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A Comparison Of Computer And Traditional Face-to-face Classroom Orientation For Beginning Critical Care Nurses

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A COMPARISON OF COMPUTER AND TRADITIONAL FACE-TO-FACE CLASSROOM ORIENTATION FOR BEGINNING CRITICAL CARE NURSES

by

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ABSTRACT

Purpose**:** Education of the novice critical care nurse has traditionally been conducted by critical care educators in face-to-face classes in an orientation or internship. A shortage of qualified educators and growth in electronic modes of course delivery has led organizations to explore electronic learning (e-learning) to provide orientation to critical care nursing concepts. Equivalence of e-learning versus traditional critical care orientation has not been studied. The primary aim of this study was to examine the equivalency of knowledge attainment in the cardiovascular module of the Essentials of Critical Care Orientation (ECCO) e-learning program to traditional face-to-face critical care orientation classes covering the same content. Additional aims were to determine if learning style is associated with a preference for type of learning method, and to determine any difference in learning satisfaction between the two modalities.

Methods: The study was conducted using a two-group pretest-posttest experimental design. Forty-one practicing volunteer nurses with no current critical care experience living in southwest Florida were randomly assigned to either the ECCO (n=19) or face-to-face (n=22) group. Those in the face-to-face group attended 20 hours of classroom instruction taught by an expert educator. Those in the ECCO group completed the lessons on line and had an optional 2-hour face-to-face discussion component. Pre-test measures included the Basic Knowledge Assessment Test (BKAT-7), modified ECCO Cardiovascular (CV) Examination, and Kolb Learning Style Inventory (LSI). Post-tests included the BKAT-7, modified CV Examination, and Affective Measures Survey.

Results: The majority of subjects were female, married, and educated at the associate degree level. Their mean age was 39.5 $\pm$ 12 years, and they averaged 9.9 $\pm$ 11.7 years of nursing experience. The diverging learning style was assessed in 37% of subjects. Classroom instruction was preferred by 61% of participants. No statistical differences were noted between groups on any demographic variables or baseline knowledge. Learning outcomes were compared by repeated measures analysis of variance. Mean scores of subjects in both groups increased statistically on both the BKAT-7 and modified CV Examination ($p=<.01$); however, no significant differences ($p>.05$) were found between groups. Preference for online versus classroom instruction was not associated with learning style ($X^2 = 3.39$, $p = .34$). Satisfaction with learning modality was significantly greater for those in the classroom group ($t=4.25$, $p=.000$).

Discussion/Implications: This is the first study to evaluate the ECCO orientation program and contributes to the growing body of knowledge exploring e-learning versus traditional education. The results of this study provide evidence that the ECCO critical care education produces learning outcomes at least equivalent to traditional classroom instruction, regardless of the learning style of the student. As participant satisfaction was more favorable toward the classroom learning modality, consideration should be given to providing blended learning if using computer-based orientation programs. Replication of this study with a variety of instructors in varied geographic locations, expanded populations, larger samples, and different subject matter is recommended.

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LIST OF ACRONYMS/ABBREVIATIONS

AACN	American Association of Critical Care Nurses
BKAT	Basic Knowledge Assessment Test
CAI	Computer-Assisted Instruction
CBI	Computer-Based Instruction
CMI	Computer-Managed Instruction
CNS	Clinical Nursing Specialist
CV	Cardiovascular
ECCO	Essentials of Critical Care Orientation
ELT	Experiential Learning Theory
LSI	Learning Style Inventory
PI	Principal Investigator
RN	Registered Nurse

CHAPTER ONE: THE PROBLEM

Education of the novice critical care nurse has traditionally been conducted by critical care educators in the format of face-to-face classes presented in an orientation or an internship. The current and looming nursing shortage—especially the shortage of qualified educators—has led hospital organizations to explore new, novel, and cost-effective ways of providing education necessary for the novice critical care nurse to provide safe, effective patient care. Critical care education using electronic learning is a strategy being implemented in many acute care organizations. The question of equivalence or superiority of electronic learning (e-learning) versus traditional orientation/internships has been posed.

The primary aim of this study was to examine the equivalency of knowledge attainment in the cardiovascular module of the Essentials of Critical Care Orientation (ECCO) on-line computer program to traditional face-to-face critical care orientation classes. Additional aims were to determine if and how learning style is associated with a preference for computerized learning or face-to-face orientation methods and to determine any difference in student satisfaction between the two learning modalities

Background and Significance

The student-teacher relationship has great importance in nursing education (Teeley, 2007). A successful learning situation incorporates the experiential learning in the form of discussion, problem solving, case studies, and simulations (Knowles, Holton, & Swanson, 1998) all of which occur in an ideal classroom environment.

According to Wofford, Spickard, and Wofford (2001), the lecture format not only presents information, but does so in a way that allows synthesis of information from

multiple sources and from presentation of material not in print. The skillful educator communicates enthusiasm for the subject and engages the learners. Face-to-face classes allow competent teachers to meet the varying needs of those present.

In a traditional classroom setting, clinical application can be provided with examples and anecdotes. Dilemmas and case studies can be posed to allow for development of critical thinking —a skill vital for the successful critical care nurse. Salient points may be summarized and repeated as many times as necessary. Classroom education can be collaborative with the use of brainstorming techniques along with direct questioning and discussion. Visual aids are used to generate better recall. Commonly, written handouts supplement and enhance lectures.

The use of electronic learning is growing, and has many advantages inherent in its format. Among those are convenience, cost-effectiveness, and efficiency (American Association of Critical Care Nurses [AACN], 2006). Many learners have successfully completed courses taught completely or partially by computer modalities. Case studies and interactive components can be built into the specific program.

The study used a two-group pretest-posttest experimental design to compare outcomes of traditional versus electronic learning for teaching basic critical care cardiovascular content. The independent variable was learning modality (ECCO or traditional face-to face classroom presentation). Dependent variables were cardiovascular knowledge attainment and program satisfaction as expressed in affective behavior. (Operational Definitions are summarized in Table 1.)

This study is significant in critical care education because it systematically examines the efficacy of the widely used ECCO program in contrast to conventional

classroom methods used traditionally in orienting the novice critical care nurse. No published research to date has compared outcomes of these two modalities. This study will add to the science of outcomes of electronic learning in critical care orientation.

Table 1: Conceptual and Operational Definitions

Variable	Conceptual Definition	Operational Definition
Cardiovascular knowledge attainment	The amount of didactic learning related to cardiovascular nursing that has taken place after completion of the face-to-face or the ECCO courses	The mean difference between pretest/posttest scores on the BKAT-7 and ECCO module examinations
Traditional face-to-face orientation classes	Orientation presented in a classroom with students and instructor present using a lecture format with visual aids, discussion, case studies, and question and answer teaching/learning modalities	The cardiovascular component of critical care orientation for the nurse new to the specialty presented in five four-hour classes and taught by one instructor
Electronic learning	A general term describing computer instruction delivered online, over the internet, or private learning networks, or by the intranet	The ECCO computer program cardiovascular module delivered on-line over the Web. A two-hour classroom component adding discussion and case studies will be given to supply a blended learning aspect (see blended learning)
Computer-assisted learning	Use of a computer for education and instruction	
On-line or Web-based distance education	Use of the Web to deliver education from a remote site	
Blended learning	A combination of the computer learning modality with traditional teaching/learning activities such as discussion groups, reading assignments, case studies, and clinical preceptorships	ECCO computer cardiovascular module with a two-hour case study/discussion component

ECCO

ECCO is a Web-based learning program marketed by the American Association of Critical Care Nurses (AACN) since 2002. The purpose of the ECCO program is to teach the basic theoretical knowledge necessary to care for critical care patients to nurses new to the specialty. ECCO is a self-paced, educational program that features critical care core curriculum components with graphics, slides, and animation. A printed version may be read on the computer screen and/or an audio track may be heard. Helpful, but non-essential content is provided in the modules by clicking an icon, which opens a window and gives a “pearl of wisdom.”

ECCO features nine modules organized by body system and offers 64 Continuing Education Units for nurses upon completion. Approximately 300 hospitals and schools of nursing have purchased the ECCO program and use it in orientation and internship classes. Its purported benefits include efficiency, standardization, and cost-effectiveness (AACN, 2006). The AACN is responsible for updating content on a regular basis.

The AACN who sponsor ECCO, cite as a limitation of electronic learning the absence of face-to-face interactions, which are an important adjunct to learning for the critical care nurse (AACN, 2004a). Consequently, the AACN suggests offering ECCO as a “blended program” of computer and face-to-face interaction with an instructor or preceptor.

This author can find no study (randomized controlled or otherwise) comparing the ECCO system with another mode of education. Vivekananda-Schmidt, Hassell, and McLean (2004) discuss the scarcity of research evaluating computer-assisted learning. They state that what research there is has methodological problems and lacks defining

outcome criteria. Although largely positive, studies have no definitive answers and do not unequivocally show the advantages of computer-assisted learning for orientation of nurses to critical care content.

Kolb Learning Style Inventory

A secondary aim of this study was to determine whether learning styles were associated with a preference for either computer or face-to-face learning modality. Achievement, degree of understanding, retention, and attitude toward mode of learning all determine the effectiveness of instruction (Matta & Kern, 1989). Learners are more engaged and motivated when the learning mode matches their own cognitive processing style (Sternberg, 1997). In other words, performance is improved when instruction is consistent with the student's cognitive style.

A Learning Skills and Research Center report in Great Britain found 71 learning styles in the literature, some with rather minor alterations and adaptations of others (Coffield, Moseley, Hall, & Ecclestone, 2004). All were rather complex and each had a different lexicon. Four of the learning style models most widely used in nursing research and education are Dunn and Dunn (1996), Honey and Mumford (1986), Kolb (1984), and Myers-Briggs (Myers & McCauley, 1985). No one theory has emerged as the "best," although Kolb's Experiential Learning Theory is the most widely used in nursing, and has a relatively simple format. It was therefore chosen for this study.

David Kolb developed the Learning Style Inventory (LSI) in 1971 to assess individual learning styles and to assist learners in understanding their strengths and weaknesses (Kelly, 1997). Four statistically prevalent learning styles were identified:

diverging, assimilating, converging, and accommodating (Kolb, Boyatzis, & Mainemelic, 1999). These learning styles are summarized in Table 2.

Table 2: Learning Styles with Associated Characteristics and Career Paths

Learning style	Learning ability	Characteristic	Career
Diverging	Concrete; reflective observation	Introverted; feeling; valuing skills	Social Service; arts
Assimilating	Abstract; reflective observation	Introverted; initiative; thinking skills	Research; science/math; informatics; law
Converging	Abstract; active experimentation	Extraverted; thinking; decision skills	Engineering; medicine; technology
Accommodating	Concrete; active experimentation	Extraverted; sensation; action skills	Sales; social service; education; nursing

The Diverging style's dominant learning characteristics are Concrete Experience and Reflective Observation. People with a diverging learning style like to gather information, are interested in people, and have broad cultural interests (Kolb et al., 1999; Smith, 2001). Broadly speaking, people working in the creative disciplines such as the arts are divergent learners (Atherton, 2002).

The Assimilating style's dominant learning characteristics are Abstract Conceptualization and Reflective Observation. Learners with an assimilating learning style are more concerned with abstract concepts than people, excel in inductive reasoning, and have a strong ability to create theoretical models (Kolb et al., 1999;

Smith, 2001). The Assimilative learning quadrant includes pure scientists and mathematicians (Atherton, 2002).

The Converging style's dominant learning characteristics are Abstract Conceptualization and Active Experimentation. Those with a converging learning style have strong skills in practical application of ideas, are unemotional, and prefer to deal with technical tasks and problems rather with social or interpersonal issues (Kolb et al., 1999; Smith, 2001). The Convergent quadrant encompasses applied scientists and lawyers (Atherton, 2002).

The Accommodating style's dominant learning characteristics are Concrete Experience and Active Experimentation. Their greatest strength is in doing things. They are risk takers and usually perform well in reaction to immediate circumstances. They use intuition to solve problems rather than logical analysis (Kolb et al., 1999; Smith, 2001). People with careers in marketing, sales, or nursing could fall into the Accommodating quadrant (Kolb et al., 1999).

Use of the LSI enables learners to understand their preferred learning styles and teachers to cover materials in ways that fit a diverse group of students (Kelly, 1997). Accommodators and divergers may to be more amenable to computer learning, as both learning styles depend upon the concrete experience that computer-assisted instruction can provide (Khoiny, 1995).

Assumptions

The underlying assumptions of this study are:

1. The study sample is representative of the general population of non-critical care Registered Nurses.

2. Students will learn better when they are taught in a style they prefer.
3. A successful adult learning situation must provide experiential learning.
4. The instructor for the face-to-face classroom study arm will have achieved at least the Competent stage in Benner's Novice to Expert theory.
5. Participants in the ECCO study arm will follow the oral and written instructions provided by the Principal Investigator. They will not review modules other than the cardiovascular module and they will not review the module examination.

Hypotheses

This study tests the following hypotheses:

Hypothesis 1: The mean difference between pretest/posttest scores on two cardiovascular knowledge exams will be equivalent between participants in the online ECCO and face-to-face cardiovascular education courses.

Hypothesis 2: Learning style is not associated with participants' prestudy preference for online versus face-to-face learning modality.

Hypothesis 3: Satisfaction with learning modality will be greater for participants in the face to face critical care orientation classes than for participants in the ECCO program.

This study contributes to the existing body of knowledge related to critical care education, computer-assisted nursing education, and the relevance of learning styles in nurse-learners. It examined the use of computer-assisted critical care education with its attendant expected advantages of accessibility, flexibility, convenience, use of differing instructional strategies, provision of consistent information, and cost and time

effectiveness (Benson, 2004). Additionally, the effectiveness of traditional face-to-face classes was explored in order to continue investigation of teaching modalities for an optimal educational outcome of safe practice in critical care units.

Further understanding and development of critical care educational modalities is essential to producing safe, effective critical care nurses who are able to give the best possible care to acutely ill patients. Nurses, physicians, hospital administrators, and (most of all) patients are stakeholders in this vitally important process.

Summary

This study examined the efficacy of two teaching modalities: traditional classroom critical care education and the ECCO critical care educational program. Additionally, learning style association with learning preference and student satisfaction with learning modality was explored. It is hoped that this study will contribute to understanding methods of orientation for the novice critical care nurse.

Chapter Two includes a review of the relevant literature related to computer-assisted instruction and learning styles as well as an organizing framework based on a quality improvement model. Chapter Three describes research methods, encompassing design, sample, intervention, instruments and data collection procedures. Chapter Four incorporates results, including demographic analyses and hypothesis testing. Lastly, Chapter Five is a discussion of findings, limitations, implications, as well as future research recommendations

CHAPTER TWO: REVIEW OF RELEVANT LITERATURE/FRAMEWORK

This research examined traditional versus electronic education, specifically the use of ECCO in critical care orientation. It also investigated the possibility that learning style was related to preference for a specific learning modality. Considering the dearth of nursing research relating specifically to ECCO, relevant nursing and educational research literature referring to computer-assisted instruction, electronic learning (e-learning), and learning styles are reviewed and critiqued. An organizing conceptual framework is introduced.

Computer-Assisted Instruction (CAI)

Computer Assisted Instruction (CAI), as defined by Hannafin and Peck (1988), is “any instance in which instructional content or activities are delivered via computer” (p.5). Firestone (2003) studied outcomes of an on-line program for 40 Pennsylvania high school students to supplement math and language arts education. The program was self-paced, teacher-customized, and adapted to student needs. The researcher reported that these students gained six months to two years in both math and language arts skills. This study, suggests the efficacy in computer learning. It may not be generalizable to adult learners who may learn differently nor the ECCO program, which has different content and is not individualized.

Ackay, Feyzioglu, and Tuysuz (2003) found in their study of 84 high school chemistry students, that computer-based education was more effective than traditional classroom education for achievement in chemistry. These results indicate the effectiveness of computer education, but are not necessarily generalizable to adults or to the nurse-learner.

Cochran, Edelman, Morris, and Saffle (2008) studied learning outcomes in medical students and interns participating in a web-based curriculum for acute burn assessment and stabilization. Twenty out of 28 participants actually logged on to the program, 15 completed the exam, and 18 completed the course evaluation form. This equated to a course participation rate of 71% and a course completion rate of 54%. The mean course examination score upon completion of the program was 88%, demonstrating course effectiveness. Learners were uniformly satisfied with the course. Limitations of the study were the small sample size, single institution over one academic year (possible selection and response bias), and the lack of a pretest to determine knowledge base. Additionally, there was no control group to compare this electronic learning to any other learning modality.

