practical nurse) students took the HESI Exit Exam during the first year of their schooling and within four months of their graduation from the program. Results revealed a significance ($p = 0.001$) in the accuracy of the HESI Exit Exam ability to predict licensure success. Students who performed poorly on the HESI Exit Exam were found to be at risk for failing the licensure exam then those students who performed highly on the Exit Exam. Since the study also looked at results from two testing periods, the study also revealed a significance ($p = 0.05$) that the Exit Exam could be utilized as a benchmark or guide for remediation and still attain licensure success.

Nibert and Young (2001) and Nibert, Young, and Adamson (2002) further examined the accuracy of the HESI Exit Exam to predict NCLEX success for graduating registered nurse nursing students. The results from both of these studies revealed similar results as the first two studies had concluded and therefore provided more evidence supporting the use of the HESI Exit Exam to not only be used as a predictor for licensure success, but also to be utilized as benchmarks for academic program progression and remediation.

Since, the measurement of learning outcomes is an essential evaluative component in assessing learning and HESI has a proven success and accuracy, this study chose to utilize the custom-made HESI exam to measure and evaluate the learning outcomes that occurred from the exposure to a particular learning activity.

High-fidelity Computer Simulation

One of the challenging endeavors for an educator is to plan learning activities that are realistic. Hotchkiss, Biddle, and Fallacaro (2002) examined the videotapes of crisis resource management performances on high-fidelity computer simulators. Forty-two nurse anesthesia students participated in the study. During the simulation time, each student encountered a crisis event. Each student's performance was evaluated and rated by these three reviewers who had substantial knowledge surrounding crisis resource management. Upon data analysis of the student performances, the study demonstrated satisfactory agreement among the 3 reviewers ($k= 0.75-0.90$) and that the case scenarios were realistic and highly valued.

Chopra, Gesnik, DeJong, Bovill, Spierdijk, and Brand (1994) studied 28 physician anesthetists and anesthesia trainees from one hospital to evaluate and determine the efficacy of a simulator as a training tool in anesthesia. Two simulator scenarios were created: anaphylactic shock and malignant hyperthermia. The performance of each participant was videotaped and evaluated using a standardized scoring tool. The study involved three phases. During phase 1, all participants were videotaped and their performance was scored and evaluated for the anaphylactic scenario. During phase 2, participants were divided into two groups and underwent training on the simulator: Group A trained on the anaphylactic scenario and Group B trained on the malignant hyperthermia scenario. Four months later, during phase 3, all participants were videotaped and their performance was scored and evaluated as they went through the malignant hyperthermia scenario. The researchers concluded that Group B responded much quicker and performed better than Group A in phase 3 since in phase 2, Group B

had experienced the malignant hyperthermia scenario in their simulation training.

Overall, the investigation concluded that training on a simulator improved performance when dealing with emergency situations.

Learning various technical medical skills is a standard component of medical education, however, the instructional methods is variable and dependent on the academic program. Owen and Plummer (2002) examined the learning and performance of endotracheal intubation skills of 115 participants, which included medical students (n=95), paramedics, and critical care medicine providers. All participants received a short course (75-90 minutes) on endotracheal intubation in the clinical simulation unit at Finders University School of Medicine in Australia which contained airway trainers and computer-controlled patient simulators. Group sizes ranged between one and five students. By completion of the short course, most participants (93%) were able to reach the standard to safely perform endotracheal intubation. After completion of the short course, participants completed a self-evaluation of the experience. Feedback regarding the experience was positive and that the experience was beneficial. Students also shared that they were more comfortable learning on a simulator than on a real patient. Researchers also concluded that the ideal group size was two students to one instructor. The only negative feedback that was received was that there should have been more time to practice.

Schwid, Rooke, Carline, Steadman, Murray, Olympio, Tarver, Steckner, and Westone (2002) evaluated the validity and reliability of realistic simulator scenarios. Ninety-nine anesthesia residents were videotaped and the clinical management on four simulated scenarios was evaluated. Each scenario was played on a mannequin-based

anesthesia simulator while the resident responded to the clinical needs portrayed through the simulator. Videotaped performances were analyzed and scored by three evaluators. Results suggested that the scenarios were realistic and that the reliability of internal consistency was very good ($\alpha= 0.71-0.76$). Results also supported moderate correlation of simulation scores with departmental faculty evaluations ($\alpha= 0.37-0.41$, $p< 0.01$). Overall, this study added a new dimension to assessing student performances and that no matter the level of the student, clinical errors are still made.

A cardiology review course for internal medicine residents was developed and implemented, and then learning outcomes and course effectiveness were evaluated in a study conducted by Issenberg, McGaghie, Gordon, Symes, Petrusa, Hart, and Harden (2002). Study participants included Group 1, which consisted of 67 second and third year internal medicine residents; and Group 2, which consisted of 155 fourth year medical students at the University of Miami, School of Medicine. Group 1 received a review course and Group 2 served as historical comparisons and did not receive a specific educational intervention. A pretest, which was developed to measure bedside cardiology clinical skills, was given to all study participants prior to beginning the review course sequence. The review course consisted of five, 2-hour sessions in an attempt to improve bedside skills. During each 2-hour session, the first hour was committed to instructor-based teaching and the second hour was committed to self-learning and practice. A cardiac simulator (Harvey the cardiology patient simulator) and the UMedic multimedia computer curriculum with 15 cardiac modules were utilized to cover and practice the bedside skills. At the conclusion of the review course, a posttest was administered to all participants. Both the pretest (27-items) and posttest (25-items) utilized a rigorous eight-

step procedure that required the participant to assess (auscultatory and nonauscultatory findings), identify, interpret, and correlate the clinical findings with cardiovascular disease. Analysis of the items and test demonstrated a reliability coefficient of .81 (pretest) and 0.84 (posttest). Results demonstrated that there was a 6.4-fold improvement in bedside skills which was large and significant ($p \leq 0.0001$) improvement when comparing pretest (S.D. = 1.97) and posttest (S.D. = 2.94) information of Group 1. Results also concluded substantial significance ($p \leq 0.0001$) when comparing posttest scores between Group 1 and Group 2. The study concluded that brief educational instruction featuring simulation and deliberate practice can result in large improvements in bedside skills.

Morgan, Cleave-Hogg, McIlroy, and Devitt (2002) compared experiential and visual learning methods in 144 undergraduate medical students from the University of Toronto. Subjects were randomized into 3 groups. Group 1 (n= 43) received the scenario myocardial ischemia, Group 2 (n= 48) received the anaphylaxis scenario, and Group 3 (n= 53) received the hypoxemia scenario. Pretest and posttests were given to each group and were constructed to include the recognition and management of the types of patients portrayed in each of the scenarios. Subjects from each group were randomly assigned to either a simulator or video group. The simulator group received a pre-programmed scenario on an anesthesia mannequin based upon their assigned scenario and were supervised by a faculty member or senior anesthesia resident. The video session group received a video presentation of a faculty member managing the scenario on the simulator. There was no difference in change of performance-based scores between the two groups ($F_{1,142} = 1.099$, $p = 0.296$). However, there was a significant

($F_{2,136} = 34.07$, $p < 0.001$) improvement between pretest and posttest scores for each scenario learned and tested for all groups. Finally, there was also significant ($F_{1,138} = 252.4$, $p < 0.001$) improvement between pretest and posttest scores regardless of the scenario that was tested.

Determining an effective type of instruction to be utilized in a learning activity is important for the educator in order to assure that learning objectives are met and that learning has occurred. Nyssen, Larbuisson, Janssens, Pendeville, and Mayne (2002) compared the effectiveness of utilizing computer screen based and mannequin-based simulators when training anesthesia residents. Forty anesthesia physician trainees (novices and more-experienced) in Belgium participated in the study and were divided into two groups (group 1 $n = 20$; group 2 $n = 20$). From each group, subjects were divided and half from each group received training on the mannequin-based simulator and the other half were trained on the computer-screen simulator. The study consisted of two phases. During phase 1, the participants were randomly assigned to an anaphylaxis scenario or to the malignant hyperthermia scenario (control scenario). Phase 2, occurred one month later, and both groups were exposed to the anaphylaxis scenario. Subjects were evaluated on their performance and patient management (treatment and diagnosis time) during both phases. The use of simulators significantly ($p < 0.05$) improved performance of the anesthesia trainees, however, the learning of management and treatment of simulated crisis situations did not significantly vary between the mannequin-based and computer screen-based simulators.

Gaba and DeAnda (1989) explored the responses of anesthesia trainees to simulated critical incidents. Nineteen (10 first-year and 9 second-year) anesthesia

residents from Stanford University School of Medicine participated in the study. During the study, subjects were exposed to five simulated critical incidents: endotracheal intubation, kinked intravenous line, onset of atrial fibrillation with hypotension, anesthesia machine breathing circuit disconnection, and cardiac arrest. Each subject's performance during the case scenario was videotaped. Prior to beginning the simulated scenario, each participant received a brief patient description, physical examination findings, and laboratory results. During the simulated scenario, the simulation director actively played the role of surgeon and circulating nurse and answered any questions that were posed by the participant. At the completion of the simulated scenario, each videotape was transcribed and response times for detection and correction of each problem encountered were recorded. Investigators concluded that there were different response characteristics for each of the different problems. However, the response of different individuals was highly variable with level of experience being a significant ($p= 0.03$) factor for correction, but not for the overall detection of problems.

In another study conducted by DeAnda and Gaba (1991), the role of experience in the response to simulated critical incidents was examined. Eight experienced anesthesiologists participated in the study. During the study, subjects were exposed to the same five simulated critical incident scenarios utilized in a previous study by Gaba and DeAnda (1989): endotracheal intubation, kinked intravenous line, onset of atrial fibrillation with hypotension, anesthesia machine breathing circuit disconnection, and cardiac arrest. During each scenario, response times for detection and correction of each problem encountered were recorded. Results suggested that experience facilitates a quicker reaction in a simulated critical incident but differences between experienced

anesthesiologists and second-year anesthesia residents were not significant. There was also high performance variability between incidents (unplanned errors and management flaws) within the group of experienced subjects.

Schwid and O'Donnell (1992) evaluated the clinical management of 30 anesthesiologists (10 residents, 10 faculty anesthesiologists, and 10 private practice anesthesiologists) on six simulated cases in conjunction with advanced cardiac life support guidelines. The six simulated cases included: a healthy patient that was at risk for gastric aspiration; an elderly, dehydrated patient with little myocardial reserve; a patient with an esophageal intubation; a patient with a history of coronary artery disease and stable angina who progressed to ischemia during anesthetic management; a patient in cardiac arrest; and a patient with a severe anaphylactic reaction. Study participants were tested on their management of the cardiac arrest according to advanced cardiac life support guidelines and patient outcomes of the six simulated patients. The study results demonstrated that only 40% of the subjects (n= 12) correctly diagnosed the anaphylactic reaction, 27% of the subjects (n= 8) adequately intervened and treated the myocardial ischemic patient, and 30% of the subjects (n= 10) managed the cardiac arrest patient appropriately. Since the timing of advanced cardiac life support training could be a predictor of successful management of the cardiac arrest patient, the time since the last training was collected. Data analysis concluded that 71% of those trained during the past 6 months actually managed the simulated resuscitation appropriately, whereas successful management decreased to 30% when advanced cardiac life support training had occurred during the past 7 months to 2 years. Based upon the results of the study, specifically the retention of standardized protocols, Schwid and O'Donnell (1992) recommended that

anesthesiologists should review emergency management techniques every 6 months in order to maintain the appropriate skill level to appropriately and effectively handle a crisis situation.

The effectiveness and feasibility of crisis resource management (CRM) training was examined by Howard, Gaba, Fish, Yang, and Sanquist (1992). Forty-six anesthesiologists, with varying years of experience, completed a pre-course questionnaire, a pre-course crisis management test, didactic instruction in anesthesia CRM, crisis management simulation training, a debriefing session, and a post-course crisis management test. Both the pre- and post-course crisis management tests covered principles and management of perioperative critical incidents. The study demonstrated that CRM training for anesthesiologists was feasible, participants enjoyed the course, and many thought it would improve their practice. Written test scores showed a significant improvement ($p < 0.05$) for the anesthesiologist with less experience. The results from the study also provided the foundation for instituting CRM training for anesthesiologists.

Kurrek and Fish (1996) evaluated the response of anesthesiologist to simulation-based anesthesia CRM. First, the study surveyed 150 anesthesiologists to assess their simulator experience and their attitudes concerning simulation. Fifty-nine surveys were returned and showed that there was strong support for simulator use. The survey also revealed that utilizing education with simulation was felt to be relevant. However, the survey also demonstrated that there was substantial anxiety when using and training on the simulator. The second part of the study actually involved 36 anesthesiologists who participated in a CRM course. Evaluation questionnaires of the course were very positive and supported the educational use of the anesthesia simulator.

After the favorable research supporting anesthesia education and training using the CRM model, the next step was to examine techniques used to assess the anesthesiologist's performance during critical events. Gaba, Howard, Flanagan, Smith, Fish, and Botney (1998) evaluated tools that measured the technical and crisis management behavior performance of 14 teams that were managing two crisis scenarios on an anesthesia simulator. Each team's performance was videotaped. Investigators reported that the measurement of technical performance was high, while the crisis management behavioral performance varied. Even though the study reported that the technical and crisis management behavior tools were not ready to assess competency, the tools could be used as a valuable educational tool to track a resident's clinical progress.

Presently, research is still being conducted in evaluating scoring tools for anesthesiology utilizing CRM and high-fidelity computer simulation. Weller, Bloch, Young, Maze, Oyesola, Wyner, Dob, Haire, Durbridge, Walker, and Newble (2003) conducted a study using accepted practice guidelines and a five-point global rating scale to evaluate 28 videotapes of simulated crises events. Videotapes were independently rated by three judges and then by five additional judges. There was good agreement among both groups of judges for management, behavioral attributes, and overall performance. The researchers also reported good inter-rater reliability when scoring the performance of the crisis events. However, the study concluded that further research utilizing high-fidelity computer simulation should be done in order to assess and measure clinical performance.

Jacobsen, Lindek, Ostergaard, Nielsen, Ostergaard, Laub, Jensen, and Johannessen (2001) investigated the performance of anesthesiologists managing anaphylactic

shock on a full-scale anesthesia simulator utilizing the principles of anesthesia crisis resource management. Study subjects consisted of 42 anesthetists (anesthesiologists and nurse anesthetists) and were paired into two-man teams consisting of one anesthesiologist and one nurse anesthetist. Each team attended a training session for the simulator. Next, each team's performance on the management of the critical incident of anaphylactic shock was videotaped in order for the performance of each team to be evaluated and also for debriefing. Team performances were evaluated by two trained observers and were graded based on a five-point scale and the anesthesia crisis resource management categories. Evaluation of the videotaped team performances indicated that 10 minutes into the simulation, none of the teams made the correct diagnosis or initiated the correct treatment. Only 29% (n= 6 teams) considered the right diagnosis after hints from the instructor 15 minutes into the performance. The total anesthesia crisis resource management score for general impression had a median value of 2.0 with normal range of 1-3. The researchers concluded that anaphylactic shock was difficult to diagnose, which indicated that the problem-solving process requires activation at the knowledge-base level and is a difficult and relatively slow process.

Evaluating the clinical performance of a health care provider is important in determining one's appropriate clinical actions. Along with evaluation also comes the importance of how realistic the evaluation situation is that is being encountered. Devitt, Kurrek, Cohen, and Cleave-Hogg (2001) conducted a study to determine whether the evaluation of assessing clinical performance utilizing a simulator-based approach could demonstrate construct validity and the perception of realism. Subjects consisted of 142 anesthesiologists (practitioners and students): 33 faculty (university-based)

anesthesiologists, 46 community-based anesthesiologists, 23 final-year anesthesiology residents, and 37 final-year medical students. None of the subjects had prior simulator experience. The study location was in the simulation center at the Sunnybrook Health Sciences Centre in Toronto, Ontario, Canada. The simulator used in the study was an Eagle Patient Simulator placed on an operating room table in a mock operating room with all the appropriate equipment. The operating room personnel included a research assistant acting as the circulating nurse and the surgeon was a mannequin with a speaker, which allowed for the simulation center director to respond to direct questions or ask a question for clarification purposes. Each subject received the same 90-minute simulation which involved active participation in patient evaluation, induction, and maintenance of anesthesia of a patient experiencing problems. Each subject was videotaped and their performance was scored on the seven items that evaluated problem recognition, formulated a medical diagnosis, and the initiation of treatment. For each item, each subject was evaluated and scored by one of two trained raters utilizing a scale from 0 to 2, with 0 equaling no response to the situation, 1 equaling undertaking a compensating intervention, and 2 equaling the correct treatment. Upon completion of the simulation experience, subjects rated the realism of the experience using a 10-point visual analog scale. The mean proportion of correct answers was statistically significant between the groups ($p < 0.0001$): anesthesia residents (0.54), faculty anesthesiologists (0.53), community-based anesthesiologists (0.38) and the medical student (0.15). Also, the visual analog scale overall realism score was 7.8, however there was no relationship between the simulator scores and the realism score ($R = -0.07$, $p = 0.41$). The researchers concluded that evaluation methods utilizing simulation were able to discriminate between

practice categories and demonstrated construct validity. The study also concluded that the simulation scenario was realistic which suggests that familiarity or comfort with the environment had little or minimal effect on performance.

Review of the Literature Summary

Analysis of the literature and of completed research studies, highlight several significant findings. First of all, the assessment of the use of measurement methods to evaluate a student's critical thinking ability demonstrate that there is inconsistent evidence for determining which is the best instrument to use. However, these inconsistent findings in the utilization of critical thinking measurement tools does support that further studies should be conducted, or that an instrument more specific to nursing education should be utilized. Secondly, even with the mixed findings on the use of various instructional methods and their effect on a student's critical thinking abilities, there is no strong conclusive evidence that supports one of the methods studied. Since the research conducted utilizing human patient computer simulation has been predominantly in medical education, the findings of the studies have been quite promising in regards to learning and management of patients. Therefore, it is time to examine the impact of various instructional strategies, such as HHPCS on undergraduate nursing students' critical thinking abilities and cognitive outcomes when presented with a learning activity.

Conceptual Framework

Learning is an individual phenomenon and dynamic process that occurs continuously throughout one's lifetime. Learning is knowledge, which progresses through a continuum from understanding, clarifying, and applying the knowledge that has

been acquired (Bradshaw, 2001; Norton, 1998). Cognitive learning theories are concerned with the mental processing of information and the relationship between the stimulus and response (Bradshaw, 2001; Knowles, 1990; Norton, 1998). For learning to occur, the learner must utilize the mental process of organizing the information being presented in order to understand it.

Carl Jung, a Swiss psychiatrist, believed that human behavior was not random but was predictable and could be classified (Jung, 1923). Jung examined the human consciousness and the cause and effect of human behavior. While studying human behavior, Jung (1923) found differences in behavior which were considered preferences to the basic functions performed throughout life. Preferences merge early in life and become the core of an individual's attractions and repulsions to people, events, and tasks for their entire life.

According to Jung (1923), all conscious mental activity is divided into four mental processes: "two perception processes (sensing and intuition) and two judgment processes (thinking and feeling)" (Lawrence, 1986, p.6). Information is perceived through a person's senses or intuition and brought into one's consciousness. In order for information to be used and remain in one's consciousness, a judgment process of thinking and feeling occurs which includes sorting, weighing, analyzing, and evaluating the perceived information (Lawrence, 1986). Learning does not occur automatically with the transfer of information from the teacher to the learner. A person learns through different preferences, which is important for the teacher to realize since each student possesses their own preference for the way they learn. Therefore, acknowledging the existence of

preferences is also an important consideration when selecting various teaching-learning strategies to be used in a learning activity.

Specific cognitive learning theories that relate to this research endeavor include the Assimilation Theory (Ausubel, 1978) and the Situated Learning Model (McLellan, 1996). Ausubel's Assimilation Theory (1978) describes the learner using a cognitive structure that stores old meanings and information but also provides a framework for the learner to use previous stored knowledge in an attempt to bring meaning to learning and utilizing new information. According to Ausubel (1978), meaningful learning can only be attained if:

1. A mental, cognitive set already exists which allows the learner to learn the task in a meaningful way.
2. The task being learned has a logical meaning.
3. The interaction of the new material with pre-existing cognitive structures containing specific and relevant concepts.

The instructional methods that are best created and utilized to facilitate meaningful learning related to the Assimilation Theory, are strategies that emphasize environments that are active, constructive, and goal-directed (Norton, 1998). The focus should be on changing the learner with the student being actively involved in the instruction and the learning process. This type of instruction not only engages the learner, but it assists the learner to concentrate and think about the content which enables the learner to interact with the material and begin to make relationships and links to concepts and principles (Norton, 1998).

The Situated Learning Model is based on the model of situated cognition (Brown, Collins, & Duguid, 1989). The model of situated cognition views knowledge as being contextually situated and is influenced by the activity, context, and culture in which it interacts (McLellan, 1996). Learning, using situated cognition, requires the learner to be actively engaged with the subject matter. Therefore, it is important to understand these implications when determining and selecting the instructional strategies chosen for a learning activity. McLellan (1996) describes eight key components for the situated learning model: 1) stories, 2) reflection, 3) cognitive apprenticeship, 4) collaboration, 5) coaching, 6) multiple practice, 7) articulation of learning skills, and 8) technology. According to McLellan (1996), the outcome of situated learning involves and includes:

1. Reasoning
2. Acting on situations
3. Resolving emergent dilemmas
4. Producing negotiated meaning
5. Solving problems

Applying learning theories to practice and to research is fundamental and necessary to insure that the learning activity has the intended and appropriate outcome for the learner. Understanding the complexities of how an individual learns is essential when planning learning activities and selecting instructional strategies to be employed.

Complexity Integration Nursing Theory

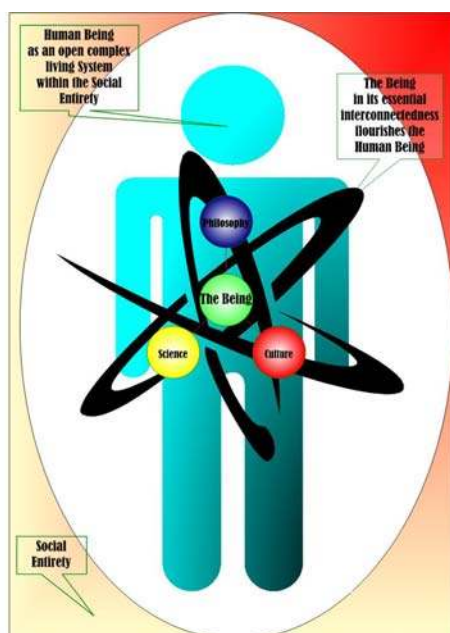
The Complexity Integration Nursing Theory characterizes the socialization process that occurs within the profession of nursing (VanSell & Kalofissudis, 2002). The

theory also relates to nursing students and their socialization into nursing practice. Overall, the theory provides a pathway to “socialize nurses into the profession, creating a world that can be perceived as objective and real by reaffirming the whole and real nature of our existence, by decoding the unconscious and promoting the meaningful interconnectedness with others” (VanSell & Kalofissudis, 2002, p.4-5).

According to VanSell and Kalofissudis (2002), the Complexity Integration Nursing Theory is unique to the science of nursing and is considered a metatheory which is comprised of the following four Nursing Grand Theories: 1) Theory of Nursing Knowledge and Practice, 2) Nursing Theory of Human Being, 3) Nursing Theory of Social Entirety, and 4) Self Observation Methodology. Figure 1 depicts VanSell and Kalofissudis’s (2002) model of metatheory.