Many studies have compared student experience and success in on-line versus face-to-face courses. Fifty undergraduate students enrolled in a Computers and Society course were participants in a comparison of face-to-face and asynchronous instructional methods conducted by Benbunan-Fich, Hiltz, and Turoff (2001). The authors found that the on-line group had broader discussions and offered more complete reports.

Tucker (2001) studied 47 undergraduate students (23 students in traditional face-to-face classes and 24 students in online classes) enrolled in a business communications course. Results found distance students had significantly better posttest and final exam scores, but no difference in homework grades, research papers, or course grades. Small sample size and a question of equivalent time for completing learning tasks for each group were limiting factors in this study.

Chernish, DeFranco, Lindner, and Dooley (2005) compared the results of a college hospitality human resource management course using three different delivery methods: traditional classroom, instructional television, and web-based instruction. Enrolling 83 participants, they found no significant difference in achievement tests among the three groups at the end of the course. Participants in all groups had a slight preference for traditional classroom delivery method when surveyed post-course.

In an analysis of data from university students from the Spring 1999 semester, Dziuban and Moskal (2001), found that courses with a face-to-face component combined with a Web component produced the same or equivalent withdrawal rates and the same or better success rates than either modality standing alone, indicating that a hybrid or blended model may be preferable. Class grades and assessment tools for specific courses defined success rates.

Allen, Bourhis, Burrell, and Mabry (2002) conducted a meta-analysis of student satisfaction with distance education compared with traditional classrooms in higher education. The meta-analysis included 24 studies. Distance education was defined as a course where student and instructor were not copresent. The authors found that on average the distance student demonstrates a significantly lower level of satisfaction with the learning process compared to the student in a traditional classroom setting.

Performance of distance education students in comparison with students in traditional classes was studied in a meta-analysis that analyzed results of 28 studies (Allen, et al., 2004). The analysis found that distance students slightly outperformed traditional students on exam and course grades. The authors advised caution in interpreting these results because of the moderating features of the studies which

included the presence of simultaneous interaction of student and instructor, type of channel (audio, visual, or written) used, and course content. They concluded that there was no decline in educational effectiveness with the use of distance education. A limitation of the study was that performance was limited to grades, thus not allowing measurement of long-term learning. Additionally, the authors believed that various learning formats were inadequately compared in the study and no assessment was made for quality of the technology or technology training of the participants.

A 2005 survey of 10 clinical nursing specialists (CNSs) from nine San Diego hospitals evaluated preference for the ECCO program versus a classroom critical care orientation program. The CNSs stated that nurses who participated in the ECCO program cited dissatisfaction with not having immediate answers to their questions when working on the computer modules (Graham, 2006). It is noted that the AACN encourages a blended learning approach for those using the ECCO program; however, some CNSs participating in the survey noted that their hospital did not comply with that suggestion.

Leners and Sitzman (2006) conducted a qualitative study of the concept of caring in online courses in a sample of 39 graduate nursing students. A major theme was that participants in online courses wanted timely communication in the form of prompt answers to queries as well as encouragement and affirmation from their instructors.

In another study of student perspectives of online graduate nursing courses, Morris, Buck-Rolland, and Gagne (2002) found that students believed that attendance in a face-to-face classroom environment was ideal, but not realistic in some circumstances. The sample included 32 graduate students in a primary care track who

were enrolled in 4 graduate courses that blended on-line instruction with traditional classes.

Day and Payne (1984) conducted a pilot study that compared outcomes of lecture versus computer-managed instruction (CMI) in a sample of 82 first-year basic nursing students enrolled in a health assessment course. The study reported no significant differences in student achievement between the two instructional methods, and no significant difference in retention of knowledge. The results of the attitude questionnaire showed a definite preference for the lecture format. The authors postulated that some reasons for the negative attitude towards computer-based learning were lack of feedback on incorrect questions, lack of opportunity for instructor/student interaction, and inadequate orientation to computer instruction.

A second publication by Day and Payne (1987) compared outcomes of two teaching strategies for a health assessment course: CMI, and traditional lecture method. The participants were 99 first-year nursing students enrolled in a baccalaureate program. No significant difference was found between groups on cognitive performance. On the attitude questionnaire, the majority of students preferred a combination of teaching/learning methods. The authors caution that differences in design and technical quality of computer programs limit generalizability of this and other studies related to computer-based learning.

Neil (1985) conducted a quasi-experimental study comparing the outcomes of CAI versus written text material in a randomly assigned sample of 32 baccalaureate nursing students. The content of the CAI and text material was Professional Nursing Functions. Cognitive learning was measured by multiple-choice exams while the

attitudes were assessed with the Affective Measures Scale. The two-group pretest/posttest design tested two hypotheses: (1) The amount of learning will be the same in both groups and (2) student attitudes toward their learning will be the same for each group. Both hypotheses were supported. This study was limited by its small sample.

The effectiveness of computer instruction versus classroom lecture in a sample of 27 baccalaureate nursing students enrolled in a nursing research course was studied by Schmidt, Arndt, Gaston, and Miller (1991). Achievement scores and grade point averages were not statistically different between the two groups. An attitudinal survey found no student preference for either method over the other. The small sample was a limitation.

Cohen and Dacanay (1994) conducted a meta-analysis of 29 studies to evaluate the effectiveness of computer-based instruction (CBI) in nursing education. Six studies compared student attitudes toward computer-based versus conventional instruction. Four of these studies favored CBI over conventional methods of instruction, however, only one of the four studies showed a significant difference in attitudes towards CBI. The meta-analysis highlighted the gaps in the literature related to learning retention, attitudes, and time to learn. These gaps included insufficient information to calculate an effect size and lack of detail in reports of studies. The authors noted that meta-analyses are limited by primary studies authors' preferences on exactly what to report.

A study of 108 students (104 physicians and 4 pharmacists) in five doctoral courses in Spain (Coma Del Corral, Guevara, Luquin, Pena, & Otero, 2006) found no statistical differences in the outcomes (knowledge increase) of two groups, traditional

classroom and on-line. The students self-selected into each of the groups (which may be a limitation of the study) and those in the on-line group were given instruction on use of the computer.

Woo and Kimmick (2000) investigated online versus lecture instruction in the teaching of nursing research to 97 graduate nursing students. They found no significant differences in test scores and student satisfaction with the course. The authors noted that the principal investigator was not blinded to the student assignments, which could have potentially biased the study. Also, lack of valid and reliable instruments was cited as a limitation, as was some amount of crossover attendance of the students assigned to the online learning group into course lectures.

Jeffries (2001) compared outcomes of computer instruction (interactive CD-ROM) versus lecture in teaching content on oral medication administration to 42 baccalaureate nursing students. This was a convenience sample with random assignment to the groups. Significant differences in cognitive knowledge gains and student satisfaction were noted. Participants assigned to the computer group demonstrated greater cognitive gains and higher satisfaction scores. Comments from the computer participants stated that the CD-ROM was easy and “fun.” Low Kuder-Richardson reliability scores for the pre and post-tests limited the study.

Salyers (2005) found no difference in learning outcomes in a study of 55 graduate nursing students enrolled in a health care issues courses. Students self-selected to either a traditional face-to-face course section or a web-enhanced section. However, student satisfaction was greater in the Web-enhanced group. Limitations of this study include student self-selection in courses, small sample, and lack of

standardized instruments. Additionally, the study author taught both the face-to-face and Web-enhanced courses, a situation fraught with potential for introducing bias.

Chumley-Jones, Dobbie, and Alford (2002) performed a review of the literature related to research on web-based learning in medical, dental, and nursing courses. They identified 206 Web-based learning papers published between 1992 and 2001 of which 76 met criteria for study inclusion. They found that Web-based learning improved knowledge attainment but did not outperform and was not superior to other educational methods, thus suggesting equivalence of learning modalities.

Cobb (2004) performed an integrative review summarizing relevant research and literature related to online learning for continuing education for health care professionals. The author reported that Internet learning was effective and that participants were satisfied with the courses. A limitation of this study was the small number of studies (17) meeting inclusion criteria. Additional limitations were lack of randomization and control in the studies and heterogeneity of study participants and subject matter of the continuing education courses. All of these factors limit generalizability.

Hundreds of studies related to online learning have been published in peer-reviewed journals. Some have innovative approaches and classic experimental designs. These studies provide thoughtful, useful insights on use of the computer medium (Meyer, 2002). More research is needed to answer the questions of which technology (or mix of technology with traditional methods) works with differing student populations in differing disciplines along with the reasons underlying why they work (Meyer). Other

specific areas for research concentration are related to clinical application of computer instruction and use of computers in nursing orientation.

Research studies for the disciplines of nursing and education have found—in general, in the past fifty years, there is no significant difference in the effectiveness of computer-aided education versus traditional classroom methods. Lack of constancy in not only the media, but also in instructional design is a weakness in some studies. Computer-aided learning differs widely in characteristics such as program design, pedagogical approach, content, and interactivity. Additionally, non-randomized designs, inattention to learning styles, student demographics, and other intervening variables are paid scant attention in some research. No studies demonstrated any attempt to control for the quality of the classroom instructors. This emphasizes the need for more well-designed problem-specific studies. Generalizability to populations other than the specific group and subject being studied is questionable.

Learning Styles

The understanding of what motivates learning, as well as what facilitates learning is vital to nursing educators in both academic and staff development settings. Penn (1996) suggests that knowledge of learning styles sharpens educators' awareness of diversity and provides justification for various teaching strategies. More globally, identification of learning styles in nursing education serves several purposes: to make learners aware of their learning needs; to steer teaching modality choices to better match learning preferences; and to assist in nursing education research related to teaching strategies and learning outcomes.

Learner characteristics such as motivation, attitude, gender, and learning styles influence e-learning (Meyer, 2002). Workman's (2004) study of 174 college students enrolled in a computer programming course found that learners who were individually focused and self-directed preferred individual-focused learning. Applying the Kolb learning theory, this may indicate that those with abstract assimilating and converging learning styles who use thinking and decision skills may prefer computer-based learning. Students who use external sources for cognitive priming and idea generation prefer a more collaborative learning environment (Workman). This may equate to the Kolb concrete diverging and accommodating learning styles that employ feeling, valuing, and active learning skills. Further, according to Workman, personalities who follow their own plan and pursue their own learning paths are attracted to uniqueness (Web-based learning may be considered unique). Those students who use an observational model to approach learning and problem solving prefer familiar learning situations. Workman concluded that learning styles should be considered recommended that educational strategies be tailored to learning style. It should be noted that this was a non-randomized study with confounding variables such as participant abilities and prior experiences. Characteristics of students in a computer programming course may be very different from those enrolled in nursing courses.

ChanLin (2001), explored gender differences in learning related to different presentation formats. Participants were 357 eighth and ninth graders. Findings suggested that males and females perceive visual information differently. The study concluded that gender differences in information processing are a consideration in choice of learning formats. Additionally, Butler (2000) concluded from a review of

literature and research from the 1980s and 1990s that boys have a more positive attitude toward computers than girls. Although these studies were of children, as nurses are predominantly female, this may have some application to the current study.

Ames (2003) studied 232 university students to determine gender and learning style interactions in attitudes toward computers. The participants were those who completed and returned a packet containing the Computer Attitude Scale and the Gregorc Style Delineator. Results showed that participants with abstract learning styles have better attitudes toward computers. Further, females with an abstract random learning style are more likely to have negative attitudes toward computer learning.

Nyamathi, Chang, Sherman, and Grech's (1989) pilot study examined the extent to which learning style influences learning and retention in nursing knowledge gained by CAI versus lecture in 23 undergraduate nursing students enrolled in a review of mobility maintenance. A random assignment, two-group, pre and post repeated measures design was used. Students were randomly assigned to either the CAI (experimental) or lecture (control) group. Kolb's Learning Style Inventory was used to assess learner preferences for specific ways of learning. The students identified as having an assimilator learning style were hypothesized to demonstrate significantly higher scores on immediate and 6-week posttest scores than assimilator style control group students. Study results did not support this. No significant differences were present in learning scores on an immediate and 6-week posttest for the students manifesting the assimilator learning style. A second hypothesis stating that both the experimental and control groups would demonstrate statistically significant increases in scores between pretest and posttest was supported. CAI was found to be as effective an instructional

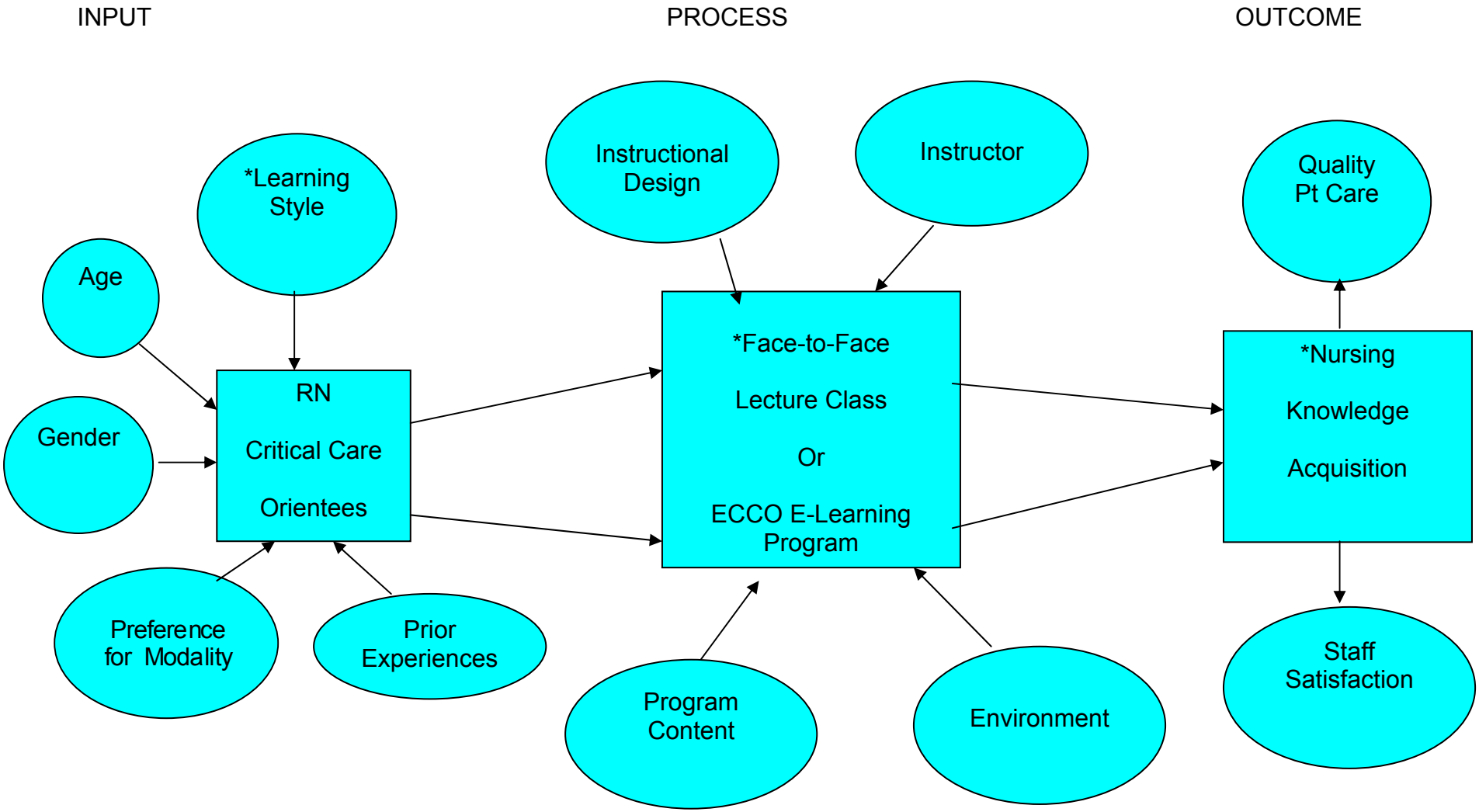
method as lecture. Retention of content was found to be approximately equal between groups.

The purpose of a study conducted by Brudenell and Carpenter (1990) was to determine if a relationship existed between learning styles and attitudes toward CAI. A one-group pretest/posttest design was used. The subjects were 40 baccalaureate nursing students enrolled in a nursing research course, which used CAI as an instructional method. Kolb's (1976) Learning Style Inventory and an attitude survey related to CAI were administered to participants. Posttest analysis showed significantly greater negative attitude towards CAI than pretest. Regardless of learning style, all participants had statistically significant greater negative attitudes toward CAI. The authors posited that the increased negative attitude toward CAI might reflect an evaluation of the CAI software and unmet subject expectation of the CAI.

The literature related to learning styles and CAI has produced mixed results. No real conclusions may be inferred. This is somewhat related to the differing computer programs studied as well as the myriad of subject matter and populations involved.

Conceptual Framework

An adaptation of a quality improvement model was selected to design and conduct the study (Figure 1). While this study evaluates learning, the global problem to be addressed is instructional quality. Specifically, does the ECCO program provide quality of instruction equivalent to that of classroom critical care orientation?



*= tested components

Figure 1: Conceptual Framework: Essential Critical Care Orientation (ECCO) Versus Face-to-Face Orientation

The framework that is most widely used to define quality in healthcare is one that differentiates between structure, process, and outcomes—the framework of Donabedian (1980). As persons who provide care indirectly contribute to quality in medical care, this framework is readily adapted to health care education quality, although has seldom been used in this context (Shipengrover & James, 1999). Donabedian offers his framework as a guide, not an absolute, and encourages free formulation of the model. Donabedian's (1980) framework is represented in a simple schematic:

Structure → Process → Outcome (p.83)

Structure is defined as the relatively stable characteristics of providers, tools, and resources available, as well as the physical and organizational evaluation of work settings--in other words, human, physical, and financial resources. Donabedian uses the term "input" in the context of structure in his explicative writings. Structure can have a positive or negative affect on process and outcome. Good structure or input can protect and promote quality. Processes are activities that occur within and between healthcare providers and patients. Process is what is actually done in giving and receiving care—diagnostic activity and implementation of treatment (Donabedian, 1988). Outcome is defined as "change in patients' current and future health status that can be attributed to antecedent health care" (Donabedian, 1980, p. 82).

A revision of Donabedian's framework incorporating the theories of both Kolb (1984) and Benner (1984) is relevant to this research (Figure 1). In the context of this study, input is the Registered Nurse critical care orientee, process is the method of delivering the course content face-to-face versus computer-based learning and critical care nursing knowledge acquisition represents the output.

David Kolb proposed his Experiential Learning Theory (ELT) in 1984. ELT provides a holistic model of the learning process along with a model of adult development, both consistent with knowledge about how people grow, learn, and develop (Kolb et al., 1999). Learning is defined by ELT as "the process whereby knowledge is created through transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984, p.41).

Learning to Kolb is not so much content acquisition or transmission; it is the interaction between content and experience, and—each transforms the other (Knowles et al., 1998). ELT can apply (and has been applied) to education, work, and adult development. Laschinger (1990) postulates the logic that experiential learning theory is applicable to professions in which clinical experience in practical settings has long played a critical role in the education of new members. Kolb's emphasis on conceptualization and experience in knowledge development corresponds to the goals of those who educate professional nurses, and so to this study. Kolb's ELT related to learning style is part of the "input" portion of Donabedian's model. It is also part of the "process" in that experiential learning is involved in the process of reaching the outcome of nursing knowledge acquisition.

Patricia Benner's theory is based upon the Dreyfus Model of Skill Acquisition, derived by two professors, Stuart and Hubert Dreyfus from their study of pilots and chess players. The Dreyfus model posits that when acquiring a skill, five levels of proficiency are traversed: novice, advanced beginner, competent, proficient, and expert (Benner, 1982). Benner found that it was practical to apply this model to nursing.

Benner (1984) infers that knowledge that is useful in clinical practice is a hybrid of theory and experience.

Novice level nurses have no experience in the clinical arena of critical care and are thus, situationally inexperienced. They need context-free rules and preceptors to assist in guiding their clinical practice (Benner, 1982). Advanced beginners demonstrate more acceptable performance because they have more prior experiences and learned recurring aspects of some clinical situations. Most nurses new to critical care are at the advanced beginner level. Novices and advanced beginners should be precepted by nurses who have attained at minimum the competent level of performance (Benner).

The competent nurse begins to be aware of long-term patient goals and nursing plans. This level nurse has neither the speed nor the flexibility of the proficient nurse, but begins develop the planning skills needed to proceed to proficiency (Benner, 1982). By contrast, the proficient nurse sees clinical situations in total, rather than as a compendium of aspects and perceives when a situation is not normal or usual. They learn best inductively with case studies and exemplars allowing them to draw on experience (Benner).

The expert nurse has a vast experiential background and approaches problems and patient care with an intuitive grasp of situations (Benner, 1982). Expert nurses who have the ability to describe their interventions in clinical situations make their knowledge visible and valuable (Benner) and are thus our best mentors and teachers.

Age, gender, learning style, and prior experiences are all variables relevant to the input segment of the framework, the RN critical care orientees. Kolb's Experiential

Learning Theory (1984) is germane to learning style, age, and prior experience in that all of these factors affect how the student learns.

ELT is also applicable in the process segment. As previously noted, some learning styles appear to benefit more from computer-assisted instruction (Khoiny, 1995). Face-to-face classroom lecture classes may provide some experiential learning through the instructor's sharing of prior experiences. Computer learning could also conceivably supply experiential learning through case studies and simulations.

Program content, instructor, and environment are variables of the process, either face-to-face lecture class or the Essentials of Critical Care Orientation (ECCO) computer program. Benner's Novice to Expert Theory speaks to the method of instruction, program content, instructor, and environment. All methods of instruction are not appropriate for a novice or advanced beginner, who practice primarily on rules and guidelines (Benner, 1984). The level of skill acquisition of the instructor is also vital. According to Benner, it is important that an instructor be at least at the competent level in the in the clinical area. A nurse educator advances through the stages of novice to expert when assuming the educator role.

Education of novice critical care nurses is a quality improvement issue for intensive care units. Introducing under-prepared nurses into a critical care unit without an evidenced-based means of orientation may contribute to poor patient outcomes and staff dissatisfaction. Donabedian's quality improvement model, incorporating aspects of the Novice to Expert and Experiential Learning Theories, was the logical matrix upon which to design and implement this study.

Summary

According to the literature, there is no significant difference in the efficacy of computer-aided instruction and traditional classroom education. However, outcomes comparing instruction typically provided in face-to-face critical care orientation have not been evaluated. There are conflicting results related to student satisfaction between the two modes of instruction. Additionally, the research examining learning style significance in CAI has produced mixed results allowing no real conclusions. Studies thus far have limitations as to differing subject matter, computer program content, and study populations.

An adaptation of the Donabedian quality improvement mode—input, process, outcome—was used as a framework upon which to conduct this study. Kolb's Experiential Learning Theory was incorporated into the input segment of the model in the form of learning styles and into the process segment as experiential learning in the instructional modalities. Benner's Novice to Expert theory, inferring that knowledge that is useful in clinical practice is a hybrid of theory and experience, is also relevant to the process segment of the model, affecting program content, choice of instructor, and environment.

CHAPTER THREE: METHODS

This chapter explicates study design, the sample, and study intervention. Instrument description, data collection procedures, ethical considerations, and data analysis procedures are included.

Design

The study was conducted using a two-group pretest-posttest experimental design. The independent variables were subject learning style, and learning modality (ECCO or traditional face-to-face classroom presentation), and learning modality preference. Permission to use the ECCO program was granted by AACN (Appendix A). Dependent variables were cardiovascular knowledge attainment and program satisfaction as expressed in affective behavior. (Operational Definitions were summarized in Table 1).

Notation of the study is:

R

$RN_1 \rightarrow O_1 \rightarrow X_1 \rightarrow O_2$

$RN_2 \rightarrow O_1 \rightarrow X_2 \rightarrow O_2$

R - Randomization of subjects to groups

RN_1 – Registered Nurses instructed in cardiovascular nursing in a face-to-face classroom setting

RN_2 – Registered Nurses instructed in cardiovascular nursing in the ECCO computer module

O_1 – Pretest

X_1 – Classroom instruction of cardiovascular nursing

X_2 – Online ECCO instruction of cardiovascular nursing

O_2 - Posttest

Sample

Power analysis for an independent group two-tailed t-test was perfomed by computer software. Estimations of standard deviations and population means of cognitive learning for face-to-face and ECCO groups were used to calculate sample size. It was anticipated that a 10% difference in scores would be attained between the two groups, yielding an effect size of .74. A sample size of 60 (30 in each group) was projected to achieve power of 0.80 and alpha 0.05 (two-tailed).

Inclusion Criteria

1. Registered nurse in the United States of America
2. Age 18 or older
3. Currently practicing nursing

Exclusion Criteria

1. Critical care/progressive care experience or training within the past five years (excepting basic nursing preparation)
2. Emergency department experience or training within the past five years (excepting basic nursing preparation)

The study subjects were 41 volunteer nurses living in southwest Florida. Twenty-two of the subjects were randomized to attend five face-to-face cardiovascular critical care orientation classes (a total of 20.5 hours of instruction) and 19 to complete the ECCO cardiovascular module in a maximum of 20.5 hours. Randomization was

accomplished by means of sealed envelopes denoting group membership. The sealed envelopes were shuffled, and numbered by the Principal Investigator (PI). Therefore, the contents were unknown. The envelope was opened after the individual had consented to participate in the study.

Instruments

All instruments were pilot tested with a volunteer group of five Registered Nurses to assess clarity of instructions and time to complete the instruments. Directions for completing the instruments were revised after pilot testing. Time to complete instruments in their entirety ranged from 45 minutes to 75 minutes.

Demographic Collection Tool

The demographic collection tool was administered to each participant. It contained: name, age, gender, marital status, ethnicity, highest degree in nursing, other degrees, years of experience in nursing, specialty, and certification. It contained one question stating, “If given the choice, which mode of learning would you prefer?” The choices were the ECCO computer program or face-to-face classes.

Basic Knowledge Assessment Test (BKAT)

The BKAT instrument (see Appendix B) is a 100-item paper and pencil test measuring recall and application of basic knowledge of critical care nursing practice in the areas of cardiovascular, hemodynamic monitoring, pulmonary, neurology, endocrine, renal, gastrointestinal/parenteral, and other categories (Toth, 2003; Wynd, 2002). The “other” category includes infection control, hypothermia, hemofiltration, and burns. BKAT Versions 1 through 7 were co-authored by Jean Toth and Kathleen

Ritchey. The authors of the test cite no theoretical model. Permission to use the BKAT (only in its entirety) for this research was granted by Dr. Jean Toth (Appendix C).

This instrument was chosen after review of existing tools used to measure critical care knowledge. It was selected for its documented reliability and validity and history of successful use in similar studies.

According to Toth (2006b), basic knowledge in critical care is that knowledge above and beyond that required for Registered Nurse licensure. The critical care nurse uses this knowledge to provide safe and effective care for acutely ill patients. The BKAT takes about 45 minutes to complete and consists of multiple choice questions and short answer questions. Both supervised and unsupervised administration of the test has been performed without statistical difference in scores (Toth, 2006b).

Possible scores on the BKAT range from 0 to 100. As of 2006, four BKAT test-takers had achieved a score of 100 (Toth, 2006b). Toth states that critical care nurses should achieve scores of 82 to 84 following orientation to the critical care setting or completion of a critical care course. The mean score of the BKAT Version 6 was 87.1 with a standard deviation of 6.7 points, which was measured on 101 critical care nurses from seven US states (Toth, 2002).

Whether an average score on the BKAT is passing or not is usually left to the discretion of the examiner, depending on importance of specific questions and the arena in which the testing takes place (Price 1993; Toth, 2006b). As an example, a question related to recognition of heart block would be essential for a nurse practicing in a coronary care unit and not answering correctly may indicate an automatic failure in that circumstance.

In their study examining the use and effect of the BKAT on orientation programs, Toth and Dennis (1993) found that the major use identified is in the orientation process. Needs assessment in the form of orientation pretest was identified as a use as well as modification of orientation program content based on posttest scores. In a follow-up survey (Toth, 2006a) found that the major use of the BKAT continues to be in the orientation process. Additional uses are to assess knowledge of nurses with previous critical care experience, evaluate knowledge of current staff, and to assess research outcomes. According to Toth (2006b), the BKAT has been used as a pretest and/or posttest to measure learning in nurses and as a dependent variable in the evaluation of different teaching modalities.

Content validity was established for the initial BKAT through literature review and interviews of practicing critical care staff nurses and head nurses and through input from a nine-member panel of experts and two critical care physicians (Toth, 2002). Succeeding versions were validated through a panel of experts. Construct validity has been supported by means of replication of research results associated with known group differences, learning theory, variables related to BKAT scores, internal consistency of items, and factor analysis (Toth & Dennis, 1993; Toth, 2003, Toth 2006b). Construct validity of BKAT-7 was supported by the use of known group differences in which the BKAT-7 scores of 172 practicing critical care nurses were compared to scores of 26 new graduate nurses. Mean score for the RNs was 82.3 points (SD = 10.7) and mean score for new graduate nurses was 74.8 points (SD = 11.7). A one-tailed t-test found significant difference ($p<.001$) in the scores of the RNs and the graduate nurses, with the RNs scoring higher (Toth, 2006b).

All versions of the BKAT have used Cronbach's coefficient alpha as the measure of internal consistency (Toth, 2006b). Reliability of the first two versions of BKAT was determined on two samples of practicing critical care nurses (total of 192 nurses) and one sample of baccalaureate nursing students (38 students) from the metropolitan Washington D.C. area. The alpha ranged from 0.83 to 0.86. The internal consistency reliability of BKAT, Version Seven, was measured on 298 experienced critical care nurses from 26 USA states. Chronbach's alpha ranged 0.88 to 0.90 (Toth, 2006b).

The BKAT is a reliable and valid assessment of basic critical care nursing knowledge and application in the United States nursing population (Bovie, Kenney, & Butcher, 1995; Henry & Holzemer, 1993; Santiano, Daffurn, & Lee, 1994; Toth, 2003). The BKAT was designed to measure knowledge over a broad range of critical care specialties and can be used to assess basic knowledge both before and after orientation, with students, and with experienced staff members (Bovie, Kenney, & Butcher, 1995), and therefore chosen for this study. Cronbach's coefficient alpha for the BKAT-7 in the current study was computed as .75.

For the purposes of this study, the 42 questions related to cardiovascular and monitoring lines were examined not only in the context of the test as a whole, but as a subscale as well. The internal consistency estimate of reliability expressed as Cronbach's coefficient alpha for the BKAT cardiovascular subscale in the current study was computed as .75.

ECCO Cardiovascular Module Examination

The ECCO Cardiovascular Module examination is a 66-question multiple-choice examination developed and validated by a panel of critical care content experts. The

examination is updated regularly to reflect nursing knowledge and practice (AACN, 2003). Access to the examination is part of the ECCO program.

For purposes of this study, 25 questions were selected from the ECCO test bank to administer via paper and pencil to every study subject. The questions were chosen by content experts to match the learning objectives of the ECCO cardiovascular module. A panel of three critical care educators independently chose 25 questions from the test bank. Each of the 25 questions referred to a different course objective and was chosen for its clinical relevance. The Principal Investigator reviewed all three question lists for agreement and resubmitted the non-agreed upon questions to the expert panel who agreed after the first resubmission. The product of this process is the Modified ECCO Cardiovascular Module Examination (Appendix D). The internal consistency estimate of reliability expressed as Chronbach's coefficient alpha for the Modified ECCO Cardiovascular Module Examination in the current study was computed as .21. The use of a subset of the entire exam is a possible explanation for this low score.

Kolb's Learning Style Inventory

David Kolb developed the LSI in 1971 to assess individual learning styles and to assist learners understand their strengths and weaknesses (Kelly, 1997). Four statistically prevalent learning styles were identified: diverging, assimilating, converging, and accommodating (Kolb et al., 1999). Results of the LSI enable learners to understand their preferred learning styles and teachers to cover materials in ways that fit a diverse group of students (Kelly, 1997). The Kolb Learning Style Inventory 3.1 (LSI 3.1), revised in 2005, is the latest version of the original LSI developed by David Kolb (Kolb & Kolb, 2005) (Appendix E).

Participants are asked to rate sentence endings for 12 items. “Most like you” is rated 4, while “least like you” is rated 1. Scores are calculated for concrete experience, reflective observation, abstract conceptualization, and active experimentation. Those scores are plotted on a four-quadrant grid, denoting the participant as in the diverging, assimilating, converging, or accommodating learning style quadrant.