Figure 1

Model of Metatheory



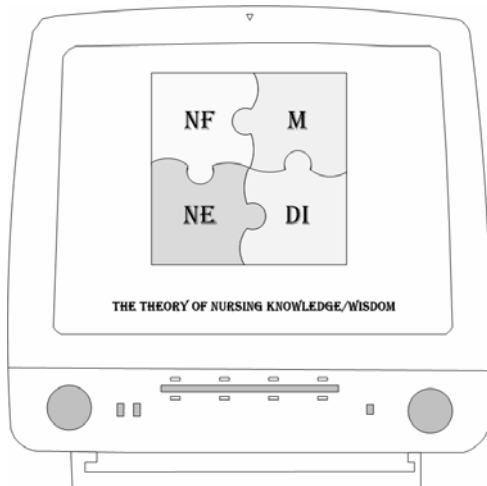
Note: From “The evolving essence of the sciences of nursing: the complexity integration nursing theory”, by S. I. VanSell and I. A. Kalofissudis, p. 155. Copyright 2002. Adapted with permission of the author.

Theory of Nursing Knowledge and Practice. In the past, educators had invested numerous endeavors into developing philosophical and conceptual frameworks that were specific to that particular program. As a result, multiple frameworks were produced which lead to variability among schools of nursing. Upon investigating the variation, VanSell and Kalfissudis (2002) state that a theoretical foundation that is applicable across nursing programs is missing. Therefore, the theoretical basis has emerged as the significant missing piece that is considered vital in the education process.

The Theory of Nursing Knowledge and Practice utilizes a global perspective of the science of nursing as it relates to nursing practice. The theory is portrayed as the intricacies, integration, and synthesis of nursing knowledge and wisdom into practice, which pivot around four diverse factors: nursing foundation, methodology, nursing essence, and disciplined inquiry. While each of these factors are separate elements in nursing practice, they are related to nursing knowledge and practice. Figure 2 illustrates the separate, yet linked relationships of the four factors. Nursing Foundation (NF) is defined as a combination of knowledge from nursing and associated disciplines (sciences and humanities). Methodology (M) is considered to be the problem solving process that would occur in a specific domain. Nursing Essence (NE) characterizes the evolution of nursing and accounts for the existence of conceptual and theoretical nursing models and theories. Disciplined Inquiry (DI) refers to the research and inquiry process. Each of these four pieces are unique, however, it is necessary that nursing possesses all four in order to support nursing practice (VanSell & Kalofissudis, 2002).

Figure 2

Four Factors of the Theory of Nursing Knowledge and Practice



Note: From “The evolving essence of the sciences of nursing: the complexity integration nursing theory”, by S. I. VanSelle and I. A. Kalofissudis, p. 151. Copyright 2002. Adapted with permission of the author.

The Theory of Nursing Knowledge and Practice utilizes inductive reasoning and is based on four inductive and two deductive premises (VanSelle & Kalofissudis, 2002).

The inductive assumptions include the following:

1. The collective nursing knowledge far exceeds the individual’s nursing knowledge. This premise allows for the existing nursing conceptual frameworks and theories to be recognized.
2. Each nursing professional must become a crusader for nursing science, which will assist in portraying the inconsistencies and bring about change.
3. Nursing knowledge is linked to and influenced by associated disciplines.

4. The uniqueness of the nurse researcher (scientist) influences clinical nursing practice (p. 29).

According to VanSell and Kalofissudis (2002), the deductive assumptions for the Theory of Nursing Knowledge and Practice include the following:

1. Scientific inquiry is valid when it is well-grounded “on principles or evidence and able to withstand criticism or objection” (p.30).
2. Nursing science is an evolutionary process that is linked to philosophy and associated disciplines which has resulted in a scientific base for nursing science.

Through the utilization of the Theory of Nursing Knowledge and Practice, one begins to see the relationship and the integration of the science and discipline of nursing into nursing practice. In nursing education, the theory is utilized when the “logic of critical thinking and the intuitiveness associated with professional nursing judgment” is taught (VanSell & Kalofissudis, 2002, p. 31). Finally, through the implementation and use of the Theory of Nursing Knowledge and Practice, nursing can be further developed.

The Theory of Human Being. In the Complexity Integration Nursing Theory, the human being incorporates philosophy, science, culture, and the being (VanSell & Kaloissudis, 2002). The human being is considered a complex, living organism that is an open system that continuously interchanges energy and information with the environment. Therefore, the human being in the Complexity Integration Nursing Theory is viewed as having “the potential to evolve into new dynamic networks” (VanSell & Kalofissudis, 2002, p. 41). As stated earlier, knowledge and cognitive development are

on a dynamic continuum during which examination, re-examination and recombination of the information occurs (Bradshaw, 2001; Norton, 1998; VanSell & Kalofissudis, 2002). The foundational construct of the human being is the search for meaning and knowledge. According to VanSell and Kalofissudis (2002), the human being is an adaptive, intelligent system in which the development of knowledge through the cognitive process should never reach equilibrium. If equilibrium is reached, inevitably death will occur since the development of knowledge has ended (VanSell & Kalofissudis, 2002).

The Nursing Theory of Social Entirety. The Nursing Theory of Social Entirety constitutes a social paradigm that expresses shared “concepts, values, perceptions, and practices which shape a specific vision of reality that is the underpinning of the way the nursing profession organizes itself” (VanSell & Kalofissudis, 2002, p. 61). In nursing practice, the patient (human being) and the nurse interact as two living systems. Energy is released by the nurse, received by the patient and transformed back to the nurse. The transformed energy “flourishes the nurse as an individual human being, flourishes the nurse’s social group, and continues into the social entirety” (VanSell & Kalofissudis, 2002, p. 69). Once the transformed energy is in the social entirety, it can transcend to the entire universe resulting in healthcare practices for the universe (VanSell & Kalofissudis, 2002).

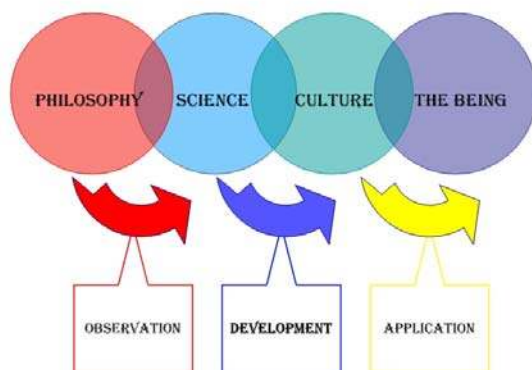
Self Observation Methodology. Self Observation is considered the process for organizing thought related to nursing practice (VanSell & Kalofissudis, 2002). According to VanSell and Kalofissudis (2002), the process of self-observation verifies the following:

1. Interrelation between the nurse and the human being (patient).
2. Immediate recognition of patient needs resulting in a deeper and more objective self-observation.
3. Identification of patient needs and execution of certain nursing practices.
4. Produces satisfaction of patient needs and the application of problem solving (p. 89).

See figure 3 for an illustration of the continuous flow of energy and interconnected components of the Self Observation Methodology.

Figure 3

Self Observation Methodology and Continuous Energy Flow



Note: From “The evolving essence of the sciences of nursing: the complexity integration nursing theory”, by S. I. VanSell and I. A. Kalofissudis, p. 156. Copyright 2002. Adapted with permission of the author.

The Complexity Integration Nursing Theory has strengths and weaknesses. The strength of the model would be that it accounts for the multi-dimensions of the nursing discipline and can be adapted and utilized in any field (clinical, administration, education). The theory also has strength within the interconnectedness of each of the

four Nursing Grand Theories and provides a framework around the central values, assumptions, concepts, propositions, and actions of nursing. However, a weakness that the model does possess is that it has not undergone any testing to determine its soundness. The Complexity Integration Nursing Theory is relevant to this study since cognitive outcomes and the utilization of various teaching-learning strategies are studied. It is essential that one understands the process of acquisition of nursing knowledge and how it is transferred and used in nursing practice.

Novice-to-Expert and Thinking-in-Action and Reasoning-in-Training

Patricia Benner's Novice-to-Expert theoretical model assists in detailing the progression of learning and the decision-making ability of the clinical practice of the nurse (Benner, 1984). Novice-to-Expert utilizes the Dreyfus model for skill acquisition and development, which in the Novice-to-Expert model is applied to nursing experience and clinical performance. The model is comprised of five stages through which one progresses: novice, advanced beginner, competent, proficient, and expert. At each stage, the learner possesses various learning behaviors and attributes (Benner, 1982, 1984, 2000; McKane & Schumacher, 1997; Schumacher, 2004). Learning behaviors and attributes of each stage are outlined in Table 2.

Another approach to learning and critical thinking in nursing practice is outlined in Benner, Hooper-Kyriakidis, and Stannard's (1999) Thinking-in-Action and Reasoning-in-Transition approach. This approach utilizes practical reasoning in an evolving clinical situation. Practical reasoning is a movement from poorer to better understanding in anticipation that errors will be reduced, limitations will be clarified, or possibilities will be encouraged.

Table 2

Novice-to-Expert Learning Behaviors and Attributes

Novice

No experience

Performance is governed by rules

Behavior is inflexible and limited

Advanced Beginner

Prior experience required for recognition of information

Task oriented

Operates according to general guidelines

Needs assistance in setting priorities

Recognizes and applies learned theory in the clinical setting

Competent

Organizes and prioritizes care appropriately

Carries plan of care out consciously and efficiently

Possesses a sense of mastery

Manages and copes with numerous clinical episodes

Sets goals for plan of care

Lacks speed and flexibility

Proficient

Perceives the situation as a dynamic whole

Provides insightful patient care

Learns from experience

Learns inductively

Analyzes patient findings

Suggests possible therapeutic interventions

Expert

Grasps things intuitively

Not reliant on an analytical principle

Draws on past clinical experiences

Makes abstract applications

Anticipates complications and other possibilities

Note. From "Simulation In Critical Care Nursing Education: Conceptual and Practical Perspectives", by L. B. Schumacher, 2004, W.F. Dunn (Ed), *Simulators in Critical Care and Beyond*, p. 115. Copyright 2004 by the Society of Critical Care Medicine. Adapted with permission of the author.

The Thinking-in-Action approach incorporates and utilizes an individual's clinical knowledge, judgment, and performance which are evident through the possession of clinical approaches and goals. The clinical approaches or styles of practice that one utilizes are expressed by Habits of Thought, whereas clinical goals and concerns are expressed as Domains of Practice (Benner et al., 1999; Schumacher, 2004). Each contain characteristics that professionals should exhibit which are outlined in Table 3.

Each characteristic in the Domains of Practice encompasses unique clinical goals and concerns. The domain of Diagnosing and Managing Physiologic Function is best characterized by the clinical goals and concerns focused around crisis management, resuscitation, maintaining vital function and physiologic stability, and maintaining multiple immediate interventions. The clinical goals and concerns for Managing a Crisis domain include organizing the management of a crisis, managing multiple and rapid interventions, recognizing and delegating skills to effectively manage a crisis situation, and being sensitive and able to adjust emotional responses to support the situation at hand. The domain of Providing Comfort is best portrayed by the clinical goals and concerns of caring, providing balanced care for the total well-being, taming the environment, building trusting relationships, and providing complementary and holistic rituals. Caring for Families encompasses the clinical goals and concerns of family involvement in care and the presence of families and providing information. The domain of Preventing Hazards focuses on using equipment properly and engaging in safe-work practices. Caring for the Family and Client at the End-of-Life includes the clinical goals and concerns focused around organizing a reasonable level of care, making decisions, providing palliative care, and the death and dying experience. The domain of

Communicating Multiple Perspectives is best portrayed through skillful communication techniques, the development of new clinical knowledge, and team building strategies.

Monitoring Quality is comprised of three clinical goals and concerns: preventing and managing interruptions in practice, resolving conflict, and repairing and redesigning work environments and work flow. The last domain of Practice is Monitoring and Clinical Leadership which consists of clinical goals and concerns centered around facilitating the professional development of others, coaching and mentoring, collaborating and networking, and transforming clinical practice (Benner et al., 1999; Schumacher, 2004).

Reasoning-in-Transition is an ongoing, dynamic process that is experienced by every nurse in every clinical situation they encounter (Benner et al., 1999).

Understanding and dealing with the situation at hand is managed by utilizing the process of Reasoning-in-Transition which incorporates one's critical thinking, decision-making abilities, and experience. As one develops these skills and better understands the reasoning behind their motives, then the skills in practical reasoning will improve (Benner et al., 1999).

Both the Thinking-in-Action and the Reasoning-in-Transition approach promote the critical thinking abilities, decision-making process, and professional development of an individual. However, one's critical thinking abilities, decision-making abilities, and professional growth is a continuing process that evolves through learning and experience.

While the Novice-to-Expert model and the Thinking-in-Action and Reasoning-in-Transition approach present various stages and characteristics one acquires and develops in order to make decisions, there is a connection to one's critical thinking abilities. In order to effectively teach and provide insight and guidance as one is learning or being

mentored in the nursing clinical process, it is essential to comprehend the facets that comprise the process of critical thinking. Therefore, aspects from the Novice-to-Expert model and the Thinking-in-Action and Reasoning-in-Transition were considered and incorporated into the planning of the learning activities that will be utilized in this research.

Table 3

Thinking-in-Action Habits of Thought and Action and Characteristics of Domains of Practice

Habits of Thought and Action

Identification of a problem which leads to problem solving

Anticipation and prevention of clinical problems

Domains of Practice- Clinical Goals and Concerns

Diagnosing and Managing Physiologic Function

Managing a Crisis

Providing Comfort

Caring for Families

Preventing Hazards

Caring for the Client and Family at the End-of-Life

Communicating Multiple Perspectives

Monitoring Quality

Mentoring and Clinical Leadership

Note. From "Simulation In Critical Care Nursing Education: Conceptual and Practical Perspectives", by L. B. Schumacher, 2004, W.F. Dunn (Ed), *Simulators in Critical Care and Beyond*, p. 116. Copyright 2004 by the Society of Critical Care Medicine. Adapted with permission of the author.

Crisis Resource Management

Managing a crisis is a dynamic process that involves critical thinking and decision-making. Critical thinking and the decision-making process are key components of clinical nursing practice and should enable one to respond in a crisis situation. In order to critically think and make decisions, one must possess the knowledge and skills of managing and providing care for a patient population. Unfortunately, the possession of knowledge and skills in a crisis situation is not enough. In a crisis, the entire situation must be managed including the patient, environment, equipment, and the health care team.

Crisis management is not new or unique. The models for medical crisis management were founded in aviation and nuclear power (Gaba, Fish, & Howard, 1994). As it is used in these industries, crisis management has been examined in an attempt to optimize human performance and maximize safety. From the accident at Three Mile Island, the nuclear power industry demonstrated the relationship between safe performance and human factors. Assessing and optimizing human performance has been evident in early military aviation prior to World War II based on the desire of pilots to stay alive while flying. From this desire, the stimulus has intensified to study human performance issues in commercial and military aviation crews and air traffic controllers. Gaba et al. (1994) and Howard, Gaba, Fish, Yang, & Sarnquist (1992) provide an example from 1979 when 60 airline accidents were examined. Data were collected and analyzed from the cockpit voice and flight data recorders. The analysis revealed that there were lethal decision-making errors and problems with communication, delegation, leadership, judgment, and team work (Gaba et al., 1994; Howard et al., 1992). Flight

simulation studies were also conducted and suggested that “many problems encountered in the cockpit are not due to lack of flying skills, but to the crew members’ inability to use resources which are readily available to them” (Howard et al., 1992, p. 764). As a result, the military, the National Aeronautics and Space Administration (NASA), and the commercial airline industry developed and embraced the training philosophy of cockpit (now entitled crew) resource management (Gaba et al., 1994; Howard et al., 1992). In cockpit resource management training, “crews are instructed not only in the ‘nuts and bolts’ of managing crises such as engine fires, but also in how to manage their individual and collective resources to work together optimally as a team” (Gaba et al., 1994, p. 7).

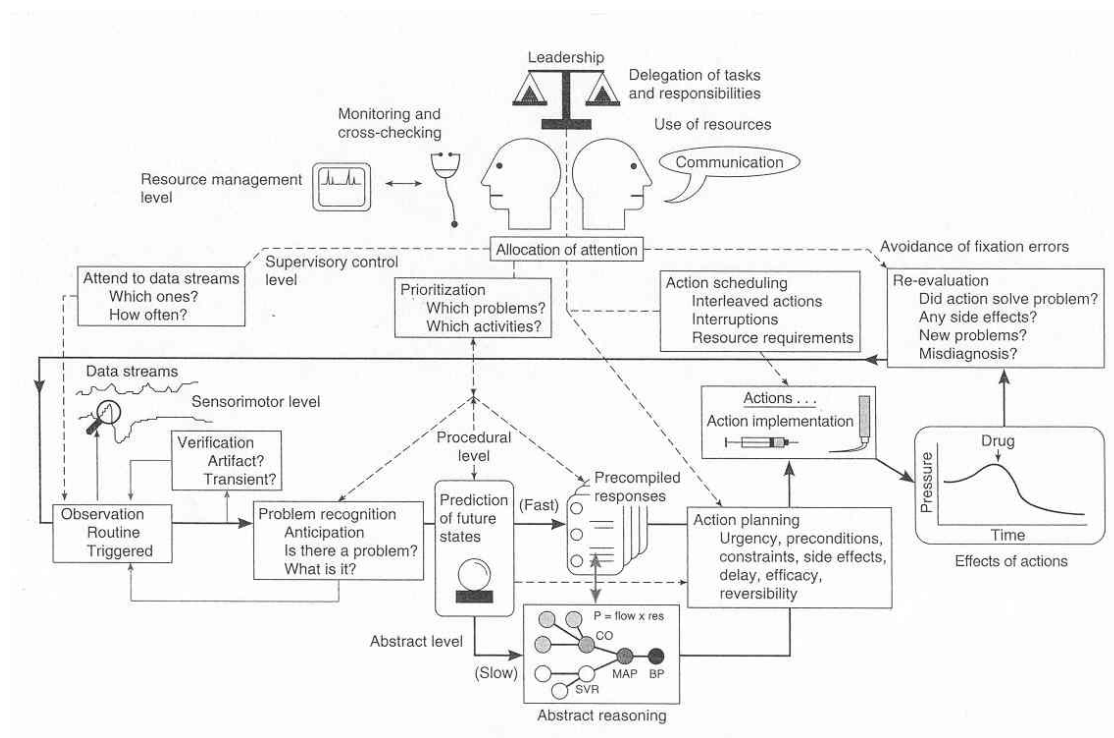
In the medical realm, crisis management and poor outcomes have been seriously scrutinized with emphasis placed on human error. Sixty-five to seventy percent of anesthesia incidents and accidents have been shown to be attributed to human error (Howard et al., 1992). Anesthesiology has been paralleled to the aviation industry due to its complex, dynamic nature and the importance of optimizing human performance while maintaining patient safety. Since the cockpit resource management strategy was having a positive impact on the aviation industry, leaders and practitioners in anesthesia developed the concept Crisis Resource Management (CRM) and the decision-making theory.

In the early 1990s, CRM was first conceptualized for healthcare use in anesthesiology through training programs and courses. In CRM, the following are emphasized: leadership, delegation, assessment, communication, monitoring and cross-checking, avoidance of preoccupation, and use of resources (Gaba et al., 1994; Howard et al., 1992). Initial program and course evaluations were favorable and assisted in identifying the concepts and structuring a conceptual model.

Gaba et al. (1994) developed a comprehensive model of dynamic decision-making and crisis resource management. The model “involves parallel processing and multitasking at multiple levels of mental activity, with a primary loop of observation, decision, action, and re-evaluation” (Gaba et al., 1994, p. 18). Figure 4 provides an illustration of the model utilized in anesthesiology.

Figure 4

Crisis Resource Management Model



Note: From *Crisis Management in Anesthesiology*, by D. M. Gaba, K. J. Fish, and S. K. Howard, p. 19. Copyright 1994 by Churchill Livingstone. Permission for use granted by publisher.

Gaba et al. (1994) developed a comprehensive model of dynamic decision-making and crisis management. The model “involves parallel processing and multitasking at multiple levels of mental activity, with a primary loop of observation,

decision, action, and re-evaluation” (Gaba et al., 1994, p. 18). See figure 4 for an illustration of the model (Gaba et al., 1994, p. 19).

The model is based on the concepts of crisis and decision-making. In this instance, crisis is defined as “a brief, intense event or sequence of events that offer a clear and present danger to the patient...and requires an active response to prevent injury to the patient” (Gaba et al., 1994, p.5). Decision-making is a complex, intrinsic, cognitive process that “involves both the typical decisions of routine care and the non-routine decisions made during the management of problems or crises” (Gaba et al., 1994, p. 17). Decision-making is a mental activity, and for the anesthetists, they must be able to operate multiple levels simultaneously. For example, an anesthetist during a surgical procedure will use the levels of sensorimotor, procedural, and abstract reasoning. Processing information simultaneously on all three levels is known as parallel processing and the ability to perform the various tasks or activities on all three levels is known as multitasking. The sensorimotor level includes activities that require minimal conscious control and are highly integrated patterns of behavior. The procedural level encompasses those activities that are subroutine, yet the anesthetist is familiar or has had past practice experience with the activity. On the other hand, the abstract reasoning level refers to recognition-primed decision-making and is used when the anesthetist is in an unfamiliar situation with no well-practiced experience. The CRM also has a metacognition level which includes supervisory control and a resource management which allows for one to control their own mental activities and command and control available resources (Gaba et al., 1994).

The CRM model interrelates to the Complexity Integration Nursing Theory and the Novice-to-Expert and the Thinking-in-Action and Reasoning-in-Transition approaches by virtue of the characteristics one should possess in order to critically think. Also, the CRM model directly relates to the purposed research in regards to the decision-making process during a crisis. The learning activities being utilized in this study incorporate emergent cardiovascular or respiratory events which will require the cognitive process outlined in the CRM in order for prioritization, a clinical judgment to occur and a decision to be made during the context of the learning activity. Ultimately, the decision-making process will be evaluated and measured as a critical thinking score.

Summary

Beginning with the fundamental essentials surrounding cognition and learning, one begins to understand the complexity of learning. It is essential that one has an appreciation and comprehension of learning theories and frameworks in an attempt to make learning meaningful. By incorporating theoretical concepts and principles into one's plan, one can then best determine the appropriate instructional strategies to be utilized during a learning activity. The premise of this research is to utilize three instructional strategies in various learning activities in an attempt to compare and contrast critical thinking abilities and learning outcomes in beginning undergraduate nursing students.

All three of the conceptual models mentioned above have an application and a role in nursing education. While presented separately, the broad theoretical overviews and concepts from each may certainly be linked to essential aspects of nursing education and clinical practice. For instance, learning about a specific medical problem and how to

provide appropriate care and manage this type of patient begins with learning about the problem. Once this cognitive process has occurred then the socialization into nursing practice begins which is described in the Complexity Integration Nursing Theory (VanSell & Kalofissudis, 2003). The Complexity Integration Nursing Theory may also be linked to Patricia Benner's Novice to Expert theory and to the Thinking-in-Action and Reasoning-in-Training approach through the socialization process of the nursing student transitioning to the novice professional nurse. CRM is also linked to each of the conceptual models presented through the division of the major concepts of crisis and decision making into the smaller components which are incorporated and utilized throughout the model. CRM is also intrinsically linked to the cognitive nature of information processing and decision making.