Kolb and Kolb (2005) have reported alpha coefficients of 0.77 to 0.84 for LSI users (N=5023). These authors report two test-retest studies of the randomized LSI 3. One study (Ruble & Stout, 1991) reported Kappa coefficients ranging from moderate to excellent. Kolb and Kolb attempt to explain the discrepancy with the observation that learning style is situational and may change from test to retest depending upon intervening experiences and environmental demands.

Coffield, et al. (2004), state that there is a long public dispute related to the validity and reliability of the LSI, although changes in the instrument have improved reliability. Further, those authors believe that the LSI has a low predictive validity, but its development was not for the purpose of prediction, but as a self-assessment exercise. According to Experience Based Learning Systems, Inc. (2005), the reliability of Version 3 is improved as a result of a new format, in which the questions are randomized. Internal consistency alphas for scale scores for an online sample of 5023 participants ranged from .77 to .84.

Affective Measure Survey

Subjects’ feelings related to method of instruction format and presentation was elicited by the Affective Measure Survey (Appendix F). Verbal permission to use the survey was obtained from the author. The rationale of this tool is based on Bloom’s

concept (1968) that positive feelings about the subject to be learned aid learning and motivate students to learn more (Huckabay, Anderson, Holm, & Lee, 1979).

The instrument is comprised of ten items in a Likert scale format. Scoring possibilities range from zero, indicating an unfavorable response to ten, the most favorable response. An additional item elicits the subjects' comments. The maximum total score is 100. The instrument was scored upon posttest and the score was averaged for each participant.

Huckabay, et al. (1979), using the tool in their study of cognitive knowledge gained in computer instruction, versus lecture classes, based the validity of the instrument on the literature and a five-judge panel with 100 percent agreement among the judges. Reliability was determined by the test-retest method. Spearman rank correlation between test/retest was 0.63 ($p<0.01$). The internal consistency estimate of reliability expressed as Cronbach's coefficient alpha for the Affective Measures Scale for the current study was computed as .97.

Data Collection Procedures

The following steps were completed as part of the data collection. Detail regarding these steps follows.

1. Recruit participants
2. Obtain informed consent
3. Randomize to either ECCO or face-to-face instruction
4. Administer pretests: Demographic Collection Tool, the Kolb LSI, the modified ECCO cardiovascular module examination, and the 100-item BKAT-7
5. Provide instruction

a. Face-to face—formal classroom instruction of 20 hours
b. ECCO—online education completed over a 3 week period

6. Administer posttests: the modified ECCO cardiovascular module examination, the 100-item BKAT-7, the Affective Measures survey
7. Provide CEUs for completion

Ethical Considerations

This study involved minimal risk. Expedited review was sought and granted from the University of Central Florida Institutional Review Board (IRB) (Appendix H). IRBs from two local hospital systems reviewed the study and granted exemption based on current recommendations. Informed consent was obtained at one-to-one or group intake meetings between the principal investigator, or meetings with one trained data collector and the participants.

Recruitment, Consent, and Randomization Process

The research was conducted between January and October of 2007. The PI contacted directors of education for four area hospitals and enlisted their cooperation. Study participants were recruited by means of a descriptive flyer (Appendix G) posted in nursing lounges and on continuing education bulletin boards in these hospitals, and placed in each nurse's unit mailboxes at two of those institutions. Additionally, the PI contacted hospital chief nursing officers, directors of nursing units, and representatives of nursing programs at a local university to discuss the study, provide recruitment flyers, and to seek referral of nurses who may be interested in the opportunity to participate in the study. Interested nurses were advised to contact the principal investigator by e-mail

or telephone. After determination of eligibility, potential subjects were given the opportunity to participate in the study and were scheduled for consenting and pretesting.

The best response was from the nursing directors in one local hospital system who actively recruited nurses working on their units. Several nurses from the university and other community agencies expressed interest, but as they had to be able to attend the face-to-face classes if necessary, scheduling prohibited their participation. No participation was forthcoming from one hospital system that would not allow the PI to personally recruit, but rather relied on their education department to do so.

The study subjects were 41 volunteer nurses living in southwest Florida. Twenty-two of the subjects were randomized to attend five face-to-face cardiovascular critical care orientation classes (a total of 20.5 hours of instruction) and 19 to complete the ECCO cardiovascular module in a maximum of 20.5 hours. Randomization was accomplished by means of sealed envelopes denoting group membership. The sealed envelopes were shuffled and numbered by the PI. Therefore, the contents were unknown. The envelope was opened after the individual had consented to participate in the study.

Although a target of 60 nurses was planned for the study, enrollment stopped after completion of intervention and testing with the third cohort (n=41). The primary reason for stopping the study was that AACN began an upgrade of the ECCO program and access was limited; a secondary reason was the significant power was achieved to answer hypothesis 3.

Pretesting

Following the acquisition of informed consent, the subjects were randomized, a copy of the completed informed consent (Appendix I) was provided to the participant, and demographic data were collected (Appendix J).

The 12-item Kolb LSI, the 25-item modified ECCO cardiovascular module examination, and the 100-item BKAT-7 were administered (in that precise order) using a paper and pencil format to the study subjects at the intake meeting. The exams were ordered by anticipated length of completion times, from the least to the most time. Written and oral computer instruction, information to access the ECCO program, and computer demonstration (if necessary) for ECCO participants were given at that meeting. Permission was granted by the Hay Group (Appendix K) to use Kolb's Learning Style Inventory (LSI) (Appendix F) to determine which of four learning styles the subject exhibits.

Participants in the ECCO group had access to ECCO for a three-week period. They were instructed not to access the Cardiovascular Module examination or any of the other system modules. It was stressed during the instructive period that the PI was available at any time by telephone or e-mail for questions or concerns. Four participants called or contacted the PI regarding access problems, all due to computer administration errors. Errors were swiftly remedied.

The PI had access to program administrative functions and found that despite instruction, four computer participants accessed the exam. Three realized their mistake quickly, and exited. One took the exam prior to data completion and obtained a score of 73%. Her posttest exam result was 74%, essentially the same.

One ECCO group participant called to question information he obtained in the ECCO module. The information was correct and further explained to the participant by the PI. On-line troubleshooting was provided by ECCO staff members, but not used by any of the participants.

Posttesting

Post-testing consisted of the 10-item Affective Measures Survey, modified ECCO cardiovascular module examination, and BKAT-7 (in that order). A two-hour face-to-face case study discussion component was presented to the ECCO participants upon completion of the computer module and taught by the instructor for the face-to-face study arm. This attempted to comply with the intent of what ECCO terms “blended learning” (a hybrid model). Post testing took place at that class, after the case study discussion was completed, for those who chose to attend.

The PI administered posttests for the face-to-face participants at the end of the last class day. If the participant did not attend the last class, the PI arranged to individually posttest that participant. Nursing continuing education contact hours were mailed to this group at the completion of posttesting. The classroom instructor was not present for posttesting, nor was she informed of the results.

All computer participants did not complete the entire module, according to ECCO administrative tracking tool. Computer participants were allowed to posttest if the tracking tool indicated that they had entered the module at all. It was not possible to determine the amount of time spent by a participant in the ECCO program, which is a limitation of the study.

Intervention

The intervention was either face-to-face classroom instruction or the ECCO method of instruction for the cardiovascular content. The face-to-face instruction consisted of 20 hours of content taught by a Clinical Nurse Specialist (CNS) who is an expert in cardiovascular clinical education. The CNS has 28 years of teaching experience, maintains the CCRN credential and consistently receives superior evaluations for classroom instruction. She typifies Benner's (1984) description of the expert instructor by her ability to illuminate principles and guidelines that help to safely and efficiently guide students' practice.

The classroom education was designed to mirror the objectives and outline of the ECCO cardiovascular module. The classes were taught in either five sessions (cohort 1) or three sessions (cohort 3) to best accommodate the schedules of those participating in the face-to-face classes. (No one in cohort 2 was randomized to face-to-face instruction, despite continuing blinded randomization.)

The ECCO instruction consisted of a self-paced education program on the cardiovascular module. AACN awards 20 contact hours for completion of the module. Permission to use the ECCO program was obtained from AACN (see Appendix A). The ECCO module also included a two-hour face-to-face case study discussion component in which post-testing was accomplished. The goal of the case study discussion was to incorporate blended learning into the method of instruction. Not all of the ECCO participants chose to attend the case study class. Those who did not were post-tested separately.

Three cohorts were recruited. Cohort 1 had 20 students. Face-to-face class sessions were conducted in five four-hour segments in a 21-day time period for the first

cohort of participants. Cohort 2 was small with only 4 students recruited and all were randomized to the ECCO group. Cohort 3 had 17 students. To accommodate scheduling, face-to-face classes were scheduled for two 8-hour sessions and one 4-hour session. Twenty hours of class time allowed for breaks and post testing.

The last cohort of participants was easier to recruit, but it was harder to get them to complete the study. This was, in part, due to the necessity of having 8-hr classes. Two participants attended 8 hrs of class and could not complete the remainder of the intervention because of their work schedule. Their director had promised them the time, but could not comply because of staffing pressures. One participant in the computer group appeared to finish the ECCO program, but did not complete the post-test. One computer subject did not even sign into ECCO program. Figure 2 demonstrates percentage of participants completing the study.

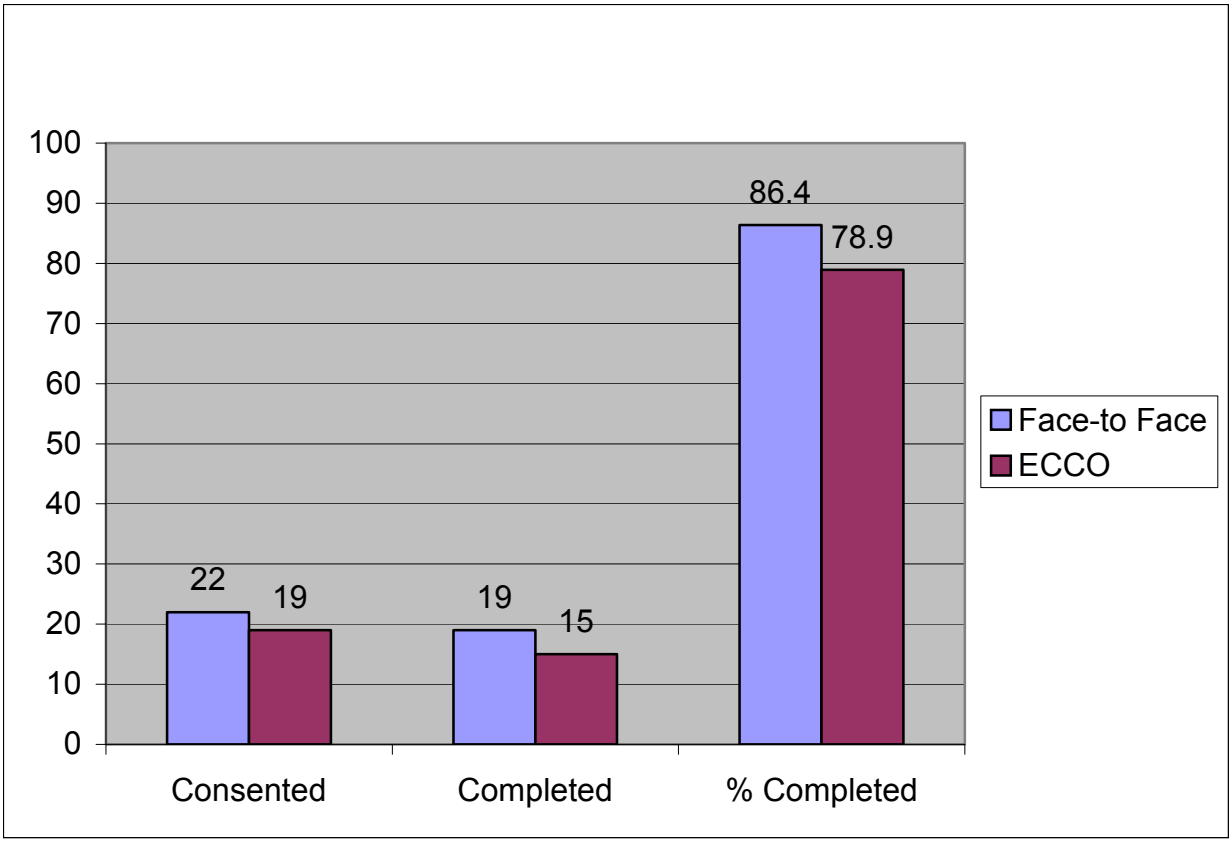


Figure 2: Participants Completing Study

One Clinical Nurse Specialist who is extensively experienced in cardiovascular clinical education taught the classes. The classroom instructor was provided with the objectives for the ECCO Cardiovascular module, but had no knowledge of the BKAT-7 or ECCO examination content. She also had no knowledge of the results of the LSI.

Data Analysis Procedures

The sample was described by frequencies (categorical data) and descriptive statistics consisting of calculation of means and standard deviations. Hypotheses were tested by t-tests and repeated measures analysis of variance comparing sample means.

Characteristics of each group were compared for congruence. Analysis was accomplished using Statistics for Social Scientists (SPSS) v.15.0.

CHAPTER FOUR: RESULTS

Results of the analysis of the Learning Styles Inventory, ECCO Cardiovascular Module Examination, BKAT-7, cardiovascular portion of the BKAT-7, and the Affective Measures Survey are reported in this chapter. Characteristics of the participants are analyzed as well as learning outcomes, learning styles relative to class preference, and participant satisfaction with learning modality.

Hypotheses were tested by means of t-tests, chi square analysis, and repeated measures ANOVA. The default level of significance for rejection of the null hypothesis was 0.05 (alpha,α). The Statistical Package for Social Science (SPSS) v 15.0 was used to conduct analyses, generate tables, and construct graphs.

Description of Participants

A total of 41 participants were enrolled into the study: 19 computer (46.3%) and 22 (53.7%) face-to-face. Sixteen participants (39%) stated that they preferred computer-based learning and 25 (61%) preferred face-to-face classes. Eighteen (43.9%) were randomized into the study arm of their preference while 23 (56.1%) were not.

Thirty-four (82.9%) participants completed the study. Of those assigned to the face-to-face class group and who completed the study, the majority (73.7%) attended all 20 hours of classes. Two (10.5%) participants attended 12 hours of classes and 3 (15.8%) attended 15 hours.

Of the 7 who did not finish, 4 (57.1%) were in the computer group and 3 (42.9%) were in the face-to-face class. One participant in the computer group did not sign into the ECCO program at all following pretesting. The primary reason cited for not completing the study was lack of time to come to classes.

Demographic data are shown in Table 3. Values on all categorical variables were compared between the two study groups to test equivalence. Chi-square demonstrated no statistical difference in gender, marital status, ethnicity, highest degree obtained in nursing, learning modality preference, or learning style between groups.

Table 3: Participant Characteristics

Characteristic		Computer	Classroom	P-value
		(N=19)	(N=22)	
Gender	Male	5	3	.307[a]
	Female	14	19	
Ethnicity	Caucasian	17	20	.506 [a]
	African-American	2	1	
	Asian	0	1	
Mean age (s.d.)		41.4 (13.6)	37.9 (10.5)	.357[b]
Years experience in nursing		11.9 (13.7)	8.3 (9.7)	.332 [b]
Highest degree in Nursing	Diploma	4	4	.453 [a]
	Associate	9	12	
	Baccalaureate	4	6	
	Masters	2	0	
Modality Preference	On-line	7	9	.790 [a]
	Classroom	12	13	

Notes: [a] Chi-square test for independence
[b] p-value for independent t-test

Gender and Marital Status of Participants

The sample consisted of 33 females (80.5%) and 8 males (19.5%). Married persons numbered 33 (53.7%) of the participants while 15 (36.6%) were single and 4 (9.8%) were divorced.

Age Distribution of Participants

Mean age of the participants was 39.54 (s.d. 12.006) with ages ranging from 21 to 60. Although the average age of the computer group was older than that of the classroom group, an independent samples t-test with equal variance assumed found no significant age difference between groups.

Highest Degree and Years Experience in Nursing

The majority of participants (n=21, 51.2%) held an associate degree in nursing. Ten (24.4%) had a baccalaureate degree, 8 (19.5%) were graduates of a diploma nursing program, and 2 (4.5%) had a master's degree.

The mean number of years of experience for the study participants was 9.94 (s.d. 11.7) years, and the range from 0 to 38 years. Participants in the computer group averaged 11.9 (s.d. 13.7) years of experience, while the classroom group averaged 8.3 (s.d. 9.7) years. An independent sample t-test with equal variance assumed found no significant differences between the groups in years of experience. .

Participant Learning Styles

The Kolb Learning Style Inventory (Kolb & Kolb, 2005) was used to determine the learning styles of the participants: diverging, assimilating, converging, or accommodating (Figure 3). There were 15 (36.6%) participants in the diverging

category, assimilators and convergers numbered 8 (19.5%) each, and 10 (24. 4%) were accommodators.

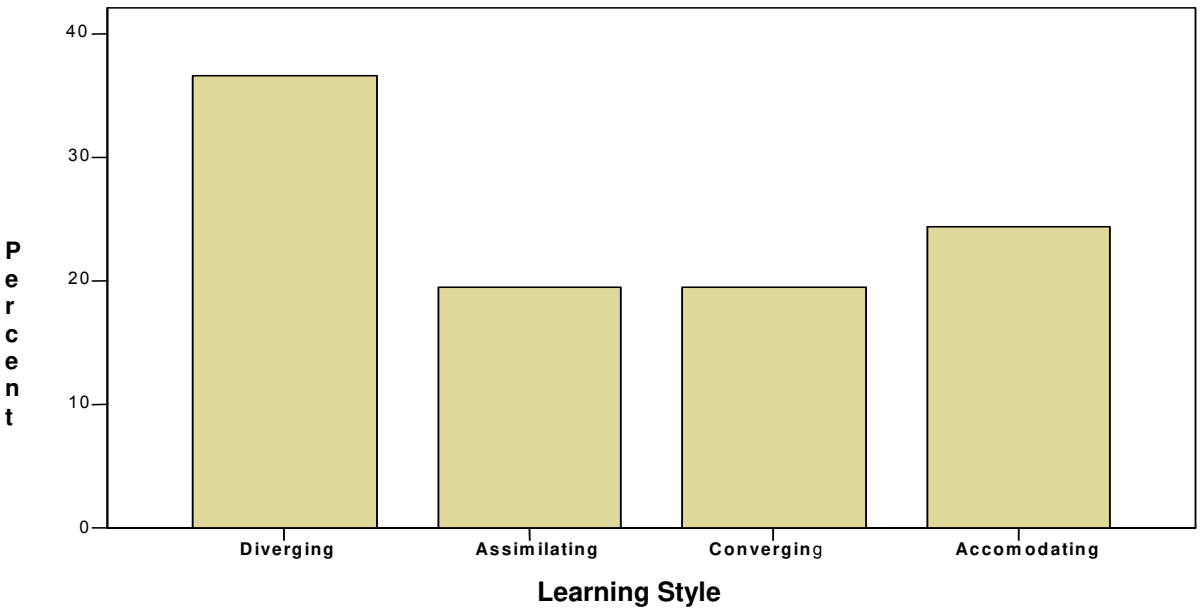


Figure 3: Participant Learning Styles

A chi-square test was conducted to assess whether there were between group differences in learning styles. There was no statistical significance between the ECCO and face-to-face groups, $\chi^2(2, N = 41) = 1.26$, p .74.

Comparison of Learning Outcomes

Learning outcomes of the classroom and computer groups were examined by using the pretest and posttest data obtained from the BKAT-7 examination and the Modified ECCO Cardiovascular Unit examination. A subset of the BKAT-7, consisting of the cardiovascular content questions, was also examined. No significant differences were noted between groups on the pretest results for the BKAT-7, Modified ECCO

Cardiovascular Unit Examination, and the BKAT Cardiovascular Subset examination. (Table 4).

Table 4: Comparison of Participant Pretest Results

Test	t	df	Sig (2 tailed)
Modified CV Preassessment	-370	39	.713
BKAT Preassessment	-.620	39	.539
BKAT CV Subset	.325	39	.747

*Note. *p>.05 (Independent sample t-test)*

Hypothesis 1: The mean difference between pretest/posttest scores on two cardiovascular knowledge exams will be equivalent between participants in the online ECCO and face-to-face cardiovascular education courses.

Pretest and posttest scores for each group on each knowledge examination are shown in Table 5. This hypothesis was supported by study results. Both study groups gained knowledge as evidenced by increases in mean group scores in the BKAT-7, the Modified ECCO Cardiovascular Module Examination, and the BKAT-7 cardiovascular subset.

Table 5: Comparison of Pretest and Posttest Mean Scores

Tool		Group		
		All Participants Mean Score (SD)	Computer Mean Score (SD)	Classroom Mean Score (SD)
Modified CV	Pretest	15.41 (2.4)	15.26 (2.5)	15.55 (2.4)
Exam	Posttest	17.85 (2.2)	17.93 (2.7)	17.79 (1.8)
BKAT-7	Pretest	62.34 (8.3)	61.47 (8.6)	63.09 (8.1)
	Posttest	67.34 (9.9)	68.20 (9.9)	67.16 (10.0)
BKAT CV	Pretest	24.00 (5.7)	24.32 (5.8)	23.73 (5.8)
Subset	Posttest	26.38 (5.9)	27.20 (5.1)	25.74 (6.5)

Two-way within subjects repeated measures analyses of variance were conducted to evaluate knowledge gained within and between groups on the BKAT-7, the Modified Cardiovascular (CV) Module Examination, and the BKAT-7 Subset (Table 6). The dependent variable was the amount of knowledge gained. The amount of knowledge gained by each group was significant (p=<.01), with the scores of those in the ECCO group slightly higher, but not statistically significant.

Table 6: Comparison of Posttest Score Gains

Tool		Wilks'Λ	F	Sig
BKAT-7	All participants	.65	17.44	<.01
	Group	.99	.381	.54
Modified CV Module	Total	.46	37.78	<.01
Exam	Group	.97	.886	.35
BKAT-7 Subset	Total	.80	7.93	<.01
	Group	1.00	.005	.95

*Note. *p>.05*

Learning Style Preference

Hypothesis 2: Learning style is not associated with participants' preference for online versus face-to-face learning modality.

This hypothesis was supported by study results. Learning style and class preference was examined by means of a chi-square test, which was not significant Pearson X^2 (2, N = 41) = 3.39, p = .34. The majority of participants (N=25, 61%) preferred the classroom instruction. It should be noted that almost twice as many convergers preferred computer classes to the classroom learning modality and 4 times as many accommodators preferred face-to-face (Figure 4). Cross tabulation of preference for instruction and learning style is shown in Table 7.

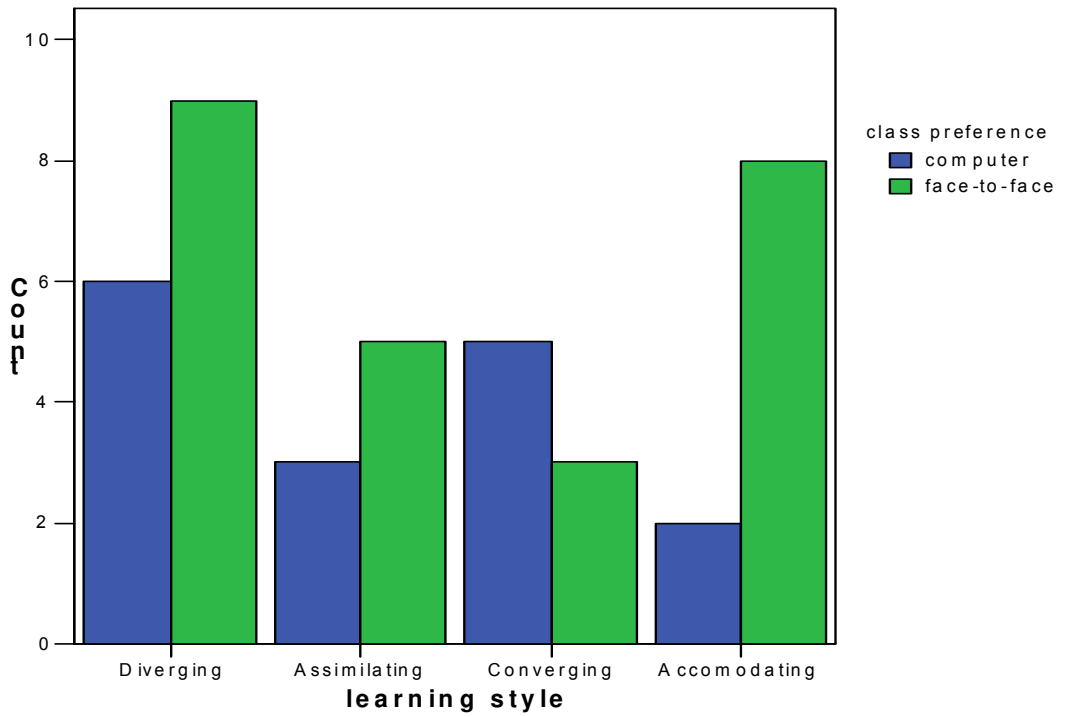


Figure 4: Class Preferences and Learning Styles

Table 7: Class Preference and Learning Styles Cross tabulation

	Learning Style				
Preference	Diverging	Assimilating	Converging	Accommodating	Total
Computer	6	3	5	2	16
Classroom	9	5	3	8	25
Total	15	8	8	10	41

Affective Measures Results

Hypothesis 3: Satisfaction with learning modality will be greater for participants in the face-to-face critical care orientation classes than for participants in the ECCO program.

This hypothesis was supported by study results. The mean score for those in the face-to-face group was 7.7 (s.d 1.1) as compared to 5.1 (s.d. 2.4) for those in the ECCO group. An independent sample one-tailed t-test found a significant difference in Affective Measures scores (Table 8). Participants were significantly more satisfied with the classroom modality of learning in this study.

Table 8: Comparison of Affective Measures Scores

Group	N	Minimum	Maximum	Mean	SD	t	df	Sig (2 tailed)
Computer	15	.8	8.4	5.1	2.4	-4.246	32	.000
Classroom	19	5	9.2	7.7	1.1			

*Note. *p>.05 (Independent sample t-test)*

The Affective Measures tool included a space for comments from the participants. Table 9 lists all comments from participants in both study groups. Participants in the ECCO group focused on difficulty of material and lack of opportunity for assistance and to ask questions. Participants in the classroom group cited difficulty of material, difficulty in retention of material, and long class times. They commented positively on the competence of the instructor.

Table 9: Affective Measures Participant Comments

Group	Comment
Computer	The computer course was too fast-paced and difficult to understand. I became frustrated very early on, which decreased my confidence and motivation to continue. I wish I had been chosen for the classroom lectures.
Computer	I personally enjoyed the course. Being that application of this information is necessary, I believe that an in-person version would be more effective
Computer	The online course was hard to get interested in and there was not an opportunity for assistance and questions. The computer portion may be used as a good review, but not for the initial teaching of material.
Classroom	The computer training may not have been convenient, but with the face-to-face the instructor was so knowledgeable, she made the subject matter clear and interesting! It also prevented procrastination of study. You had to show up at a scheduled time. No distractions or interruptions.
Classroom	I learned a lot. I felt a little overwhelmed because I knew so little. This would be a class that I would not mind repeating. I would like to retain everything, but that takes lots of repetition.
Classroom	Some parts of the class were very detailed and hard to pay complete attention to, but overall, the instruction was clear and precise.
Classroom	Eight-hour classes are too long to retain information. I enjoyed the class, but was lost after 4 hours of unknown material.

Summary

No differences were noted in demographic characteristics of subjects randomized to either the face-to-face or ECCO groups. All participants showed an increase in knowledge on the cardiovascular content as measured by the content examinations: however, no statistical differences in learning were noted between

groups. Although trends were noted, learning style was not associated with a preference for either type of learning. Those in the face-to-face group had statistically higher scores on the affective measure of satisfaction with the program.

CHAPTER FIVE: DISCUSSION

This chapter discusses the findings and conclusions of the study. Limitations of the study as well as implications for nursing practice and education are explored and further opportunities for research are recommended.

Hypothesis 1—Cardiovascular Knowledge

This study found no significant difference in the acquisition of cardiovascular nursing knowledge gained between nurses participating in the ECCO computer on-line course and a traditional face-to-face class. More broadly, although the subject of the classes differed, the results supported the findings of multiple nursing researchers who also found no difference in knowledge attainment in their studies (Coma Del Corral et al., 2006; Day & Payne, 1984, 1987; Neil, 1985; Nyamathi et al., 1989; Schmidt et al., 1991; Woo & Kimmick, 2000). No comparison of learning modalities in the orientation of the new critical care nurse was found during the review of related literature.

Results indicated that either arm (ECCO or classroom) may be equivalent in the process segment of the modified Donabedian (1980) conceptual framework upon which this study was based. One variable influencing the choice of one process over the other could be the instructor for the classroom modality.

The quality and expertise of the instructor is crucial to the success of the classroom modality in achieving the outcome of nursing knowledge acquisition. The instructor chosen for this study is a Clinical Nursing Specialist with many years of experience in nursing education and critical care practice. She has been consistently evaluated as outstanding by students in previous critical care courses and was rated as outstanding by the classroom participants in this study as well. She is widely considered

by her students and peers to be an expert educator and clinician in the novice to expert continuum (Benner, 1982). Knowledge acquisition scores in the classroom group could have been different with the use a different instructor. Classes taught by a less experienced or less skilled instructor could potentially change learning outcomes for the worse. If a less skilled instructor taught the face-to-face class, the students in the computer group may have achieved a higher level of learning, as computer instruction is always of a consistent quality.

The quality of the computer program is also germane to the study findings. A panel of experts periodically updates the ECCO program to ensure a high-quality program. All of the computer participants used precisely the same version of ECCO. Outcomes of computer-based learning versus face-to-face learning may be different if the quality of either program is inferior to the other. This study was specifically designed to ensure a high-quality program that was equivalent in content between the two groups.

Another relevant variable is instructional design. The ECCO program used by all of the computer arm participants had little case study material included. By contrast, the classroom instructor used case studies and anecdotes to illustrate her content. Case studies and anecdotes as well as interactions via questions and answers can enhance learning (Benner, 1982; Rashotte &Thomas, 2002). These are a form of experiential learning in which a student learns, not by her own experience, but by that of the instructor.

In the ECCO program, questions are asked primarily for evaluative purposes (testing knowledge gained). In the ECCO program used in this study, students had no

immediate mechanism by which to ask substantive questions of an instructor. They were instructed to either telephone or e-mail the PI with these types of questions. One computer participant telephoned once and the same student e-mailed a question once. In contrast, the classroom instructor was observed to ask 51 questions of the study participants in one 4-hour class, primarily in the Socratic manner. The participants asked 28 questions of her in that same 4-hour period. The new version of ECCO (ECCO 2.0) allows more interactivity and adds clinical judgment and decision-making screens which give feedback for wrong responses to questions.

This study measured only the cognitive and affective components of learning. One participant's comment on the Affective Measures Survey (Table 20) mentioned the lack of a psychomotor component to the ECCO course and suggested that a classroom component was necessary. This "hands-on" exposure to equipment used in cardiovascular nursing, along with the case studies and anecdotes presented by the classroom instructor correlated with Kolb's Experiential Learning Theory (1984). This particular type of instructional design was chosen by this instructor and would not necessarily be used by a different instructor.

There was no clinical orientation to critical care for participants in either the classroom or ECCO arms of the study. This is a difference from what is normal and usual in an actual orientation to the critical care setting. In this respect, the classroom instructor had the advantage of being able to supply pieces of equipment and anatomical models to illustrate her content. This allowed hands-on experiences for the participants and generated questions as well as confidence. In an actual orientation,

additional hands-on experiences would be gained during a clinical internship component.

Despite inequities in the amount of hands-on instruction, ability to receive immediate answers to questions, and case study content, there was no statistical difference in the amount of knowledge acquisition between the two groups. These factors, however, may have contributed to the higher program satisfaction scores in the face-to-face classroom group.

AACN (2004a) has suggested a blended program of both computer and face-to-face interaction for those using the ECCO program in critical care orientation. This study attempted to create a blended learning experience for ECCO participants by providing a case study application during the last data collection period. However, it was optional for the participants to attend the last two-hour portion of the final face-to-face class. Of 19 participants in the computer group, 9 (47.4%) attended the case study component of the final class. Lack of flexibility in scheduling was cited as the primary reason for inability to attend.