Unfortunately, a paucity of research concerning the linking of critical thinking abilities, high-fidelity computer simulation, and cognitive outcomes is available. The concepts of learning, integration socialization, and decision making possess elements and are strongly connect to the process of critical thinking. When critically reflecting on the concepts presented, one is definitely able to understand how each is connected and relates to clinical practice and education. Therefore, it is the purpose of this research to begin to link some of these inconclusive interests and conclusions to nursing education.

CHAPTER III

METHODS

Design

This study is a descriptive, quasi-experimental study that compared learning outcomes and critical thinking abilities of three undergraduate nursing students groups utilizing three instructional strategies in three separate learning activities. The design is quasi-experimental in nature due to the absence of a control group. However, the design for this study utilizes a comparison group instead of a control group since the groups are receiving different treatments and therefore, control is present by comparison (Polit & Hungler, 1995).

All subjects enrolled in the study completed a 60-item, custom-made HESI exam (pretest) which included specific content related to the subject matter of the learning activities: myocardial infarction (20 questions), deep vein thrombosis leading to pulmonary embolism (20 questions), and shock which included anaphylactic and hypovolemic (20 questions).

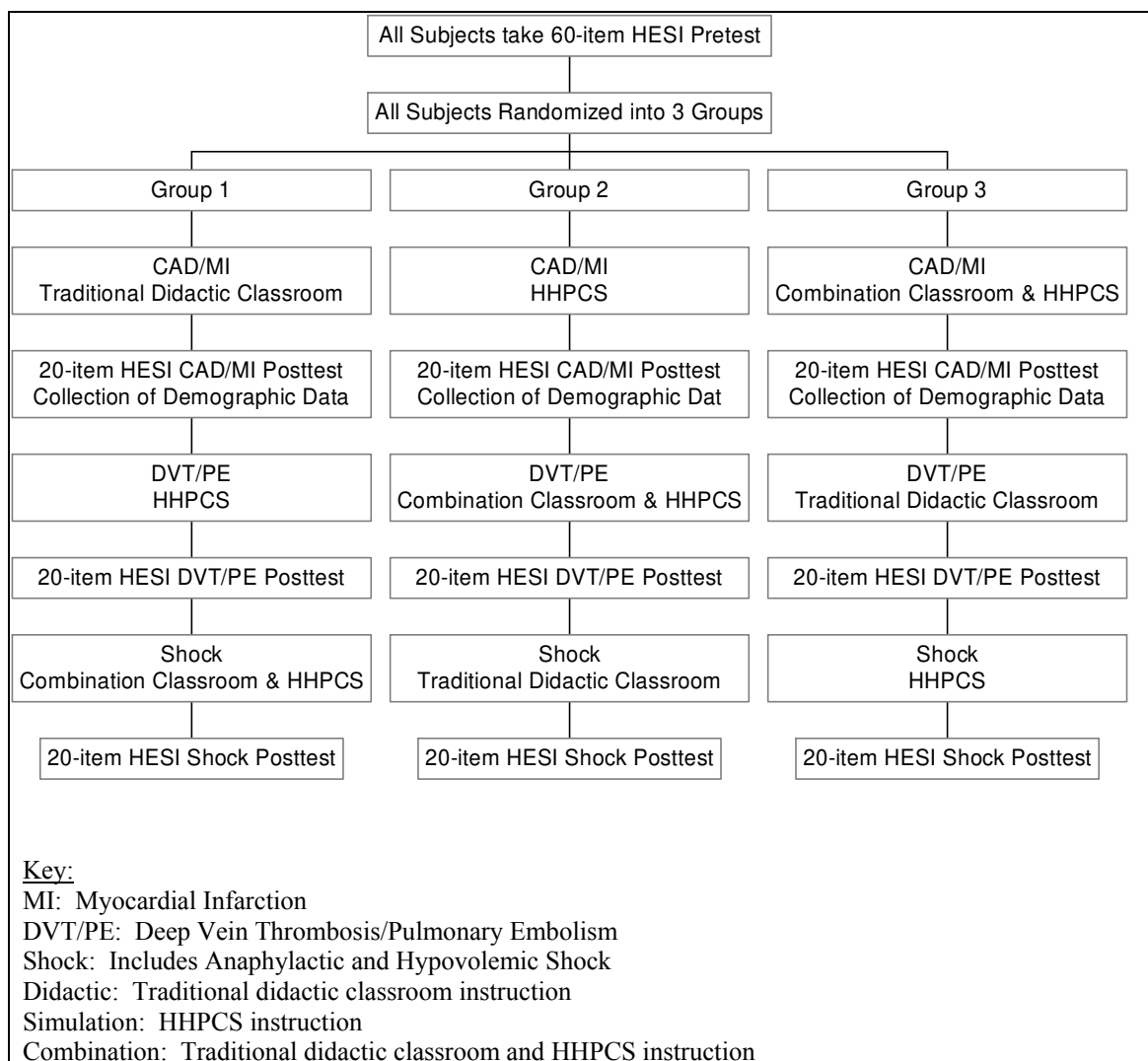
After completing the pretest, subjects were randomly assigned to three treatment groups in an attempt to equalize differences in critical thinking. Randomization will occur through a block rank ordering technique based on the initial critical thinking score from the 60-item, custom-made HESI exam. All subjects' critical thinking scores were ranked from highest to lowest. Next, the subjects' critical thinking scores were randomized into the three treatment groups using a blocking technique composed of a grouping of 3 subjects until all subjects had been assigned to a treatment group. By utilizing the rank ordering strategy and then applying randomization, each treatment

group contained a representation of a range of critical thinking scores to assure that not all the high or low scoring students have been assigned to the same treatment group.

Once the subjects were randomly divided into three groups, each group rotated through three learning activities which illustrated the nursing care of clients experiencing an emergent cardiovascular or respiratory event using one of three instructional strategies. The three emergent cardiovascular or respiratory events included the conditions of myocardial infarction, deep vein thrombosis leading to pulmonary embolism, and shock (anaphylactic and hypovolemic). The learning activity was delivered to subjects during a three-week time frame at the beginning of the fall academic semester. For each learning activity, the same emergent event was presented to the three groups, however the instructional strategy varied from group to group: one group received traditional didactic classroom instruction, while the second group received the presentation of the emergent event through the use of HHPCS instruction, and the third another group received a combination of traditional didactic classroom and HHPCS instruction. Immediately after completion of each of the three learning activities, subjects completed a 20-item, custom-made HESI exam (posttest) which included the exact questions that were presented on the pretest however, the questions on the posttest pertained only to the content presented during the learning activity. Subjects completed a total of four tests during the study: one 60-item pretest and three 20-item posttests. Figure 5 contains a schematic diagram of the study's design.

Figure 5

Diagram of Study Design



Subjects

From a potential pool of 98 beginning junior baccalaureate nursing students, a minimum of 30 students were sought and invited to participate in the study. Subjects were recruited through a verbal announcement by the researcher during a nursing class in which all 98 students were enrolled (NXX2: Pathophysiology and Pharmacology). Recruitment of students was timely since the topics presented during each of the learning

activities for the study occur later in the semester during normal classes. Inclusion criteria included completion of the initial summer nursing course (NXX1: Principles of Professional Nursing Practice) and current enrollment as a junior nursing student during the Fall 2004 semester. No exclusion criteria existed. After informed consent was obtained, subjects received information from the researcher regarding dates and times that had been arranged for the pre-test to be administered.

Next, subjects completed the 60-item custom-made HESI exam. Once the pretest has been scored and the individual critical thinking scores were available, subjects were randomized into 3 groups with a minimum of 10 subjects in each group. The number of subjects for this study was based upon considering the past simulation research conducted. Most studies contained less than 50 participants or contained simulation groups of fewer than 10 subjects (Chopra et al., 1994; DeAnda & Gaba, 1991; Gaba & DeAnda, 1989; Jacobsen et al., 2001; Nyssen et al., 2002; Owen & Plummer, 2002; Schwid et al., 1992). Even studies with small sample sizes, statistically significant results were reported (Gaba & DeAnda, 1989; Nyssen et al., 2002). Also, another reason for the smaller number of study participants was due to the feasibility of a 'hands-on' component that is needed for each participant when utilizing simulation. Smaller group size is necessary in an attempt to provide an active, hands-on learning experience for each participant.

Assessment of the Learner/Study Subject

The subjects were second semester, junior nursing students enrolled in a baccalaureate nursing program in the Southeastern United States. The only nursing course that the student had previously completed was the summer fundamentals course

(NXX1). For the learning activities to be effective, the learner had not been exposed to the nursing concepts and principles taught in the learning activities of this research study.

Setting

The study took place on the campus of a baccalaureate nursing school in the Southeastern United States. A classroom was obtained on the campus for each of the scheduled times for the traditional didactic classroom instruction of the three learning activities being presented: myocardial infarction, deep vein thrombosis leading to pulmonary embolism, and shock (anaphylactic and hypovolemic). The classroom had PowerPoint and computer projection capability and was able to comfortably accommodate the subjects.

The HHPCS instructional component of the three learning activities was convened in the simulation laboratory where the Human Patient Simulator is housed. In the simulation laboratory, the lighting is bright and the temperature of the room is cool and adequate for learning. The cool temperature is due to the computer equipment necessary to run the simulator. The cool temperature may be a constraint for the learner initially, however once engaged in the simulation, the learner usually becomes active and room temperature does not seem to be an issue. Subjects were informed prior to coming to the simulation lab that the temperature of the room might be cool and to bring a sweater or another type of garment for their own comfort. The simulation lab is adequate size and contains a Human Patient Simulator, positioned on an operating room bed in the middle of the room. Also, there is cardiac monitoring, hemodynamic, and essential emergency equipment in the room. The disadvantage of providing instruction in the simulation lab is

the small size of the room and the inability to accommodate a large group of students which possibly could make learning less effective.

The HESI pretest and posttests were completed in the computer lab located on the campus of the School of Nursing. Testing dates and times varied and depended upon the scheduling of group's learning activity.

Framework of Study Site's Nursing Curriculum

The framework of the study site's undergraduate nursing curriculum is a key component of this study's overall design and the planning and implementation of the three learning activities. The curriculum focuses on nursing across the lifespan (beginning family, young family, middle family, and the mature family) and focuses on health, which is the dynamic state of being and influences the relationships and interactions of the individual, family, and community. Therefore, nursing students will learn basic foundational concepts and principles during the learning activities that they will be able to utilize throughout the entire nursing program, preparing and taking the licensure examination, and into their profession after completion of the nursing program. The program consists of five sequential semesters of course and clinical work that utilize and build upon previous learned knowledge from the areas of Humanities, Mathematics, Natural Science, Social Science, History, Anatomy, Physiology, Chemistry or Biology, Microbiology, and Human Growth and Development (MCG, 2003a). Upon completion of the program, graduates receive the degree Bachelor of Science in Nursing and are eligible to take the licensure examination (NCLEX) for the professional registered nurse.

The nursing philosophy at school of nursing, as it relates to this study, incorporates the following beliefs into the definition of nursing and the development of curricula:

1. Nursing is a practice-based discipline that promotes optimal health across the lifespan in which nurses exercise clinical judgment to provide care effectively and efficiently. Nursing practice is caring, sensitive to diversity, and accountable to the profession and society.
2. The nurse works independently and collaboratively with other health professionals to promote wellness and manage responses to illness. The diversity and complexity of changing health care systems requires professional nurses who think critically and creatively in providing comprehensive health care services to individuals, families, and at aggregate levels. Nursing is in a key position to promote change in health care delivery.
3. Learning is a lifelong dynamic process. Student's life experiences, educational and professional goals, as well as the requirements for professional nursing, are incorporated into the teaching/learning process. This process, which enhances the learner's acquisition of professional knowledge, skills, and attitudes, involves interaction between the learner and teacher with mutual responsibility and accountability. Faculty serve as facilitators and models of competence in nursing practice (MCG, 2003a, p. 2).

Taking into consideration the above beliefs as they relate to this study, and in order for the nursing student to be able to understand the needs of the types of clients presented in the three learning activities, the student will need to be able to: 1) assess the client, 2) plan appropriate nursing care for the client, and 3) evaluate the nursing care delivered based on the individual health needs of the client. If the student understands and comprehends these concepts and principles, then the student will be better able to understand needs and concerns and make clinical decisions in an attempt to achieve the highest level of health possible for that individual.

Curriculum Design

The curriculum design of the nursing program builds on basic concepts of life in the behavioral sciences, physical sciences, and humanities that the students have attained prior to entering the nursing program in their junior year (MCG, 2003b). Upon entering the nursing program in the summer, students are enrolled in a fundamentals course (NXX1), which covers physical assessment skills, nursing process, and basic nursing skills. During the fall and spring semester of the junior year, the basic concepts of life are integrated into many nursing concepts and principles, which are covered in sequential pathopharmacology courses (NXX3 and NXX7), lifespan nursing courses (NXX4, NXX5, NXX8, and NXX9), and sequential nursing foundation courses (NXX2 and NXX6) (See figure 6 outlining the curriculum schema). The lifespan courses are taken in a combined sequence of either NXX4 and NXX5 or NXX8 and NXX9. Appendix A contains detailed course descriptions of the aforementioned courses offered during the program.

Each of the junior courses provides continuity threads for the remainder of the nursing program. During the senior year, the sequence of courses is designed for further synthesis, utilization, and analysis of nursing concepts and principles along with the development of leadership and management skills of a beginning professional nurse. See Appendix A for detailed course descriptions.

Figure 6

School of Nursing Curriculum Schema

SUMMER	FALL	SPRING
Junior NXX1 Principles of Professional Nursing Practice	NXX2 Foundations I NXX3 Pathophysiology and Pharmacology I NXX4 Lifespan I ← NXX5 Lifespan II ←	NXX6 Foundations II NXX7 Pathophysiology and Pharmacology II NXX8 Lifespan III → NXX9 Lifespan IV →
Senior	NX10 Foundations III NX11 Professional Nursing Management NUR Elective	NX12 Foundations IV NX13 Professional Nursing Practice NUR Elective

Instructional Strategies

Three instructional strategies were utilized during this study: traditional didactic classroom, HHPCS, and a combination of traditional didactic classroom and HHPCS instruction. Each subject received all instructional strategies which were provided and

delivered by the researcher. The content covered during each specified learning activity utilized the three instructional strategies to illustrate the nursing care of clients experiencing an emergent cardiovascular or respiratory event: myocardial infarction, deep vein thrombosis leading to pulmonary embolism, and shock (anaphylactic and hypovolemic).

Learning Activity Plans

The content for each of the learning activities focused on the student's ability to process information. According to Norton (1998), cognitive learning methods such as information processing theories and Ausubel's Assimilation Theory are needed in order to assist with acquiring, organizing, and analyzing the data presented during a learning activity. Therefore, in order to deliver the essential content for each learning activity in this study, it was essential that the activity be organized to the extent that the student might acquire the knowledge needed. Since the student had been exposed and presumed to have a basic understanding of the nursing process, they should be able to take the learned concepts, understand the information that was presented, initially analyze any data collected, make clinical judgments and decisions, and evaluate the effectiveness of actions taken.

This study utilized three learning activity plans: myocardial infarction, deep vein thrombosis/pulmonary embolism, and shock (anaphylactic and hypovolemia), which are found in Appendix B. Each learning activity plan includes essential content that was delivered to the subjects during the study and is listed under the headings of objectives, topic outline, teaching strategies, method of evaluation, and student assignments. The objectives listed on each learning activity plan refer to Bloom's Taxonomy of Cognitive

Domain Educational Objectives (Bloom et al., 1956). Even though the instructional strategy employed during each learning activity differed among the groups, the essential content delivered, remained the same.

Instructional Strategies Utilized

This study utilized three instructional strategies to illustrate the nursing care of a client experiencing an emergent cardiovascular or respiratory event during the learning activity. The three instructional strategies used during the study included: traditional didactic classroom, HHPCS, and a combination of traditional didactic classroom and HHPCS instruction. All instruction and presentation of the essential content for each learning activity was presented by the researcher in an attempt to maintain consistency with the content delivered. From previous experience, the presentation of the essential content for each learning activity was estimated to occur over 50-75 minutes. However, if students had questions or difficulties with the simulator, then the actual time spent delivering the content increased. Even though the instructional method varied between groups for the learning activity, each group was presented with the same case study at the conclusion of the learning activity in an attempt to incorporate and assist students in linking and applying the concepts that had been presented during the learning activity.

Traditional Didactic Classroom. Delivery of the learning activity utilizing an instructional strategy of traditional didactic, otherwise known as classroom lecture, was presented for each three learning activities, however the group(s) exposed varied depending upon the subject's group assignment. Traditional didactic classroom instruction consisted of a PowerPoint slide presentations of the emergent cardiovascular or respiratory event being presented during the specified learning activity.

High-Fidelity Human Patient Computer Simulation. Each of the three learning activities had a subject group assigned to receive the instructional strategy of HHPCS. The essential content covered in each of the learning activities was delivered through a computer-programmed scenario that connected and manifested on the high-fidelity human patient computer simulator. By using the simulator, students are actually able to physically touch and assess the simulator, administer interventions, and evaluate response and outcomes of the client condition simulated. Scenarios are computer-programmed scripts that contain lists of instructions, which direct the simulator to perform various operations. The lists are comprised of states, events, and transitions. A state is a descriptive titling of a category or condition which has events listed underneath. An event consists of instructions that inform the simulator to change something, usually physiological in nature. Transitions define conditions that, if not met, direct the system to perform a specific action. See figure 7 for an example of a case scenario that was utilized in the hypovolemic and anaphylactic shock case study. Utilizing a computer-programmed scenario assisted in the instruction of the students and provided consistency in the delivery of the two groups receiving the HHPCS instruction for the prescribed learning activity.

Figure 7

Programmed Simulation Case Study

- Baseline ER
 - Events
 - Set Fluid Loss Volume (Blood) to 500 ml
 - Set Heart Rate Factor to 1.75
 - Set Respiratory Rate Factor to 1.25
 - Set Ischemic Index Sensitivity to 0.15
 - Set Eye Blink Speed to Fast
 - Set Venous Capacity Factor to 1.1

Figure 7 Continued

- Transitions
 - If Time in State = 180 seconds then go to Bleeding in ER
- Bleeding in ER
 - Events
 - Set Heart Rate Factor to 1.6 over 2 minutes
 - Set Fluid Loss Volume (Blood) to 1000 ml over 2 minutes
 - Set Venous Capacity Factor to 1.35 over 2 minutes
 - Transitions (Made manually)
- Post Op
 - Events
 - Set Infusion (Packed Red Blood Cells) to 720 ml
 - Set Eyes: Blink Speed to Normal
 - Set Heart Rate Factor to 1.25
 - Set Respiratory Rate Factor to 1.5
 - Set Venous Capacity Factor to 1.15
 - Transitions (made manually)
- Bleeding Post Op
 - Events
 - Set Heart Rate Factor to 1.8 over 1 minute
 - Set Fluid Loss Volume (Blood) to 1800 ml over 3 minutes
 - Set Venous Capacity Factor to 1.60 over 4 minutes
 - Transitions (Made manually)
- Second Post Op
 - Events
 - Set Heart Rate Factor to 1.25
 - Set Venous Capacity Factor to 1.25
 - Set Infusion (Packed Red Blood Cells) to 1000 ml
 - Transitions (Made manually)
- Begin Anaphylaxis
 - Events
 - Set Breath Sounds to Wheezing
 - Set Resistance Factor: Systemic Vascular to 0.8 over 1 minute
 - Set Right Bronchial Resistance to 40 cm H2O/lpm @ 20 lpm
 - Set Left Bronchial Resistance to 40 cm H2O/lpm @ 20 lpm
 - Set O2 Consumption to 400 ml/min over 30 seconds
 - Set Shunt Fraction to 0.15 over 1 minute
 - Set Volume to -400.00
 - Transitions
 - If Time in State = 120 seconds then go to Mild Anaphylaxis
- Mild Anaphylaxis
 - Events
 - Set Shunt Fraction to 0.2 over 1 minute
 - Set Swollen Tongue to Semi-swollen

Figure 7 Continued

- Set O2 Consumption to 600 ml/min over 30 seconds
- Set Resistance Factor: Systemic Vasculature to 0.7 over 1 minute
- Set Volume to -400.00
- Transitions
 - If Time in State = 120 seconds then go to Worsening Anaphylaxis
- Worsening Anaphylaxis
 - Events
 - Set Resistance Factor: Systemic Vasculature to 0.5 over 1 minute
 - Set Volume to -400.00
 - Set O2 Consumption to 800 ml/min over 30 seconds
 - Set Shunt Fraction to 0.25 over 1 minute
 - Transitions
 - If Time in State = 120 seconds then go to Severe Anaphylaxis
 - If Epinephrine > 0.10 then go to Epinephrine Given Anaphylaxis Recovery
- Severe Anaphylaxis
 - Events
 - Set Shunt Fraction to 0.3 over 1 minute
 - Set O2 Consumption to 1200 ml/min over 30 seconds
 - Set Resistance Factor: Systemic Vasculature to 0.30 over 1 minute
 - Set Swollen Tongue to Swollen
 - Set Volume to -400.00
 - Transitions
 - If Epinephrine >0.10 then go to Epinephrine Given Anaphylaxis Recovery
- Epinephrine Give Anaphylaxis Recovery
 - Events
 - Set Breath Sounds to Normal
 - Set Right Bronchial Resistance to 0.81 cmH2O/lpm @ 20 lpm over 1 minute
 - Set Left Bronchial Resistance to 0.81 cmH2O/lpm @ 20 lpm over 1 minute
 - Set Respiratory Rate Factor to 1.15 over 1 minute
 - Set Resistance Factor: Systemic Vasculature to 1 over 1 minute
 - Set Heart Rate Factor to 1 over 1 minute
 - Set Swollen Tongue to Not Swollen
 - Set O2 Consumption to 400 ml/min over 1 minute
 - Set Shunt Fraction to 0.08 over 1 minute

A total of three computer-programmed scenarios were utilized during this study: myocardial infarction, deep vein thrombosis leading to pulmonary embolism, and shock (anaphylactic and hypovolemia). All scenarios will be programmed by the researcher

and will be based from the baseline physiology of Standard Man, which is a pre-programmed patient in the software that contains the normal physiologic findings of a 33-year-old male but is adjusted and programmed to represent the specific physiological findings of the conditions presented.

Combined Didactic and HHPCS Instruction. A combination of the instructional strategies of traditional didactic classroom and HHPCS was delivered to assigned subject groups during each of the learning activities. The subject group assigned to this instructional strategy attended the traditional didactic classroom instruction for the learning activity and then received a separate time for the HHPCS instruction. During the HHPCS instructional component, the appropriate learning activity computer-programmed scenario was presented.

Instruments

For this study, four computerized examinations (one pretest and three posttests) were custom-developed by Health Education Systems Incorporated (HESI). HESI is an established and proven testing company that constructed each test utilized in this study from a testing blueprint developed by the researcher that was based upon the learning activity plans to insure that areas of learning have been covered (See Appendix C). HESI test items are written to measure cognitive outcomes based on Bloom's Taxonomy of Educational Objectives for Cognitive Domain (Bloom et al., 1956). HESI test items encompass four cognitive levels of learning: knowledge, comprehension, application, and analysis. Primarily, HESI exam items incorporate the higher cognitive levels, including application and above, which challenge one's critical thinking ability (Morrison, 1996; Morrison & Free, 2001). For the purpose of measuring critical thinking

abilities, HESI exam items attempt to require multilogical thinking, which “requires knowledge of more than one fact to logically and systematically apply concepts to a clinical problem” (Morrison, 1996, p. 28).

For the purpose of this study, HESI exam items measure both critical thinking abilities and learning outcomes. The HESI custom-made exam generates numerous scoring information based upon a mathematical model called the HESI Predictability Model (Nibert, Young, & Adamson, 2002). The mathematical model is a proprietary model that calculates a total HESI score which is calculated based on the raw score and the level of difficulty of each test item which is “determined by dividing the number of correct responses to the item by the total number of responses to that item, thus deriving the percentage of correct responses to the item” (Morrison, Adamason, Nibert, & Hsia, 2004, p. 222). The weighting of the items actually results in a student receiving more credit for correctly answering difficult items thus resulting in a precise scoring process. A total HESI score ranges from 0 to 1,500. HESI recommends that the level of performance on any item be 900, however a score of 850 is acceptable. In addition to a total HESI score, each custom-made HESI exam will also provide a score according to clinical specialty areas, nursing process categories, NCLEX client needs categories, and American Association of Colleges of Nursing (AACN) categories. See Appendix D for sample HESI scoring reports.

Critical thinking ability is also integrated into each custom-made HESI exam through the cognitive nature of the analysis level of test items. A HESI scoring report also contains a critical thinking score and for the purposes of this study, the critical thinking score in the AACN categories was utilized. Due to the higher cognitive level of

the exam items, sometimes, the critical thinking score and the total HESI score are similar or the same.

Due to the confidential nature and the security of the test bank, written copies of the exam questions are not available (See letter in Appendix E). However, all analysis questions are multiple-choice questions with four-answer choices. Figure 8 provides an example of a HESI analysis question focusing on pediatric content, which is irrelevant to this study however it provides an example of the HESI question style.

Figure 8

HESI Style Question

Which child requires follow-up intervention by the nurse?

- A. An 18-month-old scheduled for surgery who is observed playing alongside other children, but who is not playing with the children.
- B. A two-year-old scheduled for a procedure who is sitting quietly next to his parents watching other children playing in the playroom.
- C. A three-year-old who is recovering from an infection and who repeatedly insists on building a block tower and then knocking it down.
- D. A four-year-old with a chronic illness who tells the nurse about an imaginary friend who is described as “feeling sick most of the time.”

Correct answer: B.

Reliability

Items utilized in the custom exams were adapted or taken from the preexisting HESI test item bank, especially from the specialty area of Medical Surgical nursing. The

items comprised on pretest and posttest for this study have been previously tested by students taking a HESI Exit Exam or a custom-made HESI exam and the estimated reliability coefficients have been previously determined (Kuder Richardson-20 = 0.86 to 0.99) (Morrison, Adamson, Nibert & Hsia, 2004). When selecting items for use in this study, HESI estimates reliabilities ranging from KR-20 = 0.93 to 0.96. Specifically for the learning activities of this study, reliabilities were estimated by HESI to be KR-20 = 0.96 for myocardial infarction, KR-20 = 0.95 for deep vein thrombosis leading to pulmonary embolism, and KR-20 = 0.93 for shock (anaphylaxis and hypovolemia). Determining reliability coefficients is important for evaluating the level of performance on each item and exam and for data analysis purposes in determining significance of findings.

Validity

All items to be used in this study have been initially reviewed by the researcher to assure that questions address content contained in each of the three learning activities. Test items were made available for viewing through the HESI computer base system. Face validity of each test item has been previously determined by experienced nurse educators and nurse practitioners who review all items for their merit (Morrison, Adamson & Hsia, 2001). However, for the purposes of face validity for this study, two master's prepared nursing faculty who teach pathopharmacology and medical surgical nursing, were solicited to review the exam items prior to the initiation of the study. Content validity of each test will be determined by following the testing blueprint. (Morrison, Adamson & Hsia, 2001).

Procedure

Subjects were recruited and invited by the researcher to participate in this study at the beginning of the Fall semester. The researcher obtained permission from the course faculty in NXX3: Pathophysiology and Pharmacology I to present this research opportunity to 98 potential subjects during the first class of the semester. Informed consent was obtained on 88 subjects who volunteered to participate in the study. Next, participants received written correspondence and intra-campus electronic mail which detailed the directions for accessing the computerized HESI pretest. Sixty subjects completed the pretest and the computerized exam was scored by HESI and the results were electronically sent to the researcher. Each subject was assigned a computer access number and anonymity was maintained with scoring reports since subject's names were not associated with the results. The pretest critical thinking scores were ranked from high to low so subjects could be randomized into three groups utilizing the blocking technique that was described earlier.

Once the groups had been assigned, subjects participated in three different learning activities that illustrated the nursing care of clients experiencing an emergent cardiovascular or respiratory event using one of three instructional strategies. The three emergent cardiovascular or respiratory events that will be presented during the course of this study include the conditions of myocardial infarction, deep vein thrombosis leading to pulmonary embolism, and shock (anaphylactic and hypovolemia). During the first learning activity (myocardial infarction), demographic data were collected on each subject (see Appendix F). Each learning activity was scheduled around the subject's academic schedule and times and dates were agreed upon by the participants. The three

learning activities were completed within a 6-week block of time in order to avoid interfering with the subject's academic schedule. Immediately after the completion of each learning activity, each subject was asked to take a 20-item, custom-made HESI exam (posttest) over the content covered during the activity. Each posttest was electronically sent to HESI and scored, and results sent to the researcher for data analysis. Upon completion of the data collection, HESI sent the researcher a summary report on the overall performance of the total group for each test.

Procedure for Protection of Human Subjects

Initially, approval was sought for an expedited review from Duquesne University's Institutional Review Board (IRB). Once approval had been received, the researcher submitted for approval from the Human Assurance Committee (HAC) at the university affiliated with the school of nursing. See Appendix G for materials submitted to Duquesne University's IRB for approval. Materials submitted for approval from the HAC and consent form is on file and not included in this manuscript in an attempt to protect the anonymity of the study location and participants.

Since students were the subjects being sought to participate in this research study and potentially could be vulnerable subjects, certain mechanism had to be addressed in order to assure their protection. Students participating in the study were told that the purpose of this project was to investigate their learning and critical thinking abilities on three nursing topics that they will be exposed to throughout the study. Participants would also have the opportunity to be exposed to various instructional strategies. Also, they would be asked to complete four computerized tests: 1) pretest, 2) posttest after completing learning activity #1, 3) posttest after completing learning activity #2, and 4)

posttest after completing learning activity #3. Participants would be asked to actively participate in each of the learning activities which would range from 50-90 minutes. Finally, participants were asked not to share information covered on the computerized tests with other students until after the study was completed.

Participants were told that the researcher did not anticipate any risks in their participation in the study. However, participants were told that some anxiety might be experienced with the use of HHPCS. In an attempt to decrease anxiety and optimize learning, participants received a hands-on demonstration of the simulator at the onset of the learning activity. While participants would not receive any compensation for their involvement in the project, they would be provided the opportunity to discover their strengths and weaknesses in their critical thinking skills and learn in a non-threatening environment.

Students who participated in this study were protected through the implementation of the following measures. First of all, participants' names did not appear on any written report. Participants were assigned a number to use when accessing the computerized tests. Anonymity was assured since all study data was blinded to the researcher. All written materials and consent forms would be stored in a locked filing cabinet in the researcher's office. Participants' responses would only appear in statistical data summarized and all study materials would be destroyed five years following the completion of this project.

Other measures that were implemented to protect the students participating in this study include the following. First of all, the researcher was not a course faculty member. Second, the study was not associated with any course and the participation in the study

would not affect course grades. Third, students' participation and performance in the study would not be used for evaluation in any courses. Finally, although the recruitment of students would occur at a course meeting, course faculty would not be present and faculty would not be aware of students participating in the study.

Students' agreement to participate in this project was assumed by the completion of the informed consent form. However, participation in this project was considered strictly voluntary, and participants could decide to withdraw their consent at any time, for any reason. When the project was completed, the researcher would provide participants with a copy of the results, if they request them. Participants were given the phone number and address of the principal investigator and advisor to contact if they have further questions about the project.

Procedure for Data Analysis

The purpose of this study was to compare learning outcomes and critical thinking abilities of beginning undergraduate nursing students when three instructional strategies were utilized during three learning activities portraying clients experiencing an emergent cardiovascular or respiratory event. Data collected during the study included demographic data, critical thinking ability scores, and learning outcome scores (total HESI score) on each of the three subjects covered in the three learning activities.

The database for this study was developed using the Statistical Package for the Social Sciences (SPSS) version 11.0 (SPSS, Inc., 2001). To minimize errors, all entry cells were programmed to detect inconsistent and invalid data. Specifically, data was checked for invalid codes, values that are out of range, and invalid dates and skipped

patterns. All data once entered into the spreadsheets was verified against the original forms.

Descriptive statistics were used to characterize the sample of the study. Percentages, central tendencies, and analysis of variance using F ratios was applied to the data and research questions. In order to address each research question, the primary analyses for this study was to compare measures of critical thinking skill ability and learning outcomes among learning nursing concepts and principles utilizing the three instructional strategies. Critical thinking and learning outcomes are the dependent variables and the instructional strategy is the independent variable. One-way ANOVA calculations were conducted to determine the main effects of instructional strategies on critical thinking ability and learning outcomes. When significant ($p < .05$) effects are detected, a post hoc comparison test will be employed to determine which groups are significantly different.

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

The purpose of this study was to compare critical thinking abilities and learning outcomes of undergraduate nursing students when three instructional strategies (traditional didactic classroom, high-fidelity computer simulation, and a combination of didactic classroom and simulation instruction) were used to illustrate the nursing care of clients experiencing three emergent cardiovascular or respiratory events. This chapter presents and discusses the results of an analysis of data that were obtained.

Formation of Study Groups

Subjects were invited to participate in the study from junior baccalaureate nursing students enrolled in the Fall 2004 semester pathopharmacology course. Informed consent was obtained from 88 subjects after initial recruitment efforts had been conducted, which consisted of the researcher presenting a brief overview of the study to the junior students on the first day of class for the fall semester during a pathopharmacology class. After informed consent was obtained, 88 subjects were asked to complete the 60-item custom-made HESI pretest which served the purpose of randomizing subjects into the three study groups. Subjects were given one week to complete the pretest exam. Sixty subjects completed the pretest. Once the results for the pretest had been obtained, subjects were ranked based on their HESI critical thinking scores and then randomized into three groups of 20 subjects utilizing the blocking technique described earlier in Chapter 3. The HESI pretest critical thinking scores ranged from 305 to 1186 with a mean score of 681.13. Mean HESI pretest critical thinking scores and an analysis for statistical

differences for each group are presented in Table 4. No significant differences ($p = 0.99$) were detected when comparing the mean HESI critical thinking scores between the groups which assisted in determining the homogeneity of the groups.

Table 4

Pretest HESI Critical Thinking Scores (N = 60)

	Group	N	Mean	SD		
	1	20	683.50	185.11		
	2	20	680.40	204.23		
	3	20	679.50	190.98		
Source	Sum of Squares	df	Mean Squares	F Ratio	p	
Model	176.13	2	88.07	0.002	0.99	
Error	2136478.80	57	37482.08			
Corrected						
Total	2136654.93	59				

Description of Groups

After the subjects were randomized into three groups, they were contacted and dates and times for the learning activities were solicited and announced. Forty-eight subjects (Group 1, $n = 16$; Group 2, $n = 16$; Group 3, $n = 16$) completed the first learning activity, which focused on the topic of coronary artery disease and myocardial infarction. Demographic data were collected during the first learning activity time and are provided in Table 5 according to the subject's group assignment. The age of the subjects ranged

between 20 and 51 years (mean = 25.56) with a mean Grade Point Average was 3.40 (on a 4.0 scale) with a standard deviation of 0.36. The sample consisted mainly of females (n = 43). Majority of subjects' were Caucasian with approximately half of the subjects (56.3%) reporting no previous health care experience. Comparison of demographic data between the groups further assisted in determining that the randomization of the groups maintained homogeneity.

Table 5

Subject Demographic Data by Group (N = 48)

Group	Mean Age	N (Ethnicity)	Mean GPA	N (Previous Experience)
1	24.19	11 (Caucasian) 2 (African-Amer) 1 (Asian) 1 (Hispanic) 1 (Arabian)	3.248	9 (None) 1 (Nursing Assistant) 2 (Health Care Assistant) 2 (Technician) 2 (Volunteer)
2	26.13	14 (Caucasian) 1 (African-Amer) 1 (Asian)	3.434	11 (None) 2 (Nursing Assistant) 1 (Health Care Assistant) 1 (Technician) 1 (Volunteer)
3	26.38	12 (Caucasian) 1 (African-Amer) 2 (Asian) 1 (Hispanic)	3.525	7 (None) 2 (Nursing Assistant) 1 (Health Care Assistant) 2 (Technician) 4 (Volunteer)

Thirty-seven subjects (Group 1, n = 11; Group 2, n = 16; Group 3, n = 10) completed the second learning activity on deep vein thrombosis and pulmonary embolism. Thirty-six subjects (Group 1, n = 11; Group 2, n = 15; Group 3, n = 10)

completed the final learning activity on shock. Attrition between learning activities was mostly credited to the academic schedule, clinical schedules, and course examinations. In an attempt to minimize attrition, snack food items were provided during each learning activity and the dates and times were decided by each group. Three subjects withdrew due to transportation issues and one subject withdrew due to a death in the family. Subjects who withdrew from the study stated that they were stressed with their schedules and felt that they could not devote time to finishing the study. Table 6 summarizes attrition that occurred during the study.

Table 6

Study Attrition

Activity Completed	Number of Subjects
Study Consent	88
Pretest	60
Activity #1	48
Activity #2	37
Activity #3	36

Findings

The following is an analysis of each research question that was presented earlier in Chapter 1. Each question is answered through the results that are presented in this section. The findings of this study are presented in two major sections: critical thinking

abilities and learning outcomes. Results answering each research question are presented first, followed by the presentation of results according to each learning activity.

Questions 1, 2, and 3 were concerned with the beginning baccalaureate nursing students' critical thinking abilities when exposed to three different types of instructional strategies when learning the nursing care of a client experiencing a myocardial infarction, a deep vein thrombosis leading to a pulmonary embolism, and shock (anaphylaxis and hypovolemia). While each subject group was exposed to the various instructional strategies throughout this study, critical thinking mean scores varied in comparison to the instructional strategy that was utilized (See Figure 9 and Table 7).

Figure 9

Comparison of HESI Posttest Mean Critical Thinking Scores and Instructional Method

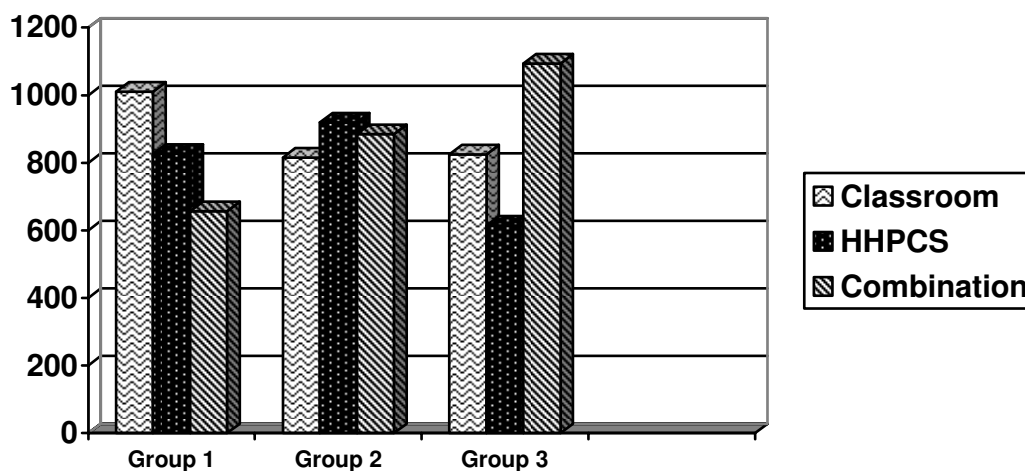


Table 7

Comparison of HESI Posttest Mean Critical Thinking Scores and Instructional Strategy

Group	N	Instructional Strategy	Critical Thinking Mean Score
1	16	Classroom	1010.38
	11	HHPCS	826.82
	11	Combination	657.18
2	15	Classroom	815.00
	16	HHPCS	919.06
	16	Combination	878.94
3	10	Classroom	825.20
	10	HHPCS	614.60
	16	Combination	1119.63

Questions 4, 5, and 6 were concerned with the learning outcomes of the beginning baccalaureate nursing student when exposed to the three different types of instructional strategies when learning the nursing care of a client experiencing a myocardial infarction, a deep vein thrombosis leading to a pulmonary embolism, and shock (anaphylactic and hypovolemic). Each group experienced the three instructional strategies that were utilized throughout the study to deliver the content of each learning activity. Figure 10 and Table 8 presents the means of the HESI total scores (learning outcome) from each group in comparison to the instructional strategy that was utilized.

Figure 10

Comparison of Posttest Mean Total HESI Scores and Instructional Method

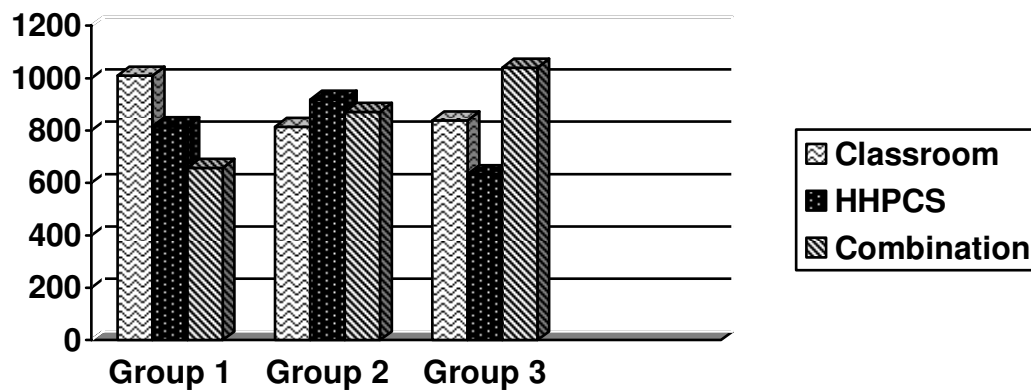


Table 8

Comparison of Posttest Mean HESI Total Scores and Instructional Strategy

Group	N	Instructional Strategy	HESI Total Mean Score
1	16	Classroom	1010.38
	11	HHPCS	817.45
	11	Combination	657.18
2	15	Classroom	815.00
	16	HHPCS	919.06
	16	Combination	872.31
3	10	Classroom	839.00
	10	HHPCS	634.50
	16	Combination	1119.63

Question 1

Question 1 states: Is there a difference between critical thinking abilities of beginning baccalaureate nursing students after being exposed to traditional didactic

classroom instruction when learning nursing care of a client experiencing an emergent cardiovascular or respiratory event?

The means and standard deviations of subjects' (n = 41) HESI critical thinking scores for the learning activities utilizing traditional didactic classroom instruction were compared using the F test. Analysis of variance was performed comparing the means of the HESI critical thinking scores (see Table 9). Critical thinking scores for traditional didactic classroom instruction ranged from 323 to 1352 (M = 893.73; SD = 271.996). Group 1 (M = 1010.38) scored higher than Group 2 (M = 815.00) and Group 3 (M = 825.20). However, no significant difference (F = 2.612, df = 2, 38, p = 0.087) was found among the learning activities when traditional didactic classroom instruction was delivered to the subjects.

Table 9

HESI Critical Thinking Scores for Traditional Didactic Classroom Instruction

Group	Activity	N	Mean	SD		
1	CAD/MI	16	1010.38	180.81		
2	Shock	15	815.00	255.79		
3	DVT/PE	10	825.20	364.42		
Source					F Ratio	p
Model					2.612	0.087
	Sum of Squares		df	Mean Squares		
Error	357636.69		2	178818.34		
	2601627.35		38	68463.88		
Corrected						
Total	2959264.05		40			

Question 2

Question 2 states: Is there a difference between critical thinking abilities of beginning baccalaureate nursing students after being exposed to high-fidelity human patient computer simulation instruction when learning nursing care of a client experiencing an emergent cardiovascular or respiratory event?

A total of 37 subjects received instruction utilizing high-fidelity human patient computer simulation during a prescribed learning activity. The means and standard deviations of these subjects' critical thinking scores were compared (see Table 10). Critical thinking scores for HHPCS instruction ranged from 289 to 1292 ($M = 809.35$; $SD = 229.471$). Group 2 ($M = 919.06$) scored higher than Group 1 ($M = 826.82$) and Group 3 ($M = 614.60$). When using the F test, a significant difference ($F = 7.41$, $df = 2, 34$, $p = 0.002$) was found among the learning activities when high-fidelity computer simulation instruction was delivered to the subjects. To determine which groups were significantly different, a post hoc comparison using the Bonferroni t-tests was used (see Table 11). When delivering the learning activity content utilizing high-fidelity computer simulation, Group 1 had received the deep vein thrombosis and pulmonary embolism content, while Group 2 had received the CAD and myocardial infarction content, and Group 3 had received the shock content. From the Bonferroni t-test comparison, a significance of $p = 0.05$ was found between Group 1 and Group 3 and a significance of $p = 0.002$ was found between Group 2 and Group 3. Therefore, subjects' critical thinking scores were higher when learning the CAD/MI and DVT/PE content than the Shock content when High-fidelity computer simulation was utilized as an instructional strategy.

Table 10

HESI Critical Thinking Scores for High-Fidelity Human Patient Computer Instruction

Group	Activity	Subjects (N)	Mean	SD	
1	DVT/PE	11	826.82	266.62	
2	CAD/MI	16	919.06	144.60	
3	Shock	10	614.60	181.32	
Source	Sum of Squares	df	Mean Squares	F Ratio	p
Model	575221.60	2	287610.73	7.41	0.002
Error	1320420.97	34	38835.91		
Corrected Total	1895642.43	36			

Table 11

Bonferroni Post Hoc Comparisons of Critical Thinking Scores and HHPCS Utilization

Group	Compared Group	Mean Difference	Std Error	Sig
Group 1	Group 2	-92.24	77.19	0.72
	Group 3	212.22	86.11	0.05
Group 2	Group 1	92.24	77.19	0.72
	Group 3	304.46	79.44	0.002
Group 3	Group 1	-212.22	86.11	0.05
	Group 2	-304.46	79.44	0.002

Question 3

Question 3 states: Is there a difference between critical thinking abilities of beginning baccalaureate students after being exposed to a combination of traditional

didactic classroom and high-fidelity computer simulation instruction when learning nursing care of a client experiencing an emergent cardiovascular or respiratory event?

Using the F test, the critical thinking scores of 43 subjects receiving learning activity instructional strategy utilizing a combination of traditional didactic classroom and simulation were compared. Critical thinking scores for subjects receiving the CAD/MI content (Group 3) were higher ($M = 1119.63$) than subjects receiving the DVT/PE content (Group 2; $M = 885.19$) and the Shock content (Group 1; $M = 657.18$). Overall, critical thinking scores ranged from 302 to 1497 across all three groups. A significance of $p < 0.001$ ($F = 11.34$, $df = 2, 40$) was found when determining the main effect of utilizing the combination of traditional didactic classroom and simulation as an instructional strategy for delivering content (see Table 12).