Hypothesis 2—Learning Styles

Study results indicated that there was no association between participants' learning style, as determined by the LSI, and pre-study preference for computer or face-to-face classroom learning modality. A majority of the 41 participants (25), 61%, preferred the classroom modality. Only convergers (5 out of 8, 63%) preferred to be placed in computer classes; however, this finding was not statistically significant. The notion that either concrete (divergers and accommodators) or abstract (assimilators and convergers) learners would prefer either computer or classroom learning modalities was

not supported. The lack of statistical significance likely related to the small sample size of the study.

The literature shows mixed results, both for correlation of learning style with preference for computer or face-to-face (Ames, 2003; Chapman & Calhoun, 2006; Englebert, Schwenk, & Grupper, 2001; Workman, 2004) and against (Brudenell & Carpenter, 1990; Nyamathi, Chang, Sherman, & Grech, 1989; Takacs, Reed, Wells, & Dombrowski, 1999; Tang, 2003). Although the idea of an association is intuitively appealing, the non-significant results of this particular hypothesis may be due to the small number of participants, or the use of differing learning style survey tools and methods in previous studies. It is also possible that no relationship between learning style and learning modality preference exists.

Another possible reason for the study findings is that participants did not express their true preference for learning modality. Other factors may have contributed to their selection of either the face-to-face or computer-based learning group. The PI, in conversations with the participants found that some participants chose the computer arm, by their own admission, because it was the mode most practical in their lives. Some based their preference on the subject matter to be covered in the study, stating that it was totally foreign to their clinical experience. These participants stated that they preferred the classroom modality because they believed they would perform better in a classroom environment where they could ask questions.

Hypothesis 3— Learning Modality

Study results found satisfaction with the learning modality was significantly greater for classroom study participants than for computer participants. This supports

the findings of Brudenell and Carpenter (1990) and Chernish et al. (2005) who found a preference for traditional classroom learning methods among their study participants. Negative attitudes may possibly reflect the ECCO program itself (an idea posited by Brudenell and Carpenter), the cardiovascular subject matter, or the participant's displeasure in randomization to the computer group.

Computer participants cited lack of opportunity for real-time questions to be answered and content complexity as negatives related to their computer learning experience. Additionally, the monotonous tone of voice of the narrator of the ECCO program was viewed by some as a drawback to the program.

Classroom participants concurred that the cardiovascular content was complex; however, they expressed positive comments about their instructor. A different instructor may possibly have affected the satisfaction scores either more positively or negatively. Eight-hour classes were viewed by some as unfavorable to learning, but hailed by others as more convenient.

Limitations

A major limitation of this study was the relatively small sample size leading to low power in the statistical analyses related to acquisition of learning. Subgroup analysis was also limited by the small sample. The difficulty of recruiting and retaining participants was related to practical problems in scheduling classes for nurses who work full-time. All potential participants had to be able and willing to attend the class sessions in order to be randomly assigned to a study group. Many prospective participants were unable to meet the requirements for attending the face-to-face classes. Recruitment from a larger geographical area would potentially have mitigated this issue, however,

that would have created additional issues related to scheduling and locations of classroom instruction.

The study was limited by practicality to one city in southwest Florida. This limits generalizability to nurses in other geographic areas. Additionally, the scope of the study included exclusively cardiovascular critical care nursing content. Generalizing results to other contents of the ECCO program or any other critical care computer instruction is unwise.

The use of one instructor to teach all of the classroom content is strength, but also a limitation of this study. As previously discussed, not only satisfaction scores, but also knowledge acquisition scores could be altered by using another instructor.

It was not possible to determine the amount of time ECCO participants spent in the cardiovascular module. The only determination that could definitely be made was whether they had actually accessed the online cardiovascular module. ECCO participants were instructed to mark each lesson within the module as “completed,” but often failed to do so. In retrospect, a learner log of time spent in the computer module would have been advantageous to collect.

Nurses who volunteered for this study received 20.5 hours of continuing education credits. They were from varying backgrounds. Study findings may have been different if the participants were planning on pursuing a critical care nursing specialty.

Lastly, respondent fatigue may have resulted from lengthy time required for pretesting and posttesting. Both pre and posttesting required from 45 minutes to 1 hour of the study participant’s time. It was not possible, due to author restrictions, to administer only the cardiovascular subset of the BKAT-7. To do so would have reduced

the 100- question BKAT-7 by over half to 42 questions. This would have reduced the administration time of the longest tool proportionately.

Implications of Findings

This study adds to the body of knowledge comparing computer-based with classroom education, particularly in orientation of practicing nurses to new clinical content. Additionally, it is the first study to specifically evaluate the ECCO computer-based critical care orientation program. It examines the processes used to achieve the outcome of critical care knowledge acquisition with attendant quality patient care and staff satisfaction. More globally, it contributes to the growing body of knowledge exploring computer versus traditional education, whether in practice or nursing education.

Modern hospital administrations search for cost-effective ways to provide quality care to patients. Nowhere is this as vital as in critical care units where orienting and retaining critical care nurses is complicated and costly. The results of this study provide evidence that ECCO critical care computer education produces learning outcomes at least equivalent to traditional classroom critical care orientation. The inherent benefits of the ECCO program are efficiency, standardization, and cost-effectiveness (AACN, 2006). Additionally, study results show that, no matter what the learning style of the student, ECCO provides knowledge gain at least equivalent to those obtained in traditional classroom orientation.

Participant satisfaction was more favorable toward the classroom learning modality. Several participant comments favored a more blended (computer and classroom) form of orientation. A frequently expressed criticism by the participants was

that there was no instructor immediately available to answer student questions. Consideration should be given to accomplishing the goal of blended learning if using computer-based orientation programs, especially since it is an AACN (2004a) recommendation. Allowing students to choose the mode of learning which suits their learning style and personal needs offers another potential alternative.

Course outlines and objectives were uniform between the ECCO and face-to-face study arms. Comments related to the classroom instructor were uniformly positive. These attitudes contributed to high course satisfaction scores for the face-to-face group. This suggests that critical care educators and classroom teachers should be carefully screened, adequately prepared, and have the teaching resources necessary for excellent teaching and learning.

Use of the ECCO program is by no means limited to the clinical arena. Although this study did not include nursing students, results can be extrapolated to include college nursing education related to critical care content. The same benefits of efficiency, standardization, and cost-effectiveness can be advantageous in the academic arena.

Future Research Recommendations

Replicating this study with a variety of instructors in varied geographic locations, expanded populations, and larger samples would be advantageous. Similar studies exploring the various subject models of the ECCO program may produce further evidence of the program's efficacy as a whole. Replicating the study in an actual critical care orientation course would be important.

Specific research questions may include:

1. Is there a difference in learning of critical care content between classroom and computer learners in teaching hospitals versus community hospitals?
2. Is there a difference in learning of critical care content between classroom and computer learners in college nursing programs?
3. Does ECCO 2.0 provide an increase in learning when compared to the current ECCO program?
4. Is there a difference in learning of critical care content between classroom and computer learners by different cultures?

Additionally, research related to more blended forms of critical care education is needed. As other vendors produce additional programs providing instruction on critical care subject matter, those, too should be explored.

The input segment of the modified Donabedian model provides fertile ground for further research. Research questions related to the selection of candidates for critical care orientation (age, gender, previous experience) and relationships to learning outcomes could be examined. Those questions could include:

1. Is age or gender of participant related to critical care knowledge attainment when instruction is provided by either traditional classroom or computer education?
2. Is years of non-critical care nursing experience related to critical care knowledge attainment when instruction is provided by either traditional classroom or computer education?

Education of the nurse new to critical care is essential to innumerable stakeholders (hospitals, patients and families, physicians, experienced critical care nurses, critical care team members, and schools of nursing) in the process leading to

excellent care. In times such as these, where nurses are being asked to do more with less, evidenced-based educational processes are crucial and topics of continuing nursing research.

Summary

This study compared computer and traditional face-to-face classroom orientation for critical care nurses. Participants in both study arms gained critical care cardiovascular knowledge. No significant difference between the groups in the amount of knowledge gained was found. Learning style was not significantly associated with the participants' preference for online versus face-to-face classroom learning. Additionally, satisfaction with the learning modality was significantly greater for the face-to-face classroom participant group.

Further study of differing populations, program content, blended learning modalities, and learning styles is needed to improve the orientation and retention of the new critical care nurse. Evidenced-based critical care nursing education is vital in order to provide excellent care to an aging population in challenging times for acute care facilities.

APPENDIX A: PERMISSION TO USE ECCO PROGRAM

American Association of Critical-Care Nurses
101 Columbia
Aliso Viejo, CA 92656
(949) 362-2000

November 17, 2006

To Whom It May Concern:

I am writing to confirm the American Association of Critical-Care Nurses (AACN) support of Patricia Anzalone and her research proposal: “A comparison of computer and traditional face-to-face classroom orientation for beginning critical care nurses.”

Pending IRB approval, Ms. Anzalone has our permission to access our Web-based program *Essentials of Critical Care Orientation (ECCO*.)

Ms. Anzalone is planning to access the cardiovascular module of ECCO for a maximum of 50 students. This access will be available for a three-month period to commence at her discretion. Additionally we will allow Ms. Anzalone access to the associated assessment items to ensure assessment standardization for all participants.

We look forward to supporting Ms. Anzalone with her research and look forward to the results.

Sincerely,

Mary P. Aust

Mary Pat Aust, RN MS

Clinical Practice Specialist

American Association of Critical-Care Nurses

APPENDIX B: BKAT-7

Code No ____ (1-3)
Card No ____ (4)

BASIC KNOWLEDGE ASSESSMENT TOOL (BKAT-7) FOR CRITICAL CARE NURSING

Version Seven

Directions: Circle the ***best*** answer or fill in the blank.

1. Initial measures for the treatment of *angina pectoris* include all of the following **EXCEPT**: (5)

   1) resting
   2) morphine
   3) oxygen
   4) nitroglycerine

2. The **classical** ECG change in acute myocardial infarction (AMI) is a: (6)

   1) wide Q wave
   2) ST segment elevation
   3) frequent PVCs
   4) prolonged P-R interval

3. Elevated cardiac iso-enzymes generally occur in all of the following **EXCEPT**: (7)

   1) congestive heart failure
   2) pericarditis
   3) closed chest injury
   4) cardiac surgery

4. The major therapeutic goal in the treatment of cardiogenic shock is to: (8)

   1) increase the afterload
   2) lower the BUN
   3) increase cardiac output
   4) decrease fluid volume

5. You receive orders to start nitroprusside (Nipride) and dobutamine (Dobutrex) in your patient with end-stage cardiomyopathy. How will this treatment regimen affect cardiac output? (9)

   1) reduces preload and improves contractility
   2) increases preload and reduces contractility
   3) reduces afterload and reduces contractility
   4) reduces afterload and improves contractility

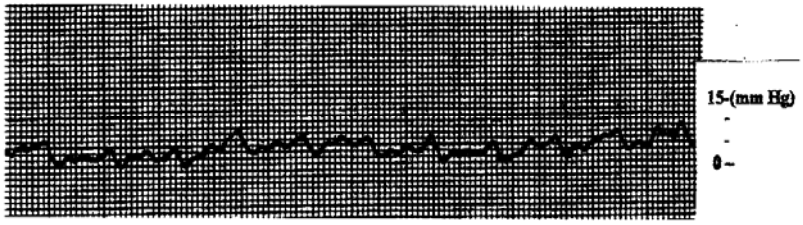
6. In dealing with a depressed patient during the first days post AMI the most appropriate nursing action would be: (10)

1) encourage the patient to ventilate his concerns
2) provide for privacy by closing the door/curtain
3) restrict visits from the family members
4) provide a quiet environment for the patient

7. Mr Seamore is receiving thrombolytics (TPA) 3 hours after an AMI. Which of the following would **most likely** require discontinuing the infusion? (11)

1) PVCs
2) bleeding gums
3) oozing at the insertion site
4) change in mental status

8. The following monitor pattern would indicate that the pulmonary artery (Swan Ganz) catheter is in which position? (12)

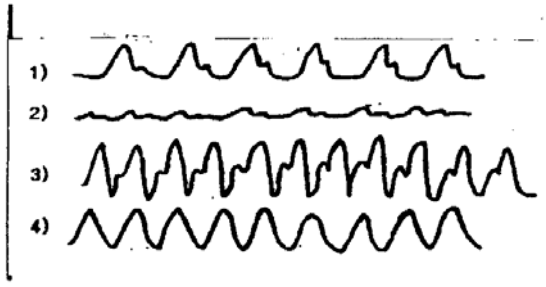


1) vena cava
2) right ventricle
3) pulmonary artery
4) pulmonary artery occlusion (wedge)

9. The use of an arterial line may be indicated for all of the following **EXCEPT**: (13)

1) shock with blood pressure too low to be determined by cuff
2) patients being treated with IV vasopressor drugs
3) mechanical ventilation requiring frequent arterial blood gases
4) for the efficient administration of prescribed drugs

10. Which of the following wave patterns indicates proper functioning of an arterial line? (14)



2

11. After an arterial catheter is removed, direct pressure should **generally** be applied to the artery: (15)

1) for 2 full minutes
2) for 5 to 10 minutes
3) until the oozing of blood from the puncture site slows
4) until a pressure dressing is applied

12. A central venous pressure (CVP) reading directly reflects pressure in the: (16)

1) left atrium
2) right atrium
3) left ventricle
4) pulmonary artery

13. An elevated CVP reading may indicate: (17)

1) right heart failure
2) a fall in hematocrit
3) acute dehydration
4) onset of left ventricular failure

14. If the monitor shows a continuous pulmonary artery occlusive [wedge] pressure (PAOP) pattern, all of the following actions are appropriate **EXCEPT**: (18)

1) releasing air from the balloon
2) repositioning the patient
3) flushing the line
4) asking the patient to cough

15. The PAOP reflects pressure in the: (19)

1) aorta
2) left ventricle
3) right atrium
4) vena cava

16. The normal pulmonary artery pressure is: (20)

1) 10-20 mean 5-10
   0-4

2) 21-30 mean 11-20
   5-15

3) 31-35 mean 21-30
   16-20

4) 36-45 mean 31-35
   21-25

17. How many mm Hg is the normal PAOP? (21)

1) 1- 3
2) 6-12
3) 15-20
4) 21-26

18. An elevated PAOP may indicate: (22)

1) hypovolemia
2) peripheral blood pooling
3) systemic hypotension
4) left ventricular failure

19. Mr Adams, a 68 yo patient, complains of feeling "a little funny in his chest". His EKG shows atrial fibrillation/flutter. Which of the following medications could be used to treat his cardiac rhythm? (23)

1) Levophed
2) nifedipine
3) Cardizem
4) adenosine

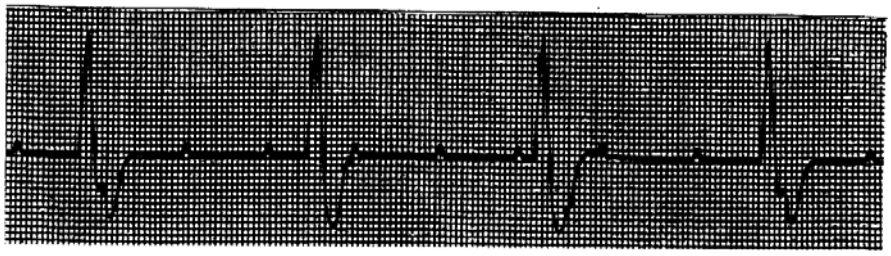
20. A QRS complex wider than 0.12 seconds most likely indicates: (24)

1) normal sinus node conduction
2) bundle branch block
3) second degree heart block
4) myocardial infarction

21. How many seconds is the normal P-R interval? (25)

1) .04 - .10
2) .12 - .20
3) .22 - .26
4) .28 - .32

22. The following rhythm strip represents: _____ (26)



23. Special care should be exercised when administering IV Dopamine because: (27)

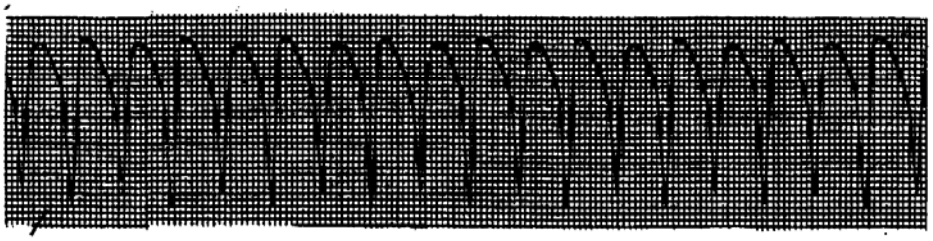
1) infiltration leads to tissue necrosis
2) high doses may lead to a profound bradycardia
3) precipitation can occur when used in a dextrose solution
4) even low doses decrease renal perfusion