Table 12

HESI Critical Thinking Scores for Combination Instruction

Group	Activity	Subjects (N)	Mean	SD	
1	Shock	11	657.18	242.05	
2	DVT/PE	16	885.19	316.09	
3	CAD/MI	16	1119.63	165.74	
Source	Sum of Squares	df	Mean Squares	F Ratio	p
Model	1415299.80	2	707649.20	11.34	<0.001
Error	2496527.82	40	62413.20		
Corrected Total	3911827.63	42			

Table 13 displays the post-hoc comparison using the Bonferroni t-tests that was used to determine which groups were significantly different with their critical thinking abilities when learning using a combination instructional strategy (traditional didactic classroom and HHPCS). A statistical significance in mean scores ($p < 0.001$) was found between Groups 1 and 3 which indicates that the subjects that received the CAD/MI content (Group 3) scored higher ($M = 1119.63$) than the subjects that received the Shock content (Group 1; $M = 657.18$). Also, a significant difference ($p = 0.034$) in mean scores were detected between Groups 2 and 3 which indicated that the subjects in Group 3 scored higher than the subjects in Group 2 ($M = 885.19$) who had received the DVT/PE content. Thus, through the post- hoc comparison, the results indicate that utilizing a combination of traditional didactic classroom and simulation instruction appears to be an effective strategy for delivery of learning activity content.

Table 13

Bonferroni Post Hoc Comparisons of Critical Thinking Scores & Combination Instruction

Group	Compared Group	Mean Difference	Std Error	Sig
Group 1	Group 2	-228.01	97.85	0.075
	Group 3	-462.44	97.85	< 0.001
Group 2	Group 1	228.01	97.85	0.075
	Group 3	-234.44	88.33	0.034
Group 3	Group 1	462.44	97.85	< 0.001
	Group 2	234.44	88.33	0.034

Critical Thinking Score Comparisons for Learning Activities

In the results presented previously, the critical thinking scores of the subject groups were analyzed and presented according to the particular instructional strategy that

had been encountered. The following is the analysis comparing the groups according to the learning activity content.

CAD/MI Learning Activity. A total of 48 subjects completed the CAD/MI learning activity (Group 1 = 16; Group 2 = 16; Group 3 = 16). The means and standard deviations of subject's HESI critical thinking scores for the CAD/MI learning activity were compared using the F test. Analysis of variance was performed comparing the means of the HESI critical thinking scores (see Table 14). Critical thinking scores for the CAD/MI learning activity ranged from 662 to 1497 ($M = 1016.35$; $SD = 180.937$). Group 3 ($M = 1119.63$) scored higher than Group 1 ($M = 1010.38$) and Group 2 ($M = 919.06$). When using the F test, a significant difference ($F = 5.97$, $df = 2, 45$, $p = 0.005$) was found among the instructional strategies that were utilized to deliver the CAD/MI content. To determine which instructional strategy was significantly different, a post hoc comparison using the Bonferroni t-tests was used (see Table 15). From the Bonferroni t-test comparison, a statistically significant difference in mean scores ($p = 0.004$) was detected between Group 2 and Group 3. Therefore, indicating that subjects' critical thinking abilities in Group 3 (combination of traditional didactic classroom and simulation instruction) were shown to be significantly higher than subject's in Group 2 (high-fidelity computer simulation instruction) when participating in the CAD/MI learning activity.

Table 14

Group Comparisons for CAD/MI Learning Activity

Group	Instructional Method	Subjects	Mean	S.D.	
1	Classroom	16	1010.38	180.81	
2	Simulation	16	919.06	144.60	
3	Combination	16	1119.63	165.74	
Source	Sum of Squares	df	Mean Squares	F Ratio	p
Model	322660.54	2	161330.27	5.97	0.005
Error	1216030.44	45	27022.90		
Corrected Total	1538690.98	47			

Table 15

Bonferroni Post Hoc Comparisons of CAD/MI Learning Activity

Group	Compared Group	Mean Difference	Std Error	Sig
Group 1	Group 2	91.31	58.12	0.369
	Group 3	-109.25	58.12	0.200
Group 2	Group 1	-91.31	58.12	0.369
	Group 3	-200.56	58.12	0.004
Group 3	Group 1	109.25	58.12	0.200
	Group 2	200.56	58.12	0.004

DVT/Pulmonary Embolism Learning Activity. The means and standard deviations of 37 subjects' HESI critical thinking scores for the DVT/PE learning activity were compared using the F test. Analysis of variance was performed comparing the means of

the HESI critical thinking scores (see Table 16). Critical thinking scores ranged from 319 to 1431 ($M = 851.62$; $SD = 308.965$). Overall, Group 2 ($M = 885.19$) scored higher than Group 1 ($M = 826.82$) and Group 3 ($M = 825.20$). However, no significant difference ($F = 0.159$, $df = 2, 34$, $p = 0.854$) was found among the instructional strategies that were utilized to deliver the DVT/PE content to the subjects.

Table 16

Group Comparisons for DVT/PE Learning Activity

Group	Instructional Method	Subjects	Mean	S.D.	
1	Simulation	11	826.82	266.624	
2	Combination	16	885.19	316.085	
3	Classroom	10	825.20	364.422	
Source	Sum of Squares	df	Mean Squares	F Ratio	p
Model	31775.03	2	15887.51	0.16	0.85
Error	3404763.67	34	100140.11		
Corrected Total	3436538.70	36			

Shock Learning Activity. Thirty-six subjects (Group 1 $n = 11$; Group 2 $n = 15$; Group 3 $n = 10$) participated in the shock learning activity. The means and standard deviations of these subjects' HESI critical thinking scores were compared (see Table 17). Critical thinking scores for the shock learning activity ranged from 289 to 1216 ($M = 711.11$; $SD = 244.062$). Group 2 ($M = 815$) scored higher than Group 1 ($M = 657.18$) and Group 3 ($M = 614.60$). When using the F test, no significant difference ($F = 2.63$,

df = 2, 33, p = 0.87) was found among the instructional strategies that were utilized to deliver the shock content to the subjects.

Table 17

Group Comparisons for Shock Learning Activity

Group	Instructional Method	Subjects	Mean	S.D.	
1	Combination	11	657.18	242.045	
2	Classroom	15	815.00	255.794	
3	Simulation	10	614.60	181.322	
Source	Sum of Squares	df	Mean Squares	F Ratio	p
Model	287029.52	2	143514.76	2.63	0.87
Error	1797782.04	33	54478.24		
Corrected Total	2084811.56	35			

Question 4

Is there a difference in learning outcomes of beginning baccalaureate nursing students after being exposed to traditional didactic classroom instruction when learning nursing care of a client experiencing an emergent cardiovascular or respiratory event?

A total of 41 subjects received instruction through the traditional didactic classroom instructional strategy. The means and standard deviations of these subjects HESI scores were compared (see Table 18). HESI scores for traditional didactic classroom instruction ranged from 292 to 1361 (M = 897.10; SD = 284.508). Group 1 (M = 1010.38) scored higher than Group 2 (M = 815) and Group 3 (M = 839). Analysis of variance was performed using the F test which determined no significant difference (F

= 2.23, $df = 2, 38$, $p = 0.121$) was found among the learning activities when subjects were exposed to traditional didactic classroom instruction.

Table 18

HESI Scores for Traditional Didactic Classroom Instruction

Group	Activity	Subjects (N)	Mean	S.D.	
1	CAD/MI	16	1010.38	180.801	
2	Shock	15	815.00	255.79	
3	DVT/PE	10	839.00	407.06	
Source	Sum of Squares	df	Mean Squares	F Ratio	p
Model	340161.86	2	170080.93	2.23	0.121
Error	2897637.75	38	76253.63		
Corrected Total	3237799.61	40			

Question 5

Is there a difference in learning outcomes of beginning baccalaureate nursing students after being exposed to high-fidelity human patient computer simulation instruction when learning nursing care of a client experiencing an emergent cardiovascular or respiratory event?

The means and standard deviations of subjects' ($n = 37$) HESI scores for the learning activities utilizing HHPCS were compared using the F test. Analysis of variance

was performed comparing the means of the HESI scores (see Table 19). HESI scores for HHPCS instruction ranged from 289 to 1165 ($M = 811.95$; $SD = 203.301$). Group 2 ($M = 919.06$) scored higher than Group 1 ($M = 817.45$) and Group 3 ($M = 634.50$). When using the F test, a significant difference ($F = 8.57$, $df = 2, 34$, $p = 0.001$) in HESI scores was detected among the learning activities when subjects were exposed to HHPCS instruction. To determine which groups were significantly different, a post hoc comparison using the Bonferroni t-tests was used (see Table 20). From the Bonferroni t-test comparison, a significance of $p = 0.05$ was found between Group 1 and Group 3 and a significance of $p = 0.001$ was found between Group 2 and Group 3. Therefore, subjects' HESI scores were shown to be higher when learning the CAD/MI and DVT/PE content than the Shock content when high-fidelity computer simulation is utilized as an instructional strategy.

Table 19

HESI Scores for High-Fidelity Human Patient Computer Simulation Instruction

Group	Activity	Subjects (N)	Mean	S.D.	
1	DVT/PE	11	817.45	187.55	
2	CAD/MI	16	919.06	144.60	
3	Shock	10	634.50	189.66	
Source	Sum of Squares	df	Mean Squares	F Ratio	p
Model	498787.73	2	249393.86	8.57	0.001
Error	989132.16	34	29092.12		
Corrected Total	1487919.89	36			

Table 20

Bonferroni Post Hoc Comparisons of HESI Scores and HHPCS Utilization

Group	Compared Group	Mean Difference	Std Error	Sig
Group 1	Group 2	-101.61	66.81	0.413
	Group 3	182.95	74.53	0.058
Group 2	Group 1	101.61	66.81	0.413
	Group 3	284.56	68.76	0.001
Group 3	Group 1	-182.95	74.53	0.058
	Group 2	-284.56	68.58	0.001

Question 6

Is there a difference in learning outcomes of beginning baccalaureate nursing students after being exposed to a combination of traditional didactic classroom and high-fidelity human patient computer simulation instruction when learning nursing care of a client experiencing an emergent cardiovascular or respiratory event?

Using the F test, the HESI scores of 43 subjects who were exposed to learning activities where a combination of traditional didactic classroom and simulation instruction were compared. HESI scores for subjects receiving the CAD/MI content (Group 3) scored higher ($M = 1119.63$) than subjects receiving the DVT/PE content (Group 2; $M = 872.31$) and the Shock content (Group 1; $M = 657.18$). Overall, HESI scores ranged from 289 to 1508 across all three groups. A significance of $p < 0.001$ ($F = 9.96$, $df = 2, 40$) was found when determining the main effect of utilizing a combination of traditional didactic classroom and simulation instruction as an instructional strategy for delivering content (see Table 21).

Table 21
HESI Scores for Combination Instruction

Group	Activity	Subjects (N)	Mean	S.D.	
1	Shock	11	657.18	242.05	
2	DVT/PE	16	872.31	353.31	
3	CAD/MI	16	1119.63	165.74	
Source	Sum of Squares	df	Mean Squares	F Ratio	p
Model	1428874.25	2	714437.12	9.96	<0.001
Error	2870304.82	40	71757.62		
Corrected Total	4299179.07	42			

Table 22 displays the post-hoc comparison using the Bonferroni t-tests which was used to determine which groups were significantly different with their HESI scores and learning outcomes when learning using a combination instructional strategy of traditional didactic classroom and simulation instruction. A statistical significance of $p < 0.001$ was found between Groups 1 and 3 which indicates that the subjects that received the CAD/MI content (Group 3) scored higher ($M = 1119.63$) than the subjects that received the Shock content (Group 1; $M = 657.18$). Also, a significant difference ($p = 0.038$) was detected between Groups 2 and 3, which indicated that the subjects in Group 3 also scored higher than the subjects in Group 2 ($M = 872.31$) who had received the DVT/PE content. Therefore, utilizing a combination of traditional didactic classroom and simulation instruction appears to be an effective strategy for delivery of learning activity content.

Table 22

Bonferroni Post Hoc Comparisons of HESI Scores and Combination Instruction

Group	Compared Group	Mean Difference	Std Error	Sig
Group 1	Group 2	-215.13	104.92	0.141
	Group 3	-462.44	104.92	< 0.001
Group 2	Group 1	215.13	104.92	0.141
	Group 3	-247.31	94.71	0.038
Group 3	Group 1	462.44	104.92	< 0.001
	Group 2	247.31	94.71	0.038

Learning Outcome Score Comparisons for Learning Activities

The learning outcome or total HESI scores of the subjects' groups has been analyzed and presented according to the particular instructional strategy that the subject had been exposed to even though the learning activity content varied. The following is the analysis and results of comparing the groups according to the learning activity content.

CAD/MI Learning Activity. A total of 48 subjects completed the CAD/MI learning activity (Group 1 = 16; Group 2 = 16; Group 3 = 16). The means and standard deviations of subjects' HESI scores for the CAD/MI learning activity were compared using the F test. An analysis of variance was performed comparing the means of the HESI scores (see Table 23). HESI scores for the CAD/MI learning activity ranged from 662 to 1497 (M = 1016.35; SD = 180.937). Group 3 (M = 1119.63) scored higher than Group 1 (M = 1010.38) and Group 2 (M = 919.06). When using the F test, a significant difference (F = 5.97, df = 2, 45, p = 0.005) was detected among the instructional

strategies that were utilized to deliver the CAD/MI content. To determine which instructional strategy was significantly different, a post hoc comparison using the Bonferroni t-tests was used (see Table 24). From the Bonferroni t-test comparison, a statistically significant difference ($p = 0.004$) was detected between Group 2 and 3. Therefore, indicating that subjects' HESI scores or learning outcomes in Group 3 (combination of traditional didactic classroom and simulation instruction) were significantly higher than the subjects' in Group 2 (high-fidelity human patient computer simulation instruction) when participating in the CAD/MI learning activity.

Table 23

Group Comparisons for HESI Scores and the CAD/MI Learning Activity

Group	Instructional Method	Subjects	Mean	S.D.	
1	Classroom	16	1010.38	180.81	
2	Simulation	16	919.06	144.60	
3	Combination	16	1119.63	165.74	
Source	Sum of Squares	df	Mean Squares	F Ratio	p
Model	322660.54	2	161330.27	5.97	0.005
Error	1216030.44	45	27022.89		
Corrected Total	1538690.98	47			

Table 24

Bonferroni Post Hoc Comparisons of CAD/MI Instructional Strategies and HESI Scores

Group	Compared Group	Mean Difference	Std Error	Sig
Group 1	Group 2	91.31	58.12	0.369
	Group 3	-109.25	58.12	0.200
Group 2	Group 1	-91.31	58.12	0.369
	Group 3	-200.56	58.12	0.004
Group 3	Group 1	109.25	58.12	0.200
	Group 2	200.56	58.12	0.004

DVT/Pulmonary Embolism Learning Activity. The means and standard deviations of 37 subjects' HESI scores for the DVT/PE learning activity were compared using the F test. Analysis of variance was performed comparing the means of the HESI scores (see Table 25). HESI scores ranged from 289 to 1508 (M = 847; SD = 322.142). Overall, Group 2 (M = 872.31) scored higher than Group 1 (M = 817.45) and Group 3 (M = 839). No significant difference (F = 0.09, df = 2, p = 0.911) was found between the mean scores of the HESI scores and the instructional strategies that were utilized to deliver the DVT/PE content to the subjects.

Shock Learning Activity. A total of 36 subjects completed the shock learning activity. The means and standard deviations of these subjects' HESI scores were compared (see Table 26). HESI scores for the shock learning activity ranged from 289 to 1216 (M = 716.64; SD = 243.610). Group 2 (M = 815.00) scored higher than Group 1 (M = 657.18) and Group 3 (M = 634.50). When using the F test, no significant difference

($F = 2.27$, $df = 2, 34$, $p = 0.119$) was found between the mean scores of the HESI scores and the instructional strategies that were utilized to deliver the shock content to the subjects.

Table 25

Group Comparisons for HESI Scores and DVT/PE Learning Activity

Group	Subjects	Mean	S.D.
1	11	817.45	187.552
2	16	872.31	353.310
3	10	839.00	407.55

Source	Sum of Squares	df	Mean Squares	F Ratio	p
Model	20493.84	2	10246.92	0.09	0.911
Error	3715422.16	34	109277.12		
Corrected Total	3735916.00				

Table 26

Group Comparisons for HESI Scores and Shock Learning Activity

Group	Subjects	Mean	S.D.
1	11	657.18	242.05
2	15	815.00	255.79
3	10	634.50	189.66

Source	Sum of Squares	df	Mean Squares	F Ratio	p
Model	251478.17	2	125739.09	2.27	0.119
Error	1825622.14	33	55321.88		
Corrected Total	2077100.31	35			

Discussion

Research questions were asked in an attempt to determine the effect of various instructional strategies on a student's learning outcomes and critical thinking abilities measured through a customized HESI computerized exam. Using analysis of variance, no difference ($F = 0.002$, $df = 2, 59$, $p = 0.99$) between the pretest HESI critical thinking means were found in comparing group assignments. The means on this critical thinking measure were almost identical between the three study groups (Group 1 = 683.50, Group 2 = 680.40, Group 3 = 679.50). The means were consistent between the groups indicating that the groups were homogeneous.

The research questions for this study focused on nursing students' critical thinking abilities and learning outcomes when exposed to various instructional strategies. As stated previously, critical thinking is an essential component of nursing curricula and is a highly valued outcome (Alfaro-LeFevre, 2004; Cook, 2001; Daly, 2001; Sedlak,

1997). Therefore, it was important to investigate the effect each instructional strategy had on critical thinking abilities. The first three research questions measured students' critical thinking ability when exposed to each of the three instructional strategies: traditional didactic, HHPCS, and a combination of didactic and HHPCS. The comparison of critical thinking scores of each group revealed that there were no significant differences between the groups when traditional didactic classroom instruction was utilized. However, significant differences were detected when comparing critical thinking scores and the use of HHPCS and a combination of traditional didactic and HHPCS. Additional post hoc analysis using a Bonferroni t-test comparison was used to determine which groups significantly differed. Significant differences were detected for the utilization of HHPCS and a combination of traditional didactic and HHPCS instruction. Since each group received different learning content when they were exposed to the various instructional strategies, these findings suggest that the instructional strategy employed should be assessed and chosen by faculty based on the complexity of the content being learned or presented and the educational level of the learner. For example, the results of this study suggested that the content for CAD/MI when presented through the instructional method of HHPCS and a combination of traditional didactic and HHPCS was more effective on critical thinking than presenting hypovolemic and anaphylactic shock through these instructional methods. One possible explanation for these differences might be related to the familiarity with the topic of myocardial infarction since each student is required to be certified in cardiopulmonary resuscitation and would have been previously exposed to the content. The complexity and cognitive learning level of the three learning activities is another possible explanation

for these differences. The content for Shock is more complex and is for a higher level learner who has previous exposure to concepts and principles that pertain to Shock and guide the management of a patient exhibiting Shock. In this study, the subjects were beginning baccalaureate nursing students who possessed basic and minimal nursing knowledge which was challenged during the Shock learning activity which might have contributed to the lower scores that were attained on the Shock posttest. By adequately assessing and choosing the appropriate instructional strategy, both faculty and students will most likely have an effective learning experience which should result in improved critical thinking abilities and learning outcomes which are two goals hoping to be accomplished along with enhancing and facilitating lifelong learning.

As noted in Chapter 2, the literature is quite limited when specifically examining the major variables that were investigated in this study. In view of this limitation, there are very few past studies in the health professions research literature that might relate and apply to the findings reported in this study. However, the study design, implementation and findings are associated to the conceptual models identified and discussed previously in Chapter 2. The learning activities utilized during the study were based upon Ausubel's Assimilation Theory (1978) since an underlying cognitive structure for previous meanings and information must exist in order to build and interact with new information. Appreciating that learning occurs over time and is individualized, an attempt was made to facilitate meaningful learning in this study through designing and implementing interactive instructional strategies that would facilitate the learning process (Ausubel, 1978; Bradshaw, 2001; Jung, 1923; Knowles, 1990; McLellan, 1996; Norton, 1998). While this study measured critical thinking and learning outcomes of subjects after each

learning activity, the timeframe during which the study was completed was relatively brief which also might have been a contributing factor to the lower scores on the later learning activities, such as Shock.

The development of one's critical thinking abilities is a dynamic process that occurs over time and is also related to one's progression of learning (Benner, 1984; Benner, et al., 1999; Gaba et al., 1994; VanSell & Kalofissudis, 2002). In this study, critical thinking was challenged in an attempt to further develop critical thinking abilities and progress learning. During each learning activity, the cognitive process of learning and problem identification was enhanced which assisted with the socialization process of the beginning nurse (Benner, 1984; VanSell & Kalofissudis, 2002). Also during each learning activity, subjects encountered and responded to an emergent cardiovascular or respiratory event. The subject involvement during each learning activity facilitated a link to information processing, practical reasoning and decision making which would hopefully contribute to the development of one's critical thinking abilities (Benner et al., 1999; Gaba et al., 1994). For the educator, this implies that they must have an understanding of the learner, the learning objectives to be accomplished for the learning activity, and the most appropriate instructional strategy that is chosen for the learning activity.

Focusing on group critical thinking scores and the comparison between learning activities, a significant difference between the CAD/MI learning activity and teaching-learning instructional strategy of utilizing a combination of traditional didactic and HHPCS was detected. No significance was detected between the other two learning

activities. Therefore, findings indicate that utilizing a combination of traditional didactic and HHPCS is effective for some learning activities, in this case CAD/MI.

Nyssen, Larbuisson, Janssens, Pendeville, and Mayne (2002) conducted research that may support the selection of an effective instructional strategy. Their goal was to determine an effective instructional strategy in order to assure that learning objectives are met and that learning occurred. While Nyssen et al. (2002) examined anesthesia physician trainees utilizing the instructional strategies of mannequin-based simulation and computer-screen simulation, they concluded that the use of mannequin-based simulation improved performance and decision-making abilities of the trainees, however, the learning outcomes did not vary significantly between the two types of instructional strategies. Since there are some similarities in this investigation and the Nyssen et al, (2002) study, then perhaps further investigation is warranted.

Learning outcomes utilizing the various instructional strategies were also examined in this study. The comparison of learning outcome (total HESI) scores of each student and group revealed that there were no significant differences between the groups when traditional didactic classroom instruction was utilized. However, significant differences were detected when comparing learning outcome scores and the use of HHPCS and a combination of traditional didactic and HHPCS. Additional post hoc analysis using a Bonferroni t-test comparison was used to determine which groups differed significantly. Again, significant differences were detected for the utilization of HHPCS and a combination of traditional didactic and HHPCS instruction. Since each group received different learning content when they were exposed to the various instructional strategies, these findings suggest that the instructional strategy employed

should be assessed and chosen based on the complexity of the content being learned or presented and the educational level of the learner. For example, the results of this study concluded that the content for CAD/MI when presented through the instructional strategy of HHPCS and a combination of traditional didactic classroom and HHPCS is more effective on learning outcomes than presenting hypovolemic and anaphylactic shock through these instructional strategies. Other variables also may have influenced the students' critical thinking abilities and learning outcomes during each instructional strategies utilized in this study. These variables include such things as performance anxiety, confidence, motivation, self-efficacy, learning difficulties, perception, and learning preferences. During this study, these variables were not measured. However, possible performance anxiety was considered as a possible variable that could affect critical thinking abilities and learning outcomes so, measures were implemented to assist subjects in becoming familiar and comfortable with utilizing the simulator.