24. The dysrhythmia in the following strip is: _____ (28)

25. A strong ventricular stimulus is potentially dangerous when it lands on the: (29)

1) U wave
2) P wave
3) T wave
4) QRS complex

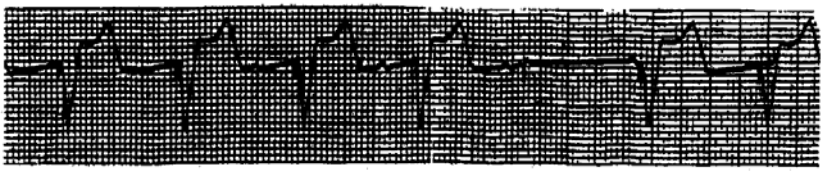
26. The rhythm strip below shows: _____ (30)



27. Indications for use of an external cardiac pacemaker include: (31)

1) PAT with block
2) Ventricular fibrillation
3) Wenckebach (Mobitz block type I)
4) Symptomatic complete heart block

28. In the following rhythm strip the transvenous pacemaker shows: (32)

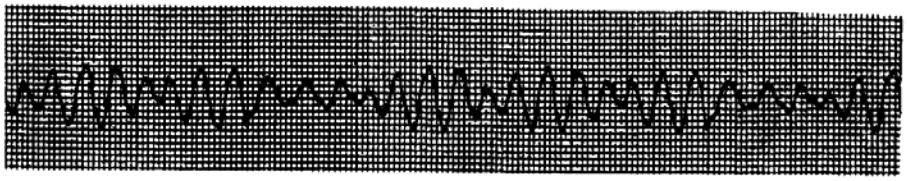


1) failure to sense
2) demand pacing
3) failure to fire
4) failure to capture

29. The initial drug treatment for sustained ventricular tachycardia when a pulse is present is: (33)

1) Isuprel 1.0 mg in 250 ml D5W drip
2) Epinephrine 1.0 mg IV push
3) atropine 0.5 mg IV push
4) amiodarone 150 mgm IV over 10 min

30. The rhythm strip below shows: _____ (34)



31. The cardiac rhythm of atrial flutter is: (35)

1) a benign condition in most people
2) normal following AMI
3) hazardous, as the ventricular rate may suddenly increase
4) hazardous, as it may progress to second degree heart block

32. Upon recognizing ventricular fibrillation, the nurse should **first**: (36)

1) perform a precordial thump
2) establish unresponsiveness
3) give amiodarone IV
4) check the ECG leads

33. One of the first therapies to be administered in the treatment of complete heart block is: (37)

1) atropine
2) transcutaneous pacing
3) metoprolol
4) digoxin

34. Your patient has atrial flutter with a ventricular response of 150 beats per minute. Therapy for this rhythm includes: (38)

1) amiodarone, Diltiazem, cardioversion
2) lidocaine, sodium bicarb, cardioversion
3) digoxin, potassium chloride, pacemaker
4) Isordil, Nitropaste, Pronestyl

35. Signs of cardiac tamponade may include all of the following **EXCEPT**: (39)

1) distended neck veins
2) pulsus paradoxus
3) decreased systolic pressure
4) bradycardia

36. In the patient with ventricular fibrillation, the correct energy setting for the first defibrillation when using a monophasic defibrillator is how many joules? (40)

1) 25-30
2) 50
3) 100
4) 200

37. A patient becomes apneic and pulseless. The monitor shows asystole. The drug that would most likely be used **initially** is: (41)

1) calcium gluconate
2) atropine
3) epinephrine
4) lidocaine

38. The antedote for heparin is: (42)

1) protamine sulfate
2) Narcan
3) glucagon hydrochloride
4) vitamin K

39. The **most** important step in preventing central venous catheter related sepsis is: (43)

1) use of a semi-permeable membrane dressing
2) weekly catheter changes
3) using antibiotic ointment
4) thorough handwashing

40. An excessive amount of chest tube drainage in the first few hours following thoracic surgery is how many cc's per hour? (44)

1) 150
2) 75
3) 50
4) 30

41. A routine check of your patient's blood gas values show a pH of 7.40, pO_2 of 98 mm Hg, pCO_2 of 38 mm Hg, and HCO_3 of 25 mEq. These results reflect: (45)

1) metabolic acidosis
2) metabolic alkalosis
3) normal values
4) respiratory compensation

42. Before suctioning a patient, you adjust the vacuum pressure so that it is: (46)

1) 120 mm Hg of vacuum pressure
2) as high as needed to remove secretions
3) 40 mm Hg of vacuum pressure
4) no higher than the diastolic blood pressure

43. Prior to the beginning of chest physical therapy (PT) on a post-operative patient with a left anterior chest tube, you auscultate the lung fields bilaterally and note that you hear diminished breath sounds in the right posterior base. This would most likely be due to: (47)

1) pleuritis
2) consolidation
3) atelectasis
4) the chest tube

44. Your patient is on a ventilator. The low volume alarm sounds. This may be due to: (48)

1) pulmonary edema
2) decreased secretions
3) a disconnected tube
4) biting the tube

45. To assess proper positioning of an endotracheal tube, the **most** appropriate nursing action would be to: (49)

1) listen for minimal leak of the cuff
2) listen for bilateral breath sounds
3) check for chest expansion
4) check the tidal volume indicator on the ventilator

46. Mr Ray has an endotracheal tube. While you are making rounds, you ask if his breathing is okay. In an audible tone, he says 'yes'. You should **first**: (50)

1) ask the patient to cough
2) record this in the nursing notes
3) notify the physician
4) check the functioning of the cuff

47. The high pressure alarm on a volume respirator may be triggered by all of the following **EXCEPT**: (51)

1) biting on the tube
2) pulmonary edema
3) leaking cuff
4) decreased lung compliance

48. Ms Phillips, who is on a ventilator, is receiving a neuromuscular blocking agent. Nursing care would include all of the following **EXCEPT**: (52)

1) frequent reassurance
2) orientation to what is happening to her
3) administration of sedation &/or analgesia
4) decreasing tactile stimulation

49. The **most** likely reason for absent breath sounds in a motor vehicle crash victim with closed chest trauma is: (53)

1) shallow breathing from pain
2) spinal cord damage
3) development of a pneumothorax
4) obstructive pulmonary disease

50. Your trauma patient, who is 4 days post fracture of the right femur, suddenly develops shortness of breath. The **most** likely cause is: (54)

1) fat embolus
2) atelectasis
3) pleural effusion
4) pulmonary edema

51. A moderately burned trauma patient is admitted to your unit. The **most** important treatment related to the burns during the first 24 hours after injury is: (55)

1) wound cultures
2) antibiotic prophylaxis
3) pain relief measures
4) fluid replacement

52. Mrs James has just been started on propranolol (Inderal) for her dysrrhythmias. It is important to know if she has a history of asthma because: (56)

1) asthmatic symptoms are masked by propranolol
2) propranolol decreases cardiac output
3) a slower heart rate could decrease alveolar gas exchange
4) bronchial constriction occurs as a side effect

53. To help prevent ventilator acquired pneumonia (VAP), the most important nursing action would be to : (57)

1) increase the FIO_2 to 50%
2) have the ventilator tubing changed q4h
3) meticulous handwashing and use of gloves when suctioning
4) observe the peak inspiratory pressures and treat low pressures

54. The **most** important nursing activity for a patient admitted with the diagnosis of cervical spinal cord injury is: (58)

1) keeping the patient flat
2) immobilizing the head
3) assessing the reflexes
4) monitoring the temperature

55. In a patient with cervical spine injury, the most important **observations** the nurse makes concerns which of the following physiological parameters? (59)

1) heart rate
2) respirations
3) urinary output
4) pupillary response to light

56. The **earliest** sign of increased intracranial pressure generally involves changes in: (60)

1) response to pain
2) level of consciousness
3) equality of pupillary reaction
4) respiratory rate

57. Increased intracranial pressure is characterized by all of the following **EXCEPT**: (61)

1) decrease in briskness of pupillary reaction
2) increase in blood pressure
3) decrease in pulse pressure
4) decrease in level of consciousness

58. A drug used to reduce increased intracranial pressure is: (62)

1) Cortisol
2) phenobarbital
3) Mannitol
4) Dilantin

59. A positive Babinski response in an adult: (63)

1) indicates hyperactive reflexes
2) is a normal finding
3) points to a corticospinal lesion
4) shows plantar flexion (curling under) of the toes

60. The nursing care of a patient during the **acute** phase of a stroke includes all of the following **EXCEPT**: (64)

1) providing a quiet environment
2) control of secretions
3) preventing injury
4) increasing sensory input

61. All of the following are included in an hourly neuro check **EXCEPT**: (65)

1) motor strength
2) urinary output
3) level of consciousness
4) pupillary response to light

62. Signs and symptoms of diabetic ketoacidosis include: (66)

1) fruity breath, and deep and rapid breathing
2) hyperactivity and diaphoresis
3) slow and shallow breathing, and headache
4) dilated pupils and flushed skin

63. Impending insulin shock (hypoglycemia) should be suspected when the diabetic patient complains of or manifests: (67)

1) decreased skin turgor, abdominal pain, fever
2) flushed skin, tachycardia, Kussmaul breathing
3) thirst, hypotension, fruity odor to the breath
4) weakness, headache, diaphoresis

64. Measures that would be taken to treat a patient in diabetic ketoacidotic coma would include all of the following **EXCEPT**: (68)

1) dextrose 50% IV infusion
2) insulin IV drip
3) potassium replacement
4) IV fluid administration

65. A previously alert and newly diagnosed diabetic patient suddenly becomes confused and weak. Nursing actions might include all of the following **EXCEPT**: (69)

1) taking the blood pressure
2) administering the prn order for Regular insulin
3) checking a blood sample for glucose
4) giving her some juice to drink

66. Patients with diabetes mellitus who are acutely ill generally require a/an: (70)

1) higher dose of insulin
2) restricted caloric intake
3) increase in fluid intake
4) less insulin

67. The psychophysiologic stress response of acute illness generally results in which of the following changes: (71)

1) increased urine output
2) decreased heart rate
3) decreased systolic blood pressure
4) decreased urine output

68. Which of the following types of insulin when given sub-q will have a peak action within 2 to 4 hours? (72)

1) Humulin Lente
2) NPH
3) Novolin (ge) Ultralente
4) Regular

69. An unconscious trauma patient who was just admitted to the ICU is a diabetic who received his usual dose of sub-q NPH insulin at 7 AM. In how many hours might you expect an insulin reaction to occur? (73)

1) 1-2
2) 3-4
3) 8-14
4) 16-24

70. A dangerous effect of rapidly re-warming a hypothermic post-operative patient is: (74)

1) bradycardia
2) vasodilitation and hypotension
3) seizure activity
4) sudden rise in blood pressure

71. Mrs Smith, who is a post-operative craniotomy patient has a fasting blood sugar of 100 mg, complains of extreme thirst, and has a urine output greater than 1,000 ml's over two hours. You should suspect: (75)

1) increased intracranial pressure
2) hyperthyroidism
3) acute adrenal insufficiency
4) diabetes insipidus

72. Mrs Reece, a 64 yo Asian with acute renal failure and oliguria, was admitted with acute renal failure and congestive heart failure. Which of the following would best reflect her condition: (76)

1) BUN of 12 mg/dl
2) dehydration
3) creatinine of 1.0 mg/dl
4) potassium of 6.0 mEq/L

73. A patient is admitted with a probable diagnosis of acute renal failure. The normal ml's of urine output per hour is: (77)

1) 75
2) 100
3) 30
4) 10

74. The following lab tests are good indices of renal function **EXCEPT**: (78)

1) hematocrit
2) BUN
3) creatinine
4) osmolality

75. Your patient has acute renal failure. Medications that are normally excreted through the kidneys will probably be: (79)

1) decreased in dosage
2) administered as usual
3) increased in dosage
4) increased in frequency

76. Enteral feeding in acute renal failure commonly includes: (80)

1) high protein, low potassium, low sodium
2) restricted protein, high potassium, low sodium
3) no protein, high potassium, high sodium
4) restricted protein, low potassium, low sodium

Code No _____ (1-3)
Card No _____ (4)

77. Sudden development of dyspnea and sinus tachycardia in an acute renal failure patient would most likely indicate which of the following? (5)

1) hyperkalemia
2) pulmonary embolism
3) fluid overload
4) infection

78. ECG changes commonly seen in hyperkalemia are: (6)

1) narrow QRS, inverted T wave
2) narrow QRS, high P wave
3) wide QRS, inverted T wave
4) wide QRS, tall peaked T wave

79. Your patient with pulmonary tuberculosis and renal failure develops a sudden high fever. Which of the following antibiotics should be used for this patient: (7)

1) vancomycin HCl
2) rifampin
3) gentamycin sulfate
4) tobramycin sulfate

80. Your renal failure patient is started on a Dopamine HCl drip to increase renal perfusion. The recommended dose IV is how many ug/Kg/min? (8)

1) 2- 4
2) 18-20
3) 21-24
4) 10-12

81. Your patient is on continuous venous-venous hemofiltration (CVVH). A potential complication is: (9)

1) build up of protein
2) failure to remove solutes
3) severe bleeding
4) fluid overload

82. When feeding a patient using **continuous** tube feedings, the **most** important intervention in preventing aspiration is to: (10)

1) keep the head of the bed elevated
2) do frequent chest PT
3) check the position of the feeding tube each shift
4) aspirate stomach contents q4h

83. Hyperosmolar, non-ketotic dehydration and coma can be easily prevented in total parenteral nutrition therapy if detected early. A method of **early** detection is checking: (11)

1) CPK-MB, SGOT, LDH
2) the blood sugar
3) for abnormal pupillary response
4) for a decrease in urinary output

84. Low intermittent suction of gastric contents is generally used in all of the following situations **EXCEPT**: (12)

1) to reduce abdominal distention
2) to prevent aspiration
3) when bowel sounds are absent
4) to control bleeding

85. The proper placement of a nasogastric tube in an unconscious patient can be **best** assessed by: (13)

1) instilling 30cc of normal saline through the tube
2) watching for gastric air bubbles in the tube
3) persistent coughing by the patient
4) checking the pH of any fluid in the tube

86. Nursing activities for patients receiving cold gastric lavage to help control acute gastrointestinal bleeding include all of the following **EXCEPT**: (14)

1) observation for abdominal distention
2) accurate intake and output
3) using distilled water for the lavage
4) monitoring of hemoglobin and hematocrit

87. While caring for a post-operative exploratory laparotomy patient, you notice 'coffeeground' material coming from her nasogastric tube. You should: (15)

1) know this is a normal finding
2) irrigate the tube right away
3) have the drainage tested for blood
4) listen for diminished bowel sounds

88. Your patient, who is receiving a blood transfusion, has a sudden increase in body temperature. Your **first** response is to: (16)

1) notify the physician
2) chart the finding
3) check for a rash
4) stop the transfusion

89. Which of the following measures generally results in the **earliest** detection of gastric bleeding in patients who have gastric tubes? (17)

1) checking the gastric contents for microscopic blood
2) observing any change in the color of the gastric aspirate
3) noting the gradual increase of abdominal distention
4) noticing a slow fall in blood pressure

90. In a symptomatic sinus bradycardia, which of the following could be used to increase the heart rate: (18)

1) Inderal
2) digoxin
3) atropine
4) verapamil

91. Which of the following drugs will crystallize when given IV with D5S? (19)

1) Ativan
2) fosphenytoin
3) Dilantin
4) phenobarbital

92. Precautions in using IV nitroprusside include all of the following **EXCEPT**: (20)

1) protection of the solution from light
2) continuous monitoring for a sudden decrease in blood pressure
3) alertness to the development of an acute hypertensive episode
4) use of a fresh mixture at appropriate intervals

93. The dosage of which drug must be tapered off slowly to prevent acute adrenal insufficiency? (21)

1) nitroprusside
2) cortisone
3) streptokinase
4) pitressin

94. All of the following may be manifestations of digitalis toxicity **EXCEPT**: (22)

1) rapid A-V conduction
2) PAT with block
3) nausea
4) yellow vision

95. The most common symptom of a toxic blood level of Lidocaine is: (23)

1) elevated blood pressure
2) mental confusion
3) abnormal clotting time
4) metal taste

96. A urine specific gravity of 1.012 indicates: (24)

1) dilute urine
2) normal urine concentration
3) concentrated urine
4) glycosuria

97. How many micrograms are in one milligram? (25)

1) 10
2) 100
3) 1,000
4) 10,000

98. In caring for an obese patient (at least 100 pounds over ideal weight), it is important to know that: (26)

1) sleep apnea rarely occurs
2) two people will be adequate to move the patient
3) a sensitivity to a cold room temperature could be a problem
4) the safety of both the patient and the nurse are considered

99. Mr Clark was admitted to the ICU following an explosion at his job. His wife says that her husband has a living will. This document might state Mr Clark's desire to: (27)

1) have his wife make all decisions regarding his care
2) enter into any research that might help his condition
3) have his organs donated, if resuscitation is unsuccessful
4) not be resuscitated, if his heart should stop beating

100. Examples of spiritual care for a seriously ill, conscious patient include all the following **EXCEPT**: (28)

1) staying with or being with the patient
2) holding the patient's hand or touching the forehead
3) telling the patient that everything is going to be all right
4) calling for a clergyman to visit the patient

This is the end of the test.