Focusing on group learning outcome scores and the comparison between learning activities, a significant difference between the CAD/MI learning activity and teaching-learning instructional strategy of utilizing a combination of traditional didactic classroom and HHPCS was detected. No significance was detected with the other two learning activities (traditional didactic classroom or HHPCS instruction). Therefore, this suggests that utilizing a combination of traditional didactic and HHPCS instruction was effective for some learning activities, in this case CAD/MI.

CHAPTER V

SUMMARY

The purpose of this study was to compare critical thinking abilities and learning outcomes of junior undergraduate nursing students when three instructional strategies were utilized to illustrate the nursing care of clients experiencing an emergent cardiovascular or respiratory event using three, defined learning activities. More specifically, this research was conducted in order to shed more light on differences between various teaching-learning instructional strategies and their impact on learning outcomes and critical thinking abilities.

Results from this descriptive, quasi-experimental study indicates that there were some significant statistical differences between instructional strategies and critical thinking abilities and learning outcomes. More specifically, the utilization of HHPCS and a combination of traditional didactic and HHPCS instruction produced a higher critical thinking and learning outcome scores than when the traditional didactic classroom instruction was utilized. Therefore, this indicates that HHPCS and the combination of traditional didactic and HHPCS instruction enables the learner to apply the knowledge learned. However, not every learning activity is appropriate for the use of the combination of instructional strategies. Prior to each learning activity, one must assess the learner, create the objectives, plan the activity, chose the appropriate instructional strategy in an attempt to reinforce concepts and principles of content being learned. This fundamental aspect was definitely experienced in this study and was seen through the results of the students' critical thinking abilities and learning outcomes. Higher critical thinking and learning outcome scores were achieved most likely due to the ease of

learning some concepts and principles, while lower critical thinking and learning outcome scores were achieved when learning more complex concepts and principles which require building upon previously attained knowledge.

Incorporating effective and various teaching-learning instructional strategies is important for nurse educators to realize and implement. Critical thinking and learning outcomes are just two results that can be achieved and were measured and evaluated during this study. One must certainly have a predetermined learning plan in order to plan, implement, and achieve outcomes from the learning activity appropriately and effectively. As demonstrated by the significant results of this study, it may be that HHPCS and/or the combination of traditional didactic classroom and HHPCS instruction would yield higher critical thinking and learning outcome scores, which would illustrate the learning of the concepts and principles and hopefully translate to decision-making abilities in the clinical setting.

Limitations

Some limitations of the study were recognized. First of all, the study was limited to nursing students from one nursing program who were enrolled at a specific point in the nursing program. Second, the results from the study may not be generalizable to a larger population. Third, the immediate testing after one learning activity may not be a true representation of learning or the measurement of one's critical thinking ability and learning outcome of the content learned since learning is a process that occurs over time. Finally, the study was conducted in the academic setting and the results might not relate to the professional nursing practice setting and the education of the professional nurse.

RECOMMENDATIONS

Based on the findings and conclusions from this study, the following recommendations for further study focusing on nursing education and clinical practice are suggested.

Implications for Nursing Academia

In the academic setting, the results of this study illustrate that there is an impact on a student's critical thinking ability and learning outcome when HHPCS, either separate or in combination with another teaching-learning instructional strategy, was utilized. HHPCS allowed the student to experience the learning activity first hand and make decisions and implement interventions on the client that was experiencing an emergent cardiovascular or respiratory event without actually jeopardizing a real client.

The use of the HHPCS is exciting in the academic setting. However, there are some drawbacks that must be considered prior to implementing and utilizing a HHPCS. First of all, the cost of a HHPCS ranges from \$50,000-\$250,000 depending upon the make and model of the simulator purchased. The cost alone can be overwhelming to already financially strapped institutions amongst budget cuts and would necessitate a formal proposal stating the advantages and disadvantages for wanting to purchase and implement HHPCS. Therefore, a cost-benefit analysis will need to be performed in order to prove that HHPCS should be purchased and adopted into an academic program. Benefits of HHPCS would include the active, kinesthetic learning, the safety and prevention of potential harmful errors without jeopardizing a real client, practicing decision-making abilities on certain types of clients, and possible utilization for clinical since some clinical sites and experiences are becoming rare. Some disadvantages of

HHPCS in the academic setting would be acceptance of HHPCS as an effective and beneficial instructional strategy along with the cost and time of training faculty to use HHPCS. Secondly, a HHPCS and its related equipment have a space requirement, which is a valued commodity in most institutions. Finally, a prudent administrator would want to know whether HHPCS has been proven effective in the academic setting with measurable outcomes. This research was an attempt to provide the answer to some of these questions since no published nursing research pertaining to this aspect has been found. The findings of this study are certainly the beginning of more work to be done, however the results did show significant differences between the use of HHPCS and a combination of traditional didactic classroom and HHPCS instruction when comparing critical thinking abilities and learning outcomes.

Another implication for utilizing HHPCS in the nursing academic setting is the appropriateness of the simulation experience to the concept and principles being taught. This study concluded that HHPCS was more effective and beneficial to some learners when learning and applying knowledge in various learning situations and activities. One important item noted from the study was that the more complex the concepts and principles are for a learning activity, the more previous knowledge one should have in order to make the instruction most beneficial to the student. Therefore, it should be noted that HHPCS should be assessed for the appropriateness in the learning activity.

The use of HHPCS may also be highlighted as an academic program strength when recruiting potential students. With the advancement of technology, HHPCS might certainly be a possible tool and teaching strategy that students and parents would find

attractive especially when related to research findings that relate to impacting critical thinking abilities and learning outcomes.

Implications for Professional Nursing Practice

In professional nursing practice, while different than the academic setting, graduate nurses are still learning and developing professionally in their careers. HHPCS may certainly have a place in educating the professional nurse. As discussed in Chapter 1, learning is a lifelong process and the professional nurse and learning objectives for a learning activity are at a higher cognitive level than that of a beginning nurse in the academic setting. While the results of this study do not directly relate to the professional nurse who is practicing clinically, the implications show the impact on a student's critical thinking ability and learning outcome when HHPCS was utilized which could potentially correspond to the clinical setting and the decision-making that occurs by each nurse. Also, HHPCS could be utilized to assess and validate clinical competencies which could lead to time and financial savings since HHPCS could be programmed for the particular competency and the prevention of errors.

When considering the uses of HHPCS for professional nursing practice and the education of clinical nurses, again, one must weigh the cost-benefit ratio when determining whether to purchase and/or adopt the use of the HHPCS. Benefits of HHPCS would include the active, kinesthetic learning which is realistic for the professional nurse and not a stagnant mannequin that is not interactive. Other benefits include practicing decision-making abilities on certain types of clients and high prone (low or high volume) problems that are experienced in a particular clinical setting, practicing new techniques and procedures that would assist in promoting the safety and

preventing potential harmful errors to a real client and would also prevent potential litigation if a problem was encountered in real life. Some disadvantages of HHPCS in the professional nursing practice setting would be acceptance of HHPCS as an effective and beneficial instructional strategy along with the cost and time of training personnel/educators to use HHPCS. Finally, a prudent administrator would want to know whether HHPCS has been proven effective in the professional setting with measurable outcomes. Although this research was an attempt to provide the answer to some of these questions in the academic setting, it is a beginning and the results can be informative to educators in the professional nursing setting.

Recommendations for Future Study

Given the small sample size in this study, it would be beneficial to expand the study. First, the sample size might be enlarged to include a larger sample of beginning baccalaureate degree nursing students from several different nursing programs. Also, the study might be expanded to include other levels of nursing degree students, such as associate degree and senior baccalaureate students, from several different nursing programs. Further studies from a larger sample size, which would include other nursing programs, would assist in further analysis of the research questions presented in this study. Also, further studies might further support the research questions and assist in the development of hypotheses to be tested.

Attrition is a potential problem when utilizing students as subjects. In this study, attrition was also a confounding problem even though the minimum group subject numbers were maintained. In an attempt to obtain a large sample size, it is recommended that study volunteers be solicited early in the semester so not to interfere with rigorous

academic schedules. Also, the scheduling of the various activities is important, and in this study, subjects selected the times to meet which was conducive to their academic and personal schedules which facilitated the number of participants that remained and completed the study.

While this study focused and tested on three learning activities, it would be beneficial to repeat the study utilizing one or all of the learning activities. However, if using the higher content level learning activities, such as shock, it would be recommended that more experienced students who had previous knowledge of fundamental concepts participate.

As noted in Chapter 2, the nursing literature contains numerous critical thinking studies, but is very limited when specifically examining the variables investigated in this particular study. However, one aspect noted in the previous critical thinking studies is that differences and correlations between critical thinking pretest and posttest scores were examined to determine program or intervention effect on critical thinking abilities. Therefore, upon conclusion of this study, it might be beneficial to correlate the pretest critical thinking and learning outcome scores to the posttests for each learning activity. By examining these data, the relationship between the pretest and posttest scores would be determined. When considering the possibility of examining the data for correlations and relationships, the confounding problem of the short time frame in which this study was conducted does exist. Critical thinking abilities should improve over time since one's decision-making abilities would be enhanced from content learned and clinical experience. However, this study may not determine an improvement in one's critical thinking abilities. Thus, it would be recommended that the study be repeated or

expanded upon to incorporate a longitudinal design that might best determine the relationship and correlation between critical thinking abilities when an instructional strategy is utilized.

Individuals possess different learning styles that they prefer to use when processing and learning information. Also, the consideration of other variables that impact one's ability to learn should be taken into account. Therefore, it would be interesting to investigate subjects' learning preferences in an attempt to determine whether any relationship exists that would relate to instructional strategies and impact on critical thinking abilities and learning outcomes. In conjunction with learning preferences, the variables of performance anxiety, confidence, perception, and learning difficulties could also be investigated for existing relationships to instructional strategies and impact on critical thinking abilities and learning outcomes.

Appendix A

The following are course descriptions of nursing courses from the Undergraduate Nursing BSN Program Curriculum which begins upon transfer of previous coursework. (MCG, 2003b, p. 1-3).

Junior Year

NXX1: Principles of Professional Nursing Practice (6 Credits)

This is an introductory course in health assessment and beginning principles of nursing care. Didactic classes and lab experiences provide a foundation on which students can build their professional nursing knowledge and practice. Strategies for health assessment, promotion, and basic provision of nursing care will be emphasized.

NXX2: Foundations I: Concepts of Professional Nursing Practice (2 Credits)

The purpose of this course is to explore the beginning development of professional nursing practice. Nurses' professional roles, professional values, and standards will be presented. The historical development of the nursing profession will be analyzed. Emphasis is placed on critical thinking, problem-solving, decision-making models, and the contribution of theory to nursing practice. Professional communication skills and group dynamics will be examined.

NXX3: Pathophysiology and Pharmacology (3 Credits)

This course introduces the pathophysiological basis of illness and the basic principles of clinical pharmacology. The focus of this course is on compromises in the body's ability to meet its physiological needs integrated with nursing-based pharmacologic interventions in response to these compromises.

NXX4: Lifespan I: Nursing Care of the Beginning Family (5 Credits)

Examination of the health and wellness activities of individuals and their families from birth to age 20. Emphasizes theories regarding beginning families and child-rearing, well-child assessment, and common health problems in children and adolescents. Explores compromises to physical, social and mental health common during these ages and the impact of these compromises on the individual and family are explored. Professional nursing activities that promote and restore optimal health/wellness are the focal points for didactic and clinical experiences. Through the use of various problem-solving methods, students can apply didactic information in actual patient situations and will be guided in bridging nursing theory and practice and in making decisions regarding nursing care. Clinical activities occur in a myriad of nursing practice settings which are both hospital and community-based.

NXX5: Lifespan II: Nursing Care of the Young Family (5 Credits)

Examines the health and wellness activities of individuals and their families from age 20 to 45. Lifespan relevant issues such as childbearing, parenting roles, family theory,

individual development and common health problems in young adulthood. Explores compromises to physical, social, and mental health common during these ages and the impact of these compromises on the individual and family. Professional nursing activities that promote and restore optimal health/wellness are the focal points for didactic and clinical experiences. Through the use of various problem-solving methods, students can apply didactic information in actual patient situations and will be guided in bridging nursing theory and practice and in making decisions regarding nursing care. Clinical activities occur in a myriad of nursing practice settings which are both hospital- and community-based.

NXX6: Foundations II: Health Care Environments (2 Credits)

This course examines the rapidly evolving field of health care and the central role of nurses as health care providers. Community based nursing practice which encompasses all health care environments is introduced. Focus is given to topics such as health care along a continuum, health care structures, and the influence of information driven and outcomes based health care systems. Nursing practice derived from national, regional, and local health priorities serve as central points for discussion. Trends which influence health and the choices people make regarding health care are explored. Students participate in learning opportunities involving analysis of practice-related issues and forecasting of trends in U.S. Health care.

NXX7: Pathophysiology and Pharmacology II (3 Credits)

This course continues to introduce the pathophysiological basis of illness and the basic principles of clinical pharmacology. The focus of this course is on compromises in the body's ability to meet its physiological needs integrated with nursing-based pharmacologic interventions in response to these compromises.

NXX8: Lifespan III: Nursing Care of the Middle Family (5 Credits)

Examines the health promotion and wellness activities of those 45-65. Explores compromises to physical, social and mental health common during this age period and the impact on the individual and family. Professional nursing activities that promote and restore optimal health/wellness are focal points for didactic and clinical experiences. Clinical activities occur in a myriad of nursing practice settings, which are both hospital- and community-based.

NXX9: lifespan IV: Nursing Care of the Mature Family (5 Credits)

Examines the health promotion and wellness activities of individuals and their families age 65 and older. Explores compromises to physical, social and mental health common during this age period and the impact on the individual and family. Focuses on lifespan-relevant issues such as loss, grief, caregiver roles and community resources. Professional nursing activities that promote and restore optimal health/wellness are focal points for didactic and clinical experiences. Clinical activities occur in a myriad of nursing practice settings, including hospital, extended care, home and community settings.

Senior Year

NX10: Foundations III: Impact of Research and Legal/Ethical Issues on Professional Nursing Practice (3 Credits)

The purpose of this course is to provide the students with opportunities to explore legal/ethical issues in nursing and the importance of research to nursing practice. Emphasis is placed on preparation for dealing with the legal and ethical problems they will be faced with in day to day nursing situations. The research process will be examined as it applies to nursing practice. The course is designed so that the student can develop critical thinking skills while analyzing case studies involving legal/ethical dilemmas and critiquing published nursing research.

NX11: Professional Nursing Management of Individuals and Families Experiencing Complex Health Problems (9 Credits)

This course focuses on health promotion, restoration and rehabilitation through application of principles of nursing practice with individuals and families experiencing complex health problems. Emphasis is on the continuity of care, collaboration with the health care team and mobilization of resources for individuals and families with complex physical, mental and social health problems. Clinical experiences occur in a variety of settings.

NX12: Foundations IV: Health Care Leadership, Management and Partnerships in Community-Based Care (3 Credits)

This course will focus on the development of knowledge and skills needed to promote health care of population groups. This course examines the impact of changes of health care on aggregate groups. Theories, concepts and models are presented and students have an opportunity to develop competencies of leadership and management needed for collaboration with community members, health care providers as well as agencies and resources in the community. The overall purpose of this course is to develop and apply creative and effective roles for managing and leading in the delivery of nursing care.

NX13: Professional Nursing Practice (9 Credits)

This course focuses on the principles of professional nursing practice and provides the student the opportunities to synthesize and integrate previous learning experiences. The purpose of this course is to provide comprehensive clinical experiences for the student to assist in the transition from student to professional nurse.

Appendix B

Teaching Plan for Myocardial Infarction- Page 1 of 2				
Objectives	Topical Outline	Teaching Strategies	Method of Evaluation	Student Assignments
<p>Upon completion of this learning activity, the student will be able to:</p> <ol style="list-style-type: none"> 1. Define CAD – Cognitive-Knowledge 2. Describe the etiology and pathophysiology of CAD and MI- Cognitive-Knowledge 3. Identify modifiable and non-modifiable risk factors for CAD- Cognitive-Knowledge 4. Summarize the nursing role in health promotion and maintenance related to the risk factors for CAD- Cognitive-Comprehension, Cognitive-Analysis, Cognitive-Evaluation 5. Describe the clinical manifestations associated with angina and myocardial infarction- Cognitive-Knowledge 6. Identify collaborative care methods for managing the patient with angina and myocardial infarction- Cognitive-Knowledge, Cognitive-Analysis 7. Interpret physical and diagnostic assessment findings in clients who have CAD and MI- Cognitive-Knowledge, Cognitive-Analysis, Cognitive-Evaluation 8. Prioritize care for clients who have CAD- Cognitive-Application, Cognitive-Synthesis 9. Justify care for clients who have CAD- Cognitive-Analysis, Cognitive-Evaluation 10. Develop a discharge plan for the client with CAD- Cognitive-Synthesis 	<p>CAD</p> <ol style="list-style-type: none"> 1. Definition of CAD 2. Overview of CAD pathophysiology 3. Risk factors 4. Health promotion strategies <p>Angina</p> <ol style="list-style-type: none"> 5. Definition of angina <p>MI</p> <ol style="list-style-type: none"> 6. Definition of MI 7. Overview of pathophysiology 8. Clinical presentation, physical assessment findings, and laboratory findings <p>Collaborative Management Strategies</p> <ol style="list-style-type: none"> 9. Therapies for angina 10. Therapies for MI <p>Nursing Care</p> <ol style="list-style-type: none"> 11. ABC's 12. Prompt assessment and relief of pain and anxiety 13. Monitoring and Assessments 14. Activity 15. Diet 16. Bowel Management 17. Coping Skills 18. Client/family education 	<p>Group 1: Lecture</p> <p>Group 2: Simulation</p> <p>Group 3: Lecture & Simulation</p>	<p>20-item multiple-choice exam designed by HESI for use in this research study.</p>	<p>None.</p>

Teaching Plan for Myocardial Infarction- Page 2 of 2				
Objectives	Topical Outline	Teaching Strategies	Method of Evaluation	Student Assignments
11. Prioritize care for clients who have CAD- Cognitive-Application, Cognitive-Synthesis 12. Justify care for clients who have CAD- Cognitive-Analysis, Cognitive-Evaluation 13. Explain the advantages of thrombolysis for a client experiencing an MI- Cognitive-Comprehension 14. Develop a discharge plan for the client with CAD- Cognitive-Synthesis	Nursing Process 4. Acute Pain 5. Anxiety/Fear 6. Risk for decreased cardiac output 7. Activity intolerance 8. Deficient knowledge 9. Risk for impaired judgment Summary of CAD and MI Concepts & Principles 10. Case Study			

Teaching Plan for Deep Vein Thrombosis and Pulmonary Embolism- Page 1 of 2				
Objectives	Topical Outline	Teaching Strategies	Method of Evaluation	Student Assignments
<p>Upon completion of this learning activity, the student will be able to:</p> <ol style="list-style-type: none"> 1. Define PE – Cognitive-Knowledge 2. Describe the etiology and pathophysiology of PE- Cognitive-Knowledge 3. Identify physical and diagnostic findings in clients who are experiencing thrombophlebitis and PE- Cognitive-Knowledge, 4. Interpret physical and diagnostic assessment findings in clients who are experiencing thrombophlebitis and PE- Cognitive-Analysis, Cognitive-Evaluation 5. Select collaborative care methods for managing and caring for the patient with thrombophlebitis- Cognitive-Knowledge, Cognitive-Analysis 6. Prioritize care for clients who are experiencing thrombophlebitis- Cognitive-Application, Cognitive-Synthesis 7. Justify care for clients who are exhibiting thrombophlebitis- Cognitive-Analysis, Cognitive-Evaluation 8. Select collaborative care methods for managing and caring for the patient with PE- Cognitive-Knowledge, Cognitive-Analysis 9. Prioritize care for clients who are experiencing a PE- Cognitive-Application, Cognitive-Synthesis 	<ol style="list-style-type: none"> 1. Define PE 2. Overview of PE pathophysiology 3. Etiology of PE from DVT and thrombophlebitis 4. Clinical manifestations and physical findings of DVT 5. Diagnostics for DVT 6. Treatment for DVT 7. Clinical manifestations and physical findings of PE 8. Diagnostics of PE 9. Treatment for PE: non-surgical and surgical <p>Nursing Process</p> <ol style="list-style-type: none"> 10. Ineffective breathing pattern 11. Impaired gas exchange 12. Ineffective cardiopulmonary tissue perfusion 13. Fear/Anxiety 14. Ineffective peripheral tissue perfusion (DVT) 15. Acute pain 16. Risk for impaired physical mobility 17. Deficient knowledge <p>Summary of DVT and PE Concepts and Principles</p> <ol style="list-style-type: none"> 18. Case Study 	<p>Group A: Simulation</p> <p>Group B: Lecture & Simulation</p> <p>Group C: Lecture</p>	<p>20-item multiple- choice exam designed by HESI for use in this research study.</p>	<p>None.</p>

Teaching Plan for Deep Vein Thrombosis and Pulmonary Embolism- Page 2 of 2				
Objectives	Topical Outline	Teaching Strategies	Method of Evaluation	Student Assignments
10. Justify care for clients who are experiencing a PE- Cognitive-Analysis, Cognitive-Evaluation				

Teaching Plan for Anaphylaxis and Hypovolemic Shock- Page 1 of 2				
Objectives	Topical Outline	Teaching Strategies	Method of Evaluation	Student Assignments
<p>Upon completion of this learning activity, the student will be able to:</p> <ol style="list-style-type: none"> 1. Define Shock – Cognitive-Knowledge 2. Describe the clinical manifestations associated with the compensatory mechanism of shock- Cognitive-Knowledge 3. Discriminate between compensatory and decompensatory shock- Cognitive-Analysis, Cognitive-Evaluation 4. Describe the etiology and pathophysiology of hypovolemic shock- Cognitive-Knowledge 5. Interpret physical and diagnostic findings in clients who are experiencing hypovolemic shock- Cognitive Knowledge, Cognitive-Analysis, Cognitive-Evaluation 6. Select collaborative care methods for managing and caring for the patient with hypovolemic shock- Cognitive-Knowledge, Cognitive-Analysis 7. Prioritize care for the clients exhibiting hypovolemic shock- Cognitive-Application, Cognitive-Synthesis 8. Justify care for clients who are exhibiting hypovolemic shock- Cognitive-Analysis, Cognitive-Evaluation 9. Describe the etiology and pathophysiology of anaphylaxis- Cognitive-Knowledge 	<p>Shock</p> <ol style="list-style-type: none"> 1. Definition 2. Compensation 3. Decompensation <p>Goals for Managing Shock</p> <ol style="list-style-type: none"> 4. Correct initiating event 5. Establish and maintain adequate tissue perfusion 6. Restore normal cell function 7. Maintain acid-base balance <p>Hypovolemic Shock</p> <ol style="list-style-type: none"> 8. Definition 9. Etiology 10. Overview of pathophysiology 11. Clinical manifestations 12. Treatment <p>Anaphylaxis</p> <ol style="list-style-type: none"> 13. Definition 14. Etiology 15. Overview of pathophysiology 16. Clinical manifestations 17. Treatment <p>Nursing Process</p> <ol style="list-style-type: none"> 18. Deficient fluid volume 19. Ineffective tissue perfusion 20. Anxiety 	<p>Group A: Lecture & Simulation</p> <p>Group B: Lecture</p> <p>Group C: Simulation</p>	<p>20-item multiple-choice exam designed by HESI for use in this research study.</p>	<p>None.</p>

Teaching Plan for Anaphylaxis and Hypovolemic Shock- Page 2 of 2				
Objectives	Topical Outline	Teaching Strategies	Method of Evaluation	Student Assignments
<p>Upon completion of this learning activity, the student will be able to:</p> <p>10. Interpret physical and diagnostic assessment findings in clients who are experiencing anaphylaxis- Cognitive-Knowledge, Cognitive-Analysis, Cognitive-Evaluation</p> <p>11. Select collaborative care methods for managing the patient with anaphylaxis- Cognitive-Knowledge, Cognitive-Analysis</p> <p>12. Prioritize care for clients who are exhibiting anaphylaxis- Cognitive-Application, Cognitive-Synthesis</p> <p>13. Justify care for the clients who are exhibiting anaphylaxis- Cognitive-Analysis, Cognitive-Evaluation</p>	<p>21. Ineffective airway clearance (anaphylaxis)</p> <p>22. Decreased cardiac output</p> <p>Summary of Shock Concepts and Principles</p> <p>23. Overview of pathophysiology</p>	<p>Group A: Lecture & Simulation</p> <p>Group B: Lecture</p> <p>Group C: Simulation</p>	<p>20-item multiple- choice exam designed by HESI for use in this research study.</p>	<p>None.</p>

Appendix C

HESI TEST BLUEPRINT**CAD/MI Learning Activity**

<u>Item #</u>	<u>Item Name</u>	<u>Specialty</u>
1	Risk Factors	Professional Issues
2	NTG dizzy	Fundamentals
3	Cc/hr Heparin	Fundamentals
4	CAD Diet	Fundamentals
5	Angina/exercise	Medical Surgical
6	Atropine use	Medical Surgical
7	CAD Risk Factors	Medical Surgical
8	Cardiac Enzymes	Medical Surgical
9	Coreg	Medical Surgical
10	HDL cholesterol	Medical Surgical
11	Lipitor-eval	Medical Surgical
12	MI	Medical Surgical
13	MI EKG Changes	Medical Surgical
14	MI Labs	Medical Surgical
15	MI Nursing Diagnosis	Medical Surgical
16	S&S MI	Medical Surgical
17	S-3 heart sound	Medical Surgical
18	Thrombolytics	Medical Surgical
19	NTG administration	Professional Issues/Medical Surgical
18	Defense mechanism	Psychiatric/Mental Health

Estimated Reliability: KR-20 = 0.96

Actual Reliability: KR-20 = 0.976

HESI TEST BLUEPRINT**DVT/PE Learning Activity**

<u>Item #</u>	<u>Item Name</u>	<u>Specialty</u>
1	Elastic stocking	Fundamentals
2	Heparin fill in blank	Fundamentals
3	Pump Heparin	Fundamentals
4	Pneumatic compression	Fundamentals/Medical Surgical
5	DC IV Heparin	Fundamentals/Medical Surgical
6	Anticoagulation therapy	Medical Surgical
7	Anticoagulation therapy	Medical Surgical
8	Anticoagulation therapy	Medical Surgical
9	Coumadin/INR	Medical Surgical
10	Heparin administration	Medical Surgical
11	IPC compression devices	Medical Surgical
12	IV Heparin fill in blank	Medical Surgical
13	Protamine sulfate	Medical Surgical
14	DVT	Medical Surgical
15	PE 2	Medical Surgical
16	DVT	Medical Surgical
17	PE	Medical Surgical
18	PE 3	Medical Surgical
19	PE 1	Medical Surgical
20	PE and heparin	Medical Surgical

Estimated Reliability: KR-20 = 0.95

Actual Reliability: KR-20 = 0.99

HESI TEST BLUEPRINT

Anaphylaxis and Hypovolemic Shock Learning Activity

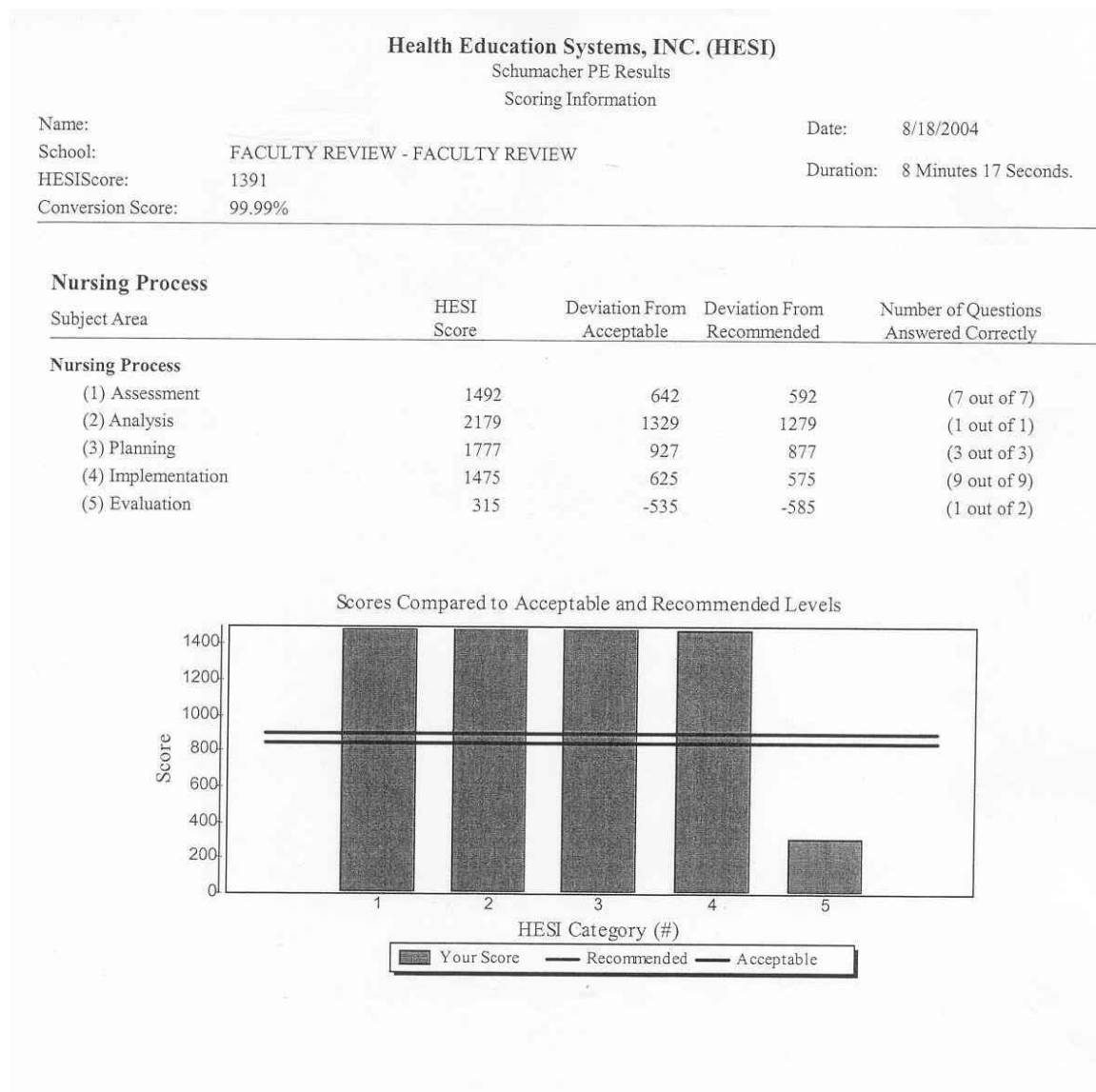
<u>Item #</u>	<u>Item Name</u>	<u>Specialty</u>
1	Hypersensitive	Community Health/Geriatrics/ Professional Issues/Medical Surgical
2	Anaphylactic reaction	Fundamentals
3	Anaphylaxis Management	Fundamentals/Medical Surgical
4	Anaphylactic shock	Medical Surgical
5	Anaphylactic shock	Medical Surgical
6	Hypovolemic shock	Medical Surgical
7	Nursing Diagnosis with shock	Medical Surgical
8	Shock category/distributive	Medical Surgical
9	Shock fluid balance	Medical Surgical
10	Shock interventions	Medical Surgical
11	Shock assess	Medical Surgical
12	Shock- hypovolemic	Medical Surgical
13	Shock- compensation	Medical Surgical
14	Shock urine output	Medical Surgical
15	Emergency shock treatment	Medical Surgical
16	GSW shock position	Medical Surgical
17	Hypovolemic shock	Medical Surgical
18	Shock nursing diagnosis	Medical Surgical
19	Shock symptoms	Medical Surgical
20	Wasp sting	Medical Surgical

Estimated Reliability: KR-20 = 0.93

Actual Reliability: KR-20 = 0.921

Appendix D

The following are sample scoring reports generated from a HESI custom-made exam.



Health Education Systems, INC. (HESI)

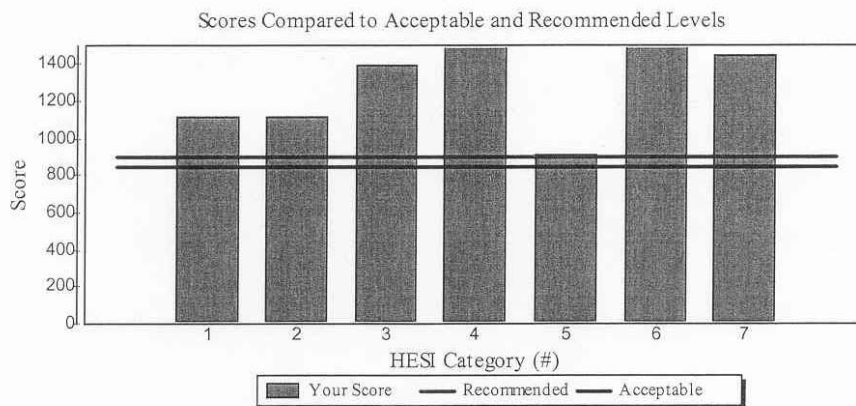
Schumacher PE Results

Scoring Information

Name:		Date:	8/18/2004
School:	FACULTY REVIEW - FACULTY REVIEW	Duration:	8 Minutes 17 Seconds.
HESIScore:	1391		
Conversion Score:	99.99%		

Client Needs

Subject Area	HESI Score	Deviation From Acceptable	Deviation From Recommended	Number of Questions Answered Correctly
Client Needs				
(1) Safe/Effective Environment	1118	268	218	(1 out of 1)
(2) Mgmt of Care	1118	268	218	(1 out of 1)
(3) Physiological Integrity	1391	541	491	(19 out of 20)
(4) Basic Care/Comfort	2179	1329	1279	(1 out of 1)
(5) Pharm & Parenteral Tx	911	061	011	(7 out of 8)
(6) Reduce Risk Potential	1593	743	693	(9 out of 9)
(7) Physio Adaptation	1451	601	551	(2 out of 2)



Health Education Systems, INC. (HESI)

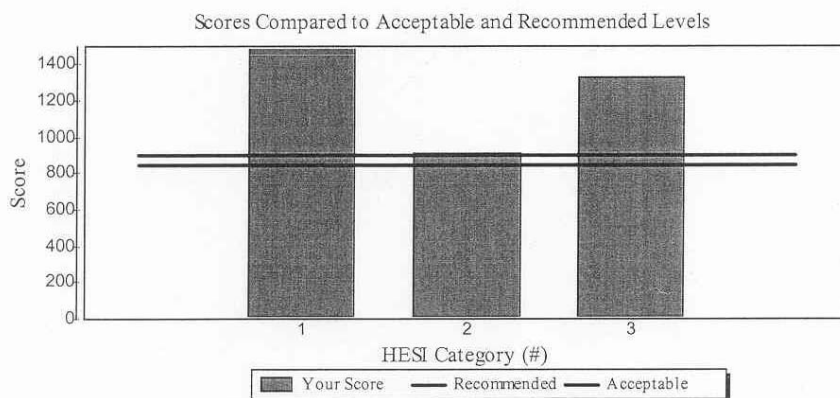
Schumacher PE Results

Scoring Information

Name: _____ Date: 8/18/2004
 School: FACULTY REVIEW - FACULTY REVIEW Duration: 8 Minutes 17 Seconds.
 HESIScore: 1391
 Conversion Score: 99.99%

Specialty Area

Subject Area	HESI Score	Deviation From Acceptable	Deviation From Recommended	Number of Questions Answered Correctly
(1) Fundamentals	1845	995	945	(3 out of 3)
(2) Maternity	913	063	013	(1 out of 1)
(3) Medical Surgical	1327	477	427	(15 out of 16)



Health Education Systems, INC. (HESI)

Schumacher PE Results

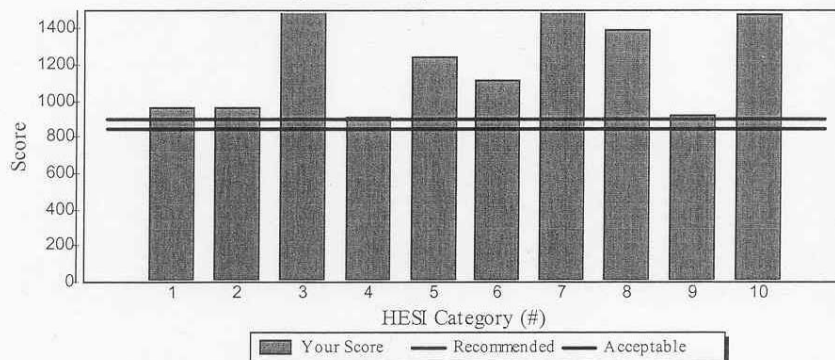
Scoring Information

Name: [REDACTED] Date: 8/18/2004
 School: FACULTY REVIEW - FACULTY REVIEW Duration: 8 Minutes 17 Seconds.
 HESIScore: 1391
 Conversion Score: 99.99%

Sub-Specialty

Subject Area	HESI Score	Deviation From Acceptable	Deviation From Recommended	Number of Questions Answered Correctly
Fundamentals				
(1) Med Administration	960	110	060	(2 out of 2)
(2) Math	960	110	060	(2 out of 2)
(3) Basic Nursing Skills	2179	1329	1279	(1 out of 1)
Maternity				
(4) Postpartum	913	063	013	(1 out of 1)
Clinical Concepts: Med-Surg/Pedi/Geri				
(5) Cardiovascular	1238	388	338	(10 out of 11)
(6) Immune/Hematology	1118	268	218	(1 out of 1)
(7) Musculoskeletal	1541	691	641	(5 out of 5)
(8) Operative	1393	543	493	(1 out of 1)
(9) Physical Assessment	923	073	023	(1 out of 1)
(10) Respiratory	1474	624	574	(2 out of 2)

Scores Compared to Acceptable and Recommended Levels



Health Education Systems, INC. (HESI)

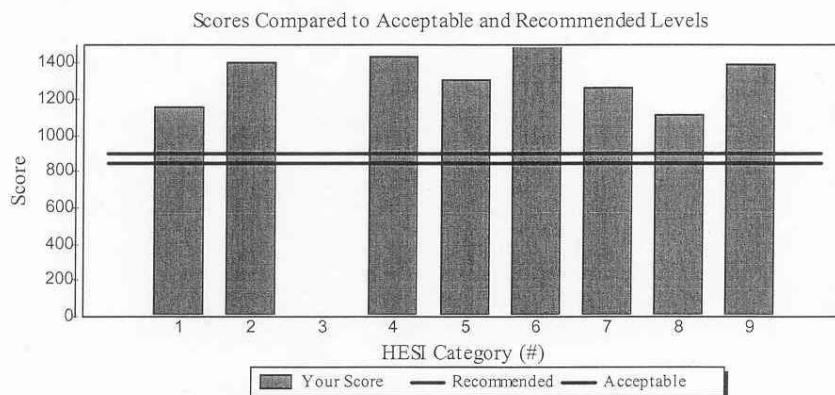
Schumacher PE Results

Scoring Information

Name: _____ Date: 8/18/2004
 School: FACULTY REVIEW - FACULTY REVIEW Duration: 8 Minutes 17 Seconds.
 HESIScore: 1391
 Conversion Score: 99.99%

AACN Accreditation Categories

Subject Area	HESI Score	Deviation From Acceptable	Deviation From Recommended	Number of Questions Answered Correctly
Core Categories				
(1) Assessment	1154	304	254	(8 out of 9)
(2) Critical Thinking	1401	551	501	(18 out of 19)
(3) Communication	000	-850	-900	(0 out of 0)
(4) Technical skills	1440	590	540	(10 out of 10)
Core Knowledge				
(5) Hlth Promo/Risk/Prvnt	1302	452	402	(12 out of 13)
(6) Illness & Disease Mgmt	1610	760	710	(9 out of 9)
(7) Info & Hlth Care Tech	1268	418	368	(3 out of 3)
Role Development				
(8) Manager of Care	1118	268	218	(1 out of 1)
(9) Provider of Care	1391	541	491	(19 out of 20)



Appendix E



CONFIDENTIAL

The enclosed HESI materials are provided to you for review ONLY.

Your receipt of these materials implies that you recognize and agree that these materials are confidential information. You recognize that it is HESI policy to treat the information contained within as confidential and agree to take all steps necessary to ensure confidentiality. Such information shall not be left in areas accessible to the public.

You agree that after reviewing these materials, within six weeks of the shipping date to your location, all materials shall be returned to HESI.

AGREED:

Health Education Systems, Inc.

AGREED:

Reviewer

Appendix F

Demographic Data Questionnaire

Please provide the following information as best as you are able by listing information requested or by circling the appropriate response.

1. Age: Please list your age _____

2. GPA: Please list your current grade point average _____

3. Please list any previous education you may have obtained (eg. Technical college, other degrees, certification, etc)

4. Previous healthcare related experience:
Please circle any of the following that pertain to your past experience related in the medical field:
 - a. none
 - b. nursing assistant
 - c. Pharmacy Technician
 - d. Surgical Technician
 - e. Laboratory Technician
 - f. Unit/Ward Secretary
 - g. Emergency Medical Technician
 - h. other (please list): _____

Appendix G



DUQUESNE UNIVERSITY

INSTITUTIONAL REVIEW BOARD

403 ADMINISTRATION BUILDING ♦ PITTSBURGH, PA 15282-0202

Dr. Paul Richer
 Chair, Institutional Review Board
 403 Administration Building
 Duquesne University
 Pittsburgh, PA 15282
 web site: <http://www2.duq.edu/research/policies.cfm#human>

July 26, 2004

Re: The impact of utilizing high-fidelity computer simulation on critical thinking

Ms. Lori Schumacher

Dear Ms. Schumacher:

Thank you for submitting your research proposal.

Based upon the recommendation of IRB member, Dr. Kathleen Sekula, along with my own review, I have determined that your research proposal is consistent with the requirements of the appropriate sections of the 45-Code of Federal Regulations-46 Part A, known as the federal Common Rule. The intended research poses no greater than minimal risk to human subjects. Consequently, under rules 46.101 and 46.110, your proposed research is approved on an expedited basis.

Oral interactions between you or the teacher with student subjects should not even implicitly convey that students are obligated to participate in the research. Even though you are not teaching the course in which research is being conducted, still you are a faculty member at their school.

The IRB stamps the consent form with an approval date and one year expiration date. This stamp appears on the front page of the consent form, which is being sent to you under separate cover. You should use the stamped page as the original for your copies. Please remember that there should be two copies of each consent form with original signatures, one for you and one for the subject.

This approval must be renewed in one year as part of the IRB's continuing review. You will need to submit a progress report to the IRB in response to a questionnaire that we will send. In addition, if you are still utilizing your consent form, you will need to have it approved for another year's use.

If, prior to the annual review, you propose any changes in your procedure or consent process, you must inform the IRB of those changes and wait for approval before implementing them. In addition, if any

procedural complications or adverse effects on subjects are discovered before the annual review, they immediately must be reported to the IRB before proceeding with the study.

When the study is complete, please provide us with a summary, approximately one page. Often the completed study's Abstract suffices. Please keep a copy of your research records, other than those you have agreed to destroy for confidentiality, over a period of three years after the study's completion.

Thank you for contributing to Duquesne's research endeavors.

If you have any questions, feel free to contact me at any time.

Sincerely yours,

A handwritten signature in black ink, appearing to read "Paul Richer".

Paul Richer, Ph.D.
Chair, IRB

C:
Dr. Kathleen Sekula
Dr. Joan Lockhart
IRB Records



DUQUESNE UNIVERSITY

INSTITUTIONAL REVIEW BOARD

403 ADMINISTRATION BUILDING ♦ PITTSBURGH, PA 15282-0202

Dr. Paul Richer
Chair, Institutional Review Board
Phone (412) 396-6326 Fax (412) 396-5176
e-mail: richer@duq.edu
web site: <http://www2.duq.edu/research/policies.cfm#human>

August 4, 2004

Ms. Lori Schumacher

Dear Ms. Schumacher,

Enclosed is your revised IRB approval letter for the project, "The impact of utilizing high-fidelity computer simulation on critical thinking."

I apologize for needing to send a revision. I simply forgot to send the letter as an attachment to Ms. Volk at the Office of Research last week. Not knowing that you and I had discussed the change in status from exempt to expedited, she naturally asked Mr. Mariani to issue an exempt letter, knowing that I had approved the project.

Please substitute the enclosed letter with the appropriate expedited approval designation and discard the letter showing exempt status. As we discussed last week on the phone, the difference it will make for you is that you will need to file an annual progress report with our office and you will need to report any unforeseen problems in regard to subjects' rights to our office at any time those problems might arise.

I'm very sorry for the confusion. If you have any questions, please feel free to send a message or call: 412-661-2437.

Sincerely yours,

Paul Richer, Ph.D.
Chair, Institutional Review Board
Duquesne University

C:
Dr. Kathleen Sekula
Dr. Joan Lockhart
Dr. Linda Goodfellow



DUQUESNE UNIVERSITY

600 FORBES AVENUE ♦ PITTSBURGH, PA 15282
 DUQUESNE UNIVERSITY
 INSTITUTIONAL REVIEW BOARD

APPROVAL DATE: 8-2-04
 EXPIRATION DATE: 8-2-05

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

TITLE: The Impact of Utilizing High-Fidelity Computer Simulation on Critical Thinking Abilities and Learning Outcomes in Undergraduate Nursing Students

INVESTIGATOR: Lori Schumacher, RN, MS, CCRN

ADVISOR: (if applicable): Dr. Joan Lockhart
 Duquesne University, School of Nursing
 Office Phone:

SOURCE OF SUPPORT: This study is being performed as partial fulfillment of the requirements for the doctoral degree in Nursing at Duquesne University.

PURPOSE: You are being asked to participate in a research project that seeks to investigate your learning and critical thinking abilities on three nursing topics that you will be exposed to throughout the study using the teaching strategies of classroom instruction and the technology of high-fidelity computer simulation. You will be asked to complete four computerized tests: 1) pretest, 2) a posttest after completing learning activity #1, 3) a posttest after completing learning activity #2, and 4) a posttest after completing learning activity #3. You will be asked to actively participate in each of the three learning activities which range from 50-90 minutes.

You will be asked not to share information covered on the pretest and posttests with other students until after the study is completed.

These are the only requests that will be made of you.

RISKS AND BENEFITS: There are no foreseeable risks for participating in this study. However, you might experience some anxiety as you learn utilizing the technology of high-fidelity computer simulation. To assist you in the learning activity during which simulation will be utilized, you will receive a hands-on demonstration of the simulator at the onset of the learning activity.

The benefits to participation include:

1. You will discover your strengths and weaknesses in your critical thinking and decision-making abilities.
2. You will be able to learn about three nursing topics in a small group atmosphere that is in a non-threatening environment since the learning activities and individual performance in this study **DOES NOT** affect your course grade and is not affiliated with any course you are enrolled in. The data obtained in this research study will **NOT** be used for evaluation in any course.

COMPENSATION:

If you agree to be in this study, there will be no compensation to you forthright. Also, participation in this project will require no monetary cost to you.

CONFIDENTIALITY:

Your name will never appear on any survey or research instruments available to the investigator. No identity will be made in the data analysis. All written materials and consent forms will be stored in a locked file in the researcher's office. Your responses will only appear in statistical data summaries. All materials will be destroyed in 5 years.

RIGHT TO WITHDRAW:

You are under no obligation to participate in this study. You are free to withdraw your consent to participate at any time.

SUMMARY OF RESULTS:

A summary of the results of this research will be supplied to you, at no cost, upon request.

VOLUNTARY CONSENT:

I have read the above statements and understand what is being requested of me. I also understand that my participation is voluntary and that I am free to withdraw my consent at any time, for any reason. On these terms, I certify that I am willing to participate in this research project.

I understand that should I have any further questions about my participation in this study, I may call Dr. Paul Richer, Chair of the Duquesne University Institutional Review Board (412-396-6326).

Participant's Signature

Date

Researcher's Signature

Date

Appendix H

Lori Schumacher - RE: Permission to Use Figures/Illustrations from Theory

Page 1

From: Lori Schumacher
Subject: RE: Permission to Use Figures/Illustrations from Theory

>>> "VanSell, Sharon" <[REDACTED]> 06/08/04 02:29PM >>>

Thank you for your e-mail, it was great to hear from you. Hope all is going well on your dissertation work.

The material was copyrighted In Entirety 2002, and I give you permission to use the illustrations with correct reference.

If you need any additional help, please contact me.

Have a great summer.

Cordially,
Dr. Sharon L. Van Sell

-----Original Message-----

From: Lori Schumacher
Sent: Monday, June 07, 2004 7:00 AM
To: VanSell, Sharon
Subject: Permission to Use Figures/Illustrations from Theory

Sharon,
Good Morning! I hope all is well. I am beginning my last stages of doctoral work. I am currently in the process of writing my first three chapters of my dissertation and getting ready for proposal defense. I am writing to request permission to use 3 illustrations from your Complexity Integration Nursing Theory. The 3 illustrations that I wish to use are:

- Illustration of the model of metatheory
- Illustration of the Theory of Nursing Knowledge and Practice
- Illustration of the Self Observation Methodology

Please let me know at your earliest convenience. Thanks!
-Lori Schumacher

From: Petra Bangs
To: Schumacher, Lori
Date: 9/1/2004 8:28:23 AM
Subject: Fwd: Permission

>>> Petra Bangs 8/30/2004 13:35:38 >>>
L.S.,

Prof. Lori Schumacher, is seeking
permission to use the following:

"Crisis Management in Anesthesiology"
by D.M. Gaba, K.J. Fish, and S.K. Howard,
Copyright 1994 by Churchill Livingstone
ISBN 0-443-08910-8
Graphic on page 19

The graphic will be used as part of her dissertation.

Please advice.

Petra B. Bangs

09/01/2004 06:21 FAX

PERMISSIONS

001



August 31, 2004

Our ref: Bangs

Petra B. Bangs

Dear Ms. Bangs:

Publication: Graphic on page 19 from Gabu, Fish, and Howard: CRISIS MANAGEMENT IN ANESTHESIOLOGY, copyright 1994 Elsevier Inc.

As per your letter dated August 30, 2004, we hereby grant you permission to reprint the aforementioned material at no charge in your thesis subject to the following conditions:

1. If any part of the material to be used (for example, figures) has appeared in our publication with credit or acknowledgement to another source, permission must also be sought from that source. If such permission is not obtained then that material may not be included in your publication/copies.
2. Suitable acknowledgment to the source must be made, either as a footnote or in a reference list at the end of your publication, as follows:

"Reprinted from Publication title, Vol. number, Author(s), Title of article, Pages No., Copyright (Year), with permission from Elsevier."
3. Reproduction of this material is confined to the purpose for which permission is hereby given.
4. This permission is granted for non-exclusive world English rights only. For other languages please reapply separately for each one required. Permission excludes use in an electronic form. Should you have a specific electronic project in mind please reapply for permission.
5. This includes permission for University Microfilms to supply single copies, on demand, of the complete thesis. Should your thesis be published commercially, please reapply for permission.

Yours sincerely,

A handwritten signature in cursive script, appearing to read "Michael J. Lacovara".
Michael J. Lacovara
for Elsevier

For your convenience, apply online at www.us.elsevierhealth.com

The Curtis Center – Independence Square West – Suite 300 – Philadelphia, PA 19106
Phone (215) 238-7869 Fax (215) 238-2239 Email: healthpermissions@elsevier.com

References

- AACN: American Association of Colleges of Nurses. (1998). *The Essentials of Baccalaureate Education for Professional Nursing Practice*. Washington D. C.: American Association of Colleges of Nursing.
- Adams, M. H., Whitlow, J. F., Stover, L. M. & Johnson, K. W. (1996). Critical thinking as an educational outcome: An evaluation of current tools of measurement. *Nurse Educator*, 21(3), 23-32.
- Alfaro-LeFevre, R. (2004). *Critical Thinking and Clinical Judgment: A Practical Approach*. 3rd Edition. St. Louis, MO: Saunders.
- Ali, J., Cohen, R. J., Gana, T. J. & Al-Bedhah, K. F. (1998). Effect of the advanced trauma life support program on medical students' performance in simulated trauma patient management. *The Journal of Trauma*, 44, 588-591.
- Ausubel, D. P. (1978). *Educational Psychology: A Cognitive View*. 2nd Edition. New York, NY: Holt, Rhinehart & Winston.
- Barker, S. J. (2003). Too much technology? *Anesthesia and Analgesia*, 97, 938-939.
- Beckie, T. M., Lowry, L. W. & Barnett, S. (2001). Assessing critical thinking in baccalaureate nursing students: A longitudinal study. *Holistic Nursing Practice*, 15(3), 18. Retrieved on March 19, 2003, from the ProQuest database.
- Beeken, J. E. (1997). The relationship between critical thinking and self-concept in staff nurses and the influence of these characteristics on nursing practice. *Journal of Nursing Staff Development*, 13, 272-278.
- Benner, P. (1982). From novice to expert. *American Journal of Nursing*, 82, 402-407.

- Benner, P. (1984). *From Novice to Expert: Excellence and Power in Clinical Nursing Practice*. Upper Saddle River: Prentice Hall.
- Benner, P. (2000). The wisdom of our practice: Thoughts on the art and intangibility of caring practice. *American Journal of Nursing*, 100(10), 99-105.
- Benner, P., Hooper-Kyriakidis, P. & Stannard, D. (1999). *Clinical Wisdom and Interventions in Critical Care: A Thinking-In-Action Approach*. Philadelphia: W. B. Saunders.
- Bloom, B., Englehart, M., Furst, E., Hill, W. & Krathwohl, D. (1956). *Taxonomy of Educational Objectives: Handbook I, Cognitive Domain*. New York: David McKay.
- Boychuck, J. E. D. (1999). Catching the wave: understanding the concept of critical thinking. *Journal of Advanced Nursing*, 29, 577-583.
- Bradshaw, M. J. (2001). Effective learning: What teachers need to know. In A. J. Lowenstein & M. J. Bradshaw (Eds). *Fuszard's Innovative Teaching Strategies in Nursing*. 3rd Edition. (pp. 3-17). Gaithersburg: Aspen Publishers, Inc.
- Brown, J. S., Collins, A. & Duguid, S. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18, 32-42.
- Browne, M. N. & Freeman, K. (2000). Distinguishing features of critical thinking classrooms. *Teaching in Higher Education*, 5, 301. Retrieved on March 30, 2003, from the ProQuest database.
- Carovano, R. (1997). *Modeling in full-scale patient simulators*. Retrieved June 7, 2004, from the World Wide Web: www.sisostds.org/webletter/siso/iss_19/art_137.htm.

- Chau, J. P. C., Chang, A. M., Lee, I. F. K., Ip, W. Y., Lee, D. T. F. & Wootton, Y. (2001). Effects of using videotaped vignettes on enhancing students' critical thinking ability in a baccalaureate nursing programme. *Journal of Advanced Nursing*, 36, 112-119.
- Chopra, V., Gesnik, B. J., DeJong, J., Bovill, J. G., Spierdijk, J. & Brand, R. (1994). Does training on an anaesthesia simulator lead to improvement in performance? *British Journal of Anaesthesia*, 73, 293-297.
- Cook, P. R. (2001). Critical thinking in nursing education. In A. J. Lowenstein & M. J. Bradshaw (Eds.), *Fuszard's Innovative Teaching Strategies in Nursing*. 3rd Edition. (pp. 29-42). Gaithersburg: Aspen Publishers, Inc.
- Daley, B. J., Shaw, C. R., Balistreri, T., Glasenapp, K. & Piacentine, L. (1999). Concept maps: A strategy to teach and evaluate critical thinking. *Journal of Nursing Education*, 38(1), 42. Retrieved on March 9, 2003, from the ProQuest database.
- Daly, W. M. (1998). Critical thinking as an outcome of nursing education. What is it? Why is it important to nursing practice? *Journal of Advanced Nursing*, 28, 323-331.
- Daly, W. M. (2001). The development of an alternative method in the assessment of critical thinking as an outcome of nursing education. *Journal of Advanced Nursing*, 36, 120-130.
- DeAnda, A. & Gaba, D. M. (1991). Role of experience in the response to simulated critical incidents. *Anesthesia and Analgesia*, 72, 308-315.
- Devitt, J. H., Kurrek, M. M., Cohen, M. M. & Cleave-Hogg, D. (2001). The validity of performance assessments using simulation. *Anesthesiology*, 95, 36-42.

- DiVito-Thomas, P. (2000). Identifying critical thinking behaviors in clinical judgments. *Journal for Nurses in Staff Development, 16*, 174-180.
- Dunn, W. F. (2004). *Simulators in Critical Care and Beyond*. Des Plaines, IL: Society of Critical Care Medicine.
- Dyer, J., Riley, J. & Yekovich, F. (1979). An analysis of three study skills: Notetaking, summarizing, and rereading. *The Journal of Educational Research, 73*, 3-7.
- Egan, M. E. (2004). The perfect patient: A new simulator for medical training could prove better than the real thing. *Forbes, June 21*, 210-211.
- Euliano, T. Y. (2001a). Small group teaching: Clinical correlation with a human patient simulator. *Advances in Physiology Education, 25*, 36-43.
- Euliano, T. Y. (2001b). Teaching respiratory physiology: Clinical correlations with a human patient simulator. *Journal of Clinical Monitoring and Computing, 16*, 465-470.
- Euliano, T. Y., Caton, D., van Muers, W. & Good, M. L. (1997). Modeling obstetric cardiovascular physiology on a full-scale patient simulator. *Journal of Clinical Monitoring, 13*, 293-297.
- Facione, N. C. (1997). *Critical Thinking Assessment in Nursing Education Programs: An Aggregate Data Analysis*. Millbrae, CA: The California Academic Press.
- Facione, P. A. (1990). *Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction*. Milbank, CA: California Academic Press.

- Facione, P. A., Facione, N. C., Blohm, S. W. & Giancarlo, C. A. F. (2002). *The California Critical Thinking Skills Test: Test Manual*. Millbrae, CA: Insight Assessment.
- Gaba, D. M. & DeAnda, A. (1989). The response of anesthesia trainees to simulated critical incidents. *Anesthesia and Analgesia*, 68, 444-451.
- Gaba, D. M., Fish, K. J. & Howard, S. K. (1994). *Crisis Management in Anesthesiology*. New York: Churchill Livingstone.
- Gaba, D. M., Howard, S. K., Flanagan, B., Smith, B. E., Fish, K. J. & Botney, R. (1998). Assessment of clinical performance during simulated crises using both technical and behavioral ratings. *Anesthesiology*, 89, 8-18.
- Girot, E. A. (2000). Graduate nurses: Critical thinkers or better decision makers? *Journal of Advanced Nursing*, 31, 288-297.
- Haffer, A. G. & Raingruber, B. J. (1998). Discovering confidence in clinical reasoning and critical thinking development in baccalaureate nursing students. *Journal of Nursing Education*, 37(2), 61-70.
- Hotchkiss, M., Biddle, C. & Fallacaro, M. (2002). Assessing the authenticity of the human simulation experience in anesthesiology. *American Association of Nurse Anesthetists*, 70, 470-473.
- Howard, S. K., Gaba, D. M., Fish, K. J., Yang, G. & Sarnquist, F. H. (1992). Anesthesia crisis resource management training: Teaching anesthesiologists to handle critical incidents. *Aviation, Space, and Environmental Medicine*, 63, 763-770.

- Issenberg, S. B., McGaghie, W. C., Gordon, D. L., Symes, S., Petrusa, E. R., Hart, I. R. & Harden, R. M. (2002). Effectiveness of a cardiology review course for internal medicine residents using simulation technology and deliberate practice. *Teaching and Learning in Medicine, 14*, 223-228.
- Jacobsen, J., Lindek, A. L., Ostergaard, H. T., Nielsen, K., Ostergaard, D., Laub, M., Jensen, P. F. & Johannessen, N. (2001). Management of anaphylactic shock evaluated using a full-scale anaesthesia simulator. *ACTA Aneesthesologica Scandinavica, 45*, 315-319.
- Johnson, J. H., Zerwic, J. J. & Theis, S. L. (1999). Clinical simulation laboratory: An adjunct to clinical teaching. *Nurse Educator, 24*(5), 37-41.
- Jung, C. (1923). *Psychological Types*. London: Routledge and Kegan Paul, LTD.
- Knowles, M. S. (1990). *The Adult Learner: A Neglected Species*. 4th Edition. Houston: Gulf.
- Kozlowski, R. (2004). Smart dummies. *Sarasota/Manatee Business, August 2004*, 24-29.
- Kurrek, M. M. & Fish, K. J. (1996). Anaesthesia crisis resource management training: An intimidating concept, a rewarding experience. *Canadian Journal of Anaesthesia, 43*, 430-434.
- Lampotang, S., Gravenstein, J. S., Euliano, T. Y., van Muers, W., Good, M. L., Kubilis, P. & Westhorpe, R. (1998). Influence of pulse oximetry on time to diagnosis of critical incidents in anesthesia: A pilot study using a full-scale patient simulator. *Journal of Clinical Monitoring and Computing, 14*, 313-321.

- Launcher, K. A., Newman, M. & Britt, R. B. (1999). Predicting licensure success with a computerized comprehensive nursing exam: The HESI exit exam. *Computers in Nursing, 17*, 120-125.
- Lawrence, G. (1986). *People Types and Tiger Stripes*. Gainesville: Center for Applications of Psychological Type, Inc.
- Loyd, G. E., Lake, C. L. & Greenberg, R. B. (2004). *Practical Health Care Simulations*. Philadelphia: Elsevier-Mosby.
- Lupien, A. E. & George-Gay, B. (2001). High-fidelity patient simulation. In A. J. Lowenstein & M. J. Bradshaw (Eds.), *Fuszard's Innovative Teaching Strategies in Nursing*. 3rd Edition. (pp. 134-148). Gaithersburg: Aspen Publishers, Inc.
- Mager, R. F. (1997). *Measuring Instructional Results*. 3rd Edition. Atlanta: The Center for Effective Performance, Inc.
- May, B. A., Edell, V., Butell, S., Doughty, J. & Langford, C. (1999). Critical thinking and clinical competence: A study of their relationship in BSN seniors. *Journal of Nursing Education, 38*, 100-110.
- Maynard, C. (1996). Relationship of critical thinking ability to professional nursing competence. *Journal of Nursing Education, 35*, 12-18.
- MCG: Medical College of Georgia. (2003a). *Nursing BSN Program Overview*. Retrieved June 4, 2004, from the World Wide Web: <http://www.mcg.edu/son/bsn/overview/htm>.
- MCG: Medical College of Georgia. (2003b). *Nursing BSN Curriculum*. Retrieved June 4, 2004, from the World Wide Web: <http://www.mcg.edu/son/bsn/curriculum.htm>.

- McKane, C. L. & Schumacher, L. (1997). Professional advancement model for critical care orientation. *Journal of Nursing Staff Development, 13*, 88-91.
- McLellan, H. (1996). *Situated Learning Perspective*. Englewood Cliffs, NJ: Educational Technology Publications.
- Morgan, P. J., Cleave-Hogg, D., McIlroy, J. & Devitt, J. H. (2002). A comparison of experiential and visual learning for undergraduate medical students. *Anesthesiology, 96*, 10-16.
- Morrison, S., Adamson, C. & Hsia, S. (2001). *Reliability and Validity of HESI Exams*. Health Education Systems Inc. Retrieved September 16, 2003, from the World Wide Web: www.myhesitest.com.
- Morrison, S., Adamson, C., Nibert, A. & Hsia, S. (2004). HESI exams: An overview of reliability and validity. *CIN: Computers, Informatics, Nursing, 22*, 220-226.
- Morrison, S. & Free, K. W. (2001). Writing multiple-choice test items that promote and measure critical thinking. *Journal of Nursing Education, 40*, 17-23.
- Morrison, S., Smith, P. & Britt, R. (1996). *Critical Thinking and Test Item Writing*. Livingston: Century II Printing.
- Murray, W. B., Good, M. L., Gravenstein, J. S., van Oostrom, J. H. & Brasfield, W. G. (2002). Learning about new anesthetics using a model driven, full human simulator. *Journal of Clinical Monitoring and Computing, 17*, 293-300.
- Newman, M., Britt, R. B. & Launcher, K. A. (2000). Predictive accuracy of the HESI exit exam: A follow-up study. *Computers in Nursing, 18*, 132-136.
- Nibert, A. T. & Young, A. (2001). A third study on predicting NCLEX success with the HESI exit exam. *Computers in Nursing, 19*, 172-178.

- Nibert, A. T., Young, A. & Adamson, C. (2002). Predicting NCLEX success with the HESI exit exam. *CIN: Computers, Informatics, Nursing*, 20, 261-267.
- Norton, B. (1998). From teaching to learning-theoretical foundation. In J. Halstead (Ed.), *Teaching in Nursing: A Guide for Faculty*. (pp. 211-245). Philadelphia: W. B. Saunders.
- Nyssen, A. S., Larbuisson, R., Janssens, M., Pendevill, P. & Mayne, A. (2002). A comparison of the training value of two types of anesthesia simulators: Computer screen-based and mannequin-based simulators. *Anesthesia and Analgesia*, 94, 1560-1565.
- Owen, H. & Plummer, J. L. (2002). Improving learning of a clinical skill: The first year's experience of teaching endotracheal intubation in a clinical simulation facility. *Medical Education*, 36, 635-642.
- Polit, D. F. & Hungler, B. P. (1995). *Nursing Research: Principles and Methods*. 6th Edition. Philadelphia: Lippincott.
- Rane-Szostak, D. & Robertson, J. F. (1996). Issues in measuring critical thinking: Meeting the challenge. *Journal of Nursing Education*, 35, 5-11.
- Rapps, J., Riegel, B. & Glaser, D. (2001). Testing a predictive model of what makes a critical thinker. *Western Journal of Nursing Research*, 23, 610. Retrieved on March 19, 2003, from ProQuest database.
- Rauen, C. A. (2004). Simulation as a teaching strategy for nursing education and orientation in cardiac surgery. *Critical Care Nurse*, 24(3), 46-51.
- Ravert, P. (2002). An integrative review of computer-based simulation in the education process. *Computers in Nursing*, 20, 203-208.

- Rowles, C. & Brigham, C. (1998). *Teaching in Nursing: A Guide for Faculty*. Philadelphia, PA: W. B. Saunders.
- Rubinfeld, M. & Scheffer, B. (1999). *Critical Thinking in Nursing: An Interactive Approach*. (2nd Edition). Philadelphia, PA: Lippincott.
- Saucier, B. L., Stevens, K. R. & Williams, G. B. (2000). Critical thinking outcomes of computer-assisted instruction versus written nursing process. *Nursing and Health Care Perspectives, 21*, 240-246.
- Scheffer, B. & Rubinfeld, M. (2000). A consensus statement on critical thinking in nursing. *Journal of Nursing Education, 39*, 352. Retrieved March 9, 2003, from the ProQuest database.
- Schumacher, L. (2004). Simulation in critical care nursing education: Conceptual and practical perspectives. In W. F. Dunn (Ed.), *Simulators in Critical Care and Beyond*. (pp. 114-118). Chicago: Society of Critical Care Medicine.
- Schwid, H. A. & O'Donnell, D. (1992). Anesthesiologists' management of simulated critical incidents. *Anesthesiology, 76*, 495-501.
- Schwid, H. A., Rooke, G., Carline, J., Steadman, R., H., Murray, W. B., Olympio, M., Tarver, S., Steckner, K., Westone, S. & Consortium, A. S. R. (2002). Evaluation of anesthesia residents using mannequin-based simulation. *Anesthesiology, 97*, 1434-1444.
- Schwirian, P. M. (1978). Evaluating the performance of nurses: A multidimensional approach. *Nursing Research, 27*, 347-351.
- Scriven, M. & Paul, R. (2004). *Defining critical thinking*. Retrieved June 5, 2004, from the World Wide Web: www.criticalthinking.org.

- Sedlak, C. A. (1997). Critical thinking of beginning baccalaureate nursing students during the first clinical nursing course. *Journal of Nursing Education, 36*, 11-18.
- Spelic, S., Parsons, M., Hereinger, M. & Andrews, A. (2001). Evaluation of critical thinking outcomes of a BSN program. *Holistic Nursing Practice, 15*(3), 27-34.
- SPSS: Statistical Package for the Social Sciences. (2001). *SPSS 11.0 Brief Guide*. Chicago: SPSS, Inc.
- Thompson, C. & Rebesch, L. M. (1999). Critical thinking skills of baccalaureate nursing students at program entry and exit. *Nursing and Health Care Perspectives, 20*, 248-252.
- VanSell, S. I. & Kalofissudis, I. A. (2002). *The Evolving Essence of the Science of Nursing: The Complexity Integration of Nursing Theory*. Dallas, TX: Entirety.
- Vaughan-Wrobel, B. C., O'Sullivan, P. & Smith, L. (1997). Evaluating critical thinking skills of baccalaureate nursing students. *Journal of Nursing Education, 36*, 485-488.
- Videbeck, S. L. (1997). Critical thinking: Prevailing practice in baccalaureate schools of nursing. *Journal of Nursing Education, 36*, 5-10.
- Walsh, C. & Hardy, R. (1999). Dispositional differences in critical thinking related to gender and academic major. *Journal of Nursing Education, 38*, 149-155.
- Watson, G. & Glaser, E. (1980). *Watson-Glaser Critical Thinking Appraisal Manual*. San Antonio, TX: The Psychological Corporation.
- Weis, P. A. & Guyton-Simmons, J. (1998). A computer simulation for teaching critical thinking skills. *Nurse Educator, 23*(2), 30-33.

Weller, J. M., Bloch, M., Young, S., Maze, M., Oyesola, S., Wyner, J., Dob, D., Haire, K., Durbridge, J., Walker, T. & Newble, D. (2003). Evaluation of high-fidelity patient simulator in assessment of performance of anesthetists. *British Journal of Anesthesia*, 90, 43-47.