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JT 1/9/06

APPENDIX C: PERMISSION TO USE BKAT-7

Hi Patricia:

This is fine. I have attached to this email, an Agreement Form for you to fill out and return. There is no charge for students.

Please send me an abstract of your findings when you are done. Best wishes for the successful completion of your doctoral dissertation.

Regards,

Jean Toth

-----Original Message-----
From: Anzalone, Patricia [mailto:patricia.anzalone@nchmd.org]
Sent: Saturday, August 12, 2006 3:19 PM
To: Toth, Jean C
Subject: Permission for Research Use

Dear Dr. Toth,

I have previously requested the use of BKAT as both pre and posttest for my doctoral dissertation. My first thought was to use the cardiovascular portion of the tool, a request that you, quite logically declined. As you may recall, the research will compare the cardiovascular module of the Essentials of Critical Care Orientation (ECCO) on-line program with traditional face-to-face lecture format. After further thought, I would like to use the entire BKAT Version 7 as both the pretest and the posttest measure of knowledge attainment. It will be interesting to see if there is any difference in the scores of any area of content when computer participants are compared to traditional classroom participants.

Please contact me for any further details you require. I look forward to your response.

Thank you,

Patricia Anzalone, MSN, RN, CCRN, CNRN

Doctoral Candidate

University of Central Florida

Patricia.Anzalone@NCHmd.org <mailto:Patricia.Anzalone@NCHmd.org>

APPENDIX D: MODIFIED ECCO CARDIOVASCULAR MODULE EXAM

1. Which of the following effects would you expect in a patient whose renin-angiotensin-aldosterone system has been stimulated?
    a. hypovolemia and oliguria
    b. increased systemic blood pressure
    c. peripheral vasodilation
    d. hypokalemia and dysrhythmias

2. A patient experiences a myocardial infarction, and blood supply to the SA node is blocked. Where will the electrical stimulation for the cardiac cycle start?
    a. internodal tracts
    b. AV node
    c. Bundle of His
    d. Purkinje fibers

3. Blood not ejected from the left ventricle will result in adverse patient symptoms as it backs up into the
    a. pulmonary vasculature
    b. right and left atria
    c. superior and inferior vena cava
    d. mesenteric circulation

4. The patient has left ventricular diastolic dysfunction, the left ventricle is noncompliant. The stroke volume will decrease.

a. true

b. false

5. Stimulation of the vagus nerve produces

   a. bradycardia

   b. tachycardia

   c. asystole

   d. ventricular bigeminy

6. Which of the following findings would be an initial indication of orthostatic hypotension?

   a. pulse pressure increases 20 mm Hg with position change

   b. diastolic pressure decreases 5 mm Hg with position change

   c. systolic pressure decreases 20 mm Hg with position change

   d. pulsus paradoxus decreases 5 mm Hg with position change

7. The physician orders serum troponin levels in a patient with a possible myocardial infarction. The nurse explains to the patient that this test

   a. is the most specific indicator for myocardial damage available

   b. measures the amount of myoglobin released from damaged myocardial cells

   c. can provide evidence of myocardial damage more quickly than any other enzyme test

d. is diagnostic for myocardial damage only when used in combination with CK-MB isoenzymes

8. Potassium, sodium, and calcium ions have the greatest impact on the action potential (change in polarity) of myocardial cells.
    a. true
    b. false

9. In a 3-lead ECG placement, where is the positive electrode placed?
    a. right shoulder
    b. left shoulder
    c. right lower chest
    d. left lower chest

10. Which of the following is normal for a P-R interval?
    a. .22 sec.
    b. .10 sec.
    c. .14 sec.
    d. .30 sec.

11. The nurse is leveling the transducer prior to measuring hemodynamic pressures. What part of the monitoring system is leveled to the phlebostatic axis?
    a. the transducer itself

b. the flush system
c. the stopcock closest to the transducer
d. the stopcock closes to the patient

12. Which procedure will the nurse use to perform the Allen test?
    a. Occlude both the radial and ulnar arteries. Release the ulnar artery and assess time for color to return to the hand.
    b. Occlude both the radial and ulnar arteries. Release the radial artery and assess time for color to return to the hand.
    c. Occlude the brachial and radial artery. Release the radial artery and assess time for color to return to the hand.
    d. Occlude the brachial and ulnar artery. Release the brachial artery and assess time for color to return to hand.

13. Vasodilation will decrease systemic vascular resistance. What effect will this have on the blood pressure?
    a. There will be no effect because the stroke volume will also change
    b. Both the systolic and diastolic blood pressure will decrease
    c. Both the systolic and diastolic blood pressure will increase
    d. The systolic blood pressure will remain the same and the diastolic blood pressure will decrease

14. Which of the following statements about myocardial infarctions is true?

a. location and size of the infarct are dependent on the vessel or vessels involved
b. myocardial cell death usually occurs within 20-40 minutes
c. causes of a myocardial infarction might include: occlusion, thrombosis or vasospasm
d. all of the above

15. A 55-year old Hispanic male security guard who works the night shift presents to the ED. Upon examination, he reports a past medical history which includes diabetes, ETOH use, and smoking. You conclude that he would be at risk for developing coronary artery disease.
    a. True
    b. false

16. An inferior wall myocardial infarction would result in which of the following ECG changes?
    a. ST-segment elevation in leads V2 – V4 and a new bundle branch block
    b. ST-segment elevation and T-wave inversion in leads II, III, and AVF with a heart rate of 52 beats per minute
    c. ST-segment elevation and T-wave inversion in leads V2 –V4
    d. ST-segment depression and T-wave inversion in leads II, III, and AVF with a heart rate of 75 beats per min

17. The goals of therapy for managing heart failure might include
    a. improving cardiac output by decreasing preload and afterload with diuretics, nitroglycerin and nitroprusside
    b. improving cardiac output by decreasing preload and increasing afterload with nitroglycerin, oxygen, and aspirin
    c. improving preload with nitroglycerin, nitroprusside and volume resuscitation
    d. improving contractility with inotropes, vasopressors and vasodilators

18. Calcium channel blockers are used with which of the cardiomyopathies?
    a. dilated cardiomyopathy
    b. hypertrophic cardiomyopathy
    c. restrictive cardiomyopathy
    d. none of the above

19. The clinical presentation of atrial dysrhythmias, systolic murmur and the presence of S3 and/or S4 heart sounds is indicative of
    a. mitral stenosis
    b. aortic stenosis
    c. mitral regurgitation
    d. aortic regurgitation

20. In order to decrease preload, which of the following interventions may be appropriate?
    a. administration of diuretics
    b. fluid restriction
    c. sodium restriction
    d. all of the above

21. Which of the following assessments is particularly important to complete prior to the cardiac catheterization?
    a. assessment of mental status
    b. assessment of dorsalis and pedal pulses
    c. assessment of prior surgeries
    d. assessment of a history of tobacco use

22. Potential complications of PTCA/stent placement include impaired renal function. This is primarily due to:
    a. occlusion of the renal artery
    b. positioning of the patient during the procedure
    c. significant endovascular injury
    d. a heavy load of injected contrast medium

23. You are caring for a patient with a permanent pacemaker. According to the patient's information about his pacemaker, it is a VVI type pacemaker.

Based on this information, you know that this is

a. a single-chamber pacemaker

b. a dual chamber pacemaker

c. an A-V sequential pacemaker

d. an asynchronous pacemaker

24. You are the nurse caring for a patient with the diagnosis of Wolff-Parkinson-White Syndrome. Based upon the understanding that this syndrome causes cardiac dysrhythmias, for which of the following procedural types could this patient be a candidate?

a. reparative

b. reconstructive

c. excisional

d. ablative

25. Which statement is true concerning the arterial waveform?

a. The highest peak represents diastolic pressure

b. The dicrotic notch represents closure of the pulmonic valve

c. The point at which the waveform returns to baseline is the diastolic pressure

d. The rapid upstroke represents ventricular emptying

APPENDIX E: LEARNING STYLES INVENTORY

LEARNING-STYLE INVENTORY

The Learning-Style Inventory describes the way you learn and how you deal with ideas and day-to-day situations in your life. Below are 12 sentences with a choice of endings. Rank the endings for each sentence according to how well you think each one fits with how you would go about learning something. Try to recall some recent situations where you had to learn something new, perhaps in your job or at school. Then, using the spaces provided, rank a "4" for the sentence ending that describes how you learn *best*, down to a "1" for the sentence ending that seems least like the way you learn. Be sure to rank all the endings for each sentence unit. Please do not make ties.

Example of completed sentence set:

1. When I learn: 2 I am happy. 1 I am fast. 3 I am logical. 4 I am careful.

Remember: **4** = *most* like you **3** = *second most* like you **2** = *third most* like you **1** = *least* like you

	A		B		C		D	
1. When I learn:	___	I like to deal with my feelings.	___	I like to think about ideas.	___	I like to be doing things.	___	I like to watch and listen.
2. I learn best when:	___	I listen and watch carefully.	___	I rely on logical thinking.	___	I trust my hunches and feelings.	___	I work hard to get things done.
3. When I am learning:	___	I tend to reason things out.	___	I am responsible about things.	___	I am quiet and reserved.	___	I have strong feelings and reactions.
4. I learn by:	___	feeling.	___	doing.	___	watching.	___	thinking.
5. When I learn:	___	I am open to new experiences.	___	I look at all sides of issues.	___	I like to analyze things, break them down into their parts.	___	I like to try things out.
6. When I am learning:	___	I am an observing person.	___	I am an active person.	___	I am an intuitive person.	___	I am a logical person.
7. I learn best from:	___	observation.	___	personal relationships.	___	rational theories.	___	a chance to try out and practice.
8. When I learn:	___	I like to see results from my work.	___	I like ideas and theories.	___	I take my time before acting.	___	I feel personally involved in things.
9. I learn best when:	___	I rely on my observations.	___	I rely on my feelings.	___	I can try things out for myself.	___	I rely on my ideas.
10. When I am learning:	___	I am a reserved person.	___	I am an accepting person.	___	I am a responsible person.	___	I am a rational person.
11. When I learn:	___	I get involved.	___	I like to observe.	___	I evaluate things.	___	I like to be active.
12. I learn best when:	___	I analyze ideas.	___	I am receptive and open-minded.	___	I am careful.	___	I am practical.

MCB200C

APPENDIX F: AFFECTIVE MEASURES SURVEY

AFFECTIVE MEASURES

At the end of each statement you will find a scale with ten gradations with zero indicating the lower end of the scale and in general an unfavorable response; and ten denoting a very favorable response. Indicate your response by circling the number that is most appropriate in your case.

1. To what extent do you feel a sense of achievement from this course taught in the given manner?

0 1 2 3 4 5 6 7 8 9 10

2. To what extent do you feel you have mastered the subject matter taught in the given manner?

0 1 2 3 4 5 6 7 8 9 10

3. To what extent this course taught in the given manner has caused you to want to learn more about the subject matter in the future?

0 1 2 3 4 5 6 7 8 9 10

4. To what extent did you enjoy or like this course taught in this form?

0 1 2 3 4 5 6 7 8 9 10

5. To what extent do you feel this method of instruction was adequate in achieving course objectives?

0 1 2 3 4 5 6 7 8 9 10

6. To what extent are you in favor of this type of instruction?

0 1 2 3 4 5 6 7 8 9 10

7. To what extent did this method of instruction facilitate your learning, i.e. facilitation in terms of time taken to achieve objectives?

0 1 2 3 4 5 6 7 8 9 10

Least facilitative
took a long time

Most facilitative
took least amount of time

8. To what extent do you think this method of instruction had a built-in positive reinforcement (rewards - e.g. feedback, knowledge of results, praise, etc.)?

0 1 2 3 4 5 6 7 8 9 10

9. To what extent do you feel this method of instruction was stimulating or exciting or challenging?

0 1 2 3 4 5 6 7 8 9 10

10. To what extent do you feel the content taught in this course was worthwhile?

0 1 2 3 4 5 6 7 8 9 10

11. Other comments.

LH/ks
11/82

APPENDIX G: RECRUITMENT FLYER

RNs!
LEARN MORE ABOUT CARDIOVASCULAR NURSING BY PARTICIPATING IN A RESEARCH STUDY AND RECEIVE 20.5 CONTACT HOURS

Study Title: A Comparison of Computer and Traditional Face-to-Face Classroom Cardiovascular Education

Purposes of the research study: The purpose of this research study is to compare learning and satisfaction in the cardiovascular module of the Essentials of Critical Care Orientation (ECCO) on-line computer program with traditional classroom teaching. Learning styles of participants will also be assessed.

Who Is Eligible to Participate? Currently practicing Registered Nurse in the US, age 18 or older with no critical care, progressive care, or emergency department training or experience within the past five years (excepting basic nursing preparation). If you have questions regarding your eligibility to participate, please contact Patti Anzalone at 239-436-5292 or e-mail patricia.anzalone@NCHmd.org

What you will be asked to do in this study: If you agree to participate, you will be randomly assigned to either a complete a computer class or a face-to-face class covering the same cardiovascular nursing content.

If you are assigned to the **computer group**, you will be given instruction and an access code to sign onto the ECCO cardiovascular module. You will then have three weeks to complete the module on any computer with Internet access. You will attend a two-hour case study discussion at the end of the study
If you are assigned to the **face-to-face class**, you will attend five four-hour classes within a three-week period taught by a Clinical Nursing Specialist. Classes will be conducted at local hospitals.

All participants will complete two multiple-choice pretests and a 12-question learning styles profile at the beginning of the study. All participants will complete two multiple-choice posttests and a short satisfaction survey at the completion of the program.

Time required: Approximately 20 hours of time within a three-week period will be required of participants.

Benefits/Compensation: There is no financial compensation offered. Participants in this study may benefit with the acquisition of increased knowledge of cardiovascular nursing. Additionally, participants will receive **20.5 continuing education contact hours**.

If you are interesting in participating in this study or need further information, please contact:

Patti Anzalone, MSN, RN, CCRN
Doctoral Candidate, University of Central Florida
Phone: 239-436-5292
e-mail: patricia.anzalone@NCHmd.org

APPENDIX H: IRB APPROVAL

University of Central Florida

Office of Research & Commercialization

December 6, 2006

Patricia Anzalone
c/o Mary Lou Sole, Ph.D.
University of Central Florida
School of Nursing
HPA 216
Orlando, FL 32816-2210

Dear Ms. Azalone & Dr. Sole:

With reference to your protocol #06-4023 entitled, "A Comparison of Computer and Traditional Face-to-Face Classroom Orientation for Beginning Critical Care Nurses," I am enclosing for your records the approved, expedited document of the UCFIRB Form you had submitted to our office. **This study was approved on 12/4/06. The expiration date for this study will be 12/3/2007.** Should there be a need to extend this study, a Continuing Review form must be submitted to the IRB Office for review by the Chairman or full IRB at least one month prior to the expiration date. This is the responsibility of the investigator.

Please be advised that this approval is given for one year. Should there be any addendums or administrative changes to the already approved protocol, they must also be submitted to the Board through use of the Addendum/Modification Request form. Changes should not be initiated until written IRB approval is received. Adverse events should be reported to the IRB as they occur.

Should you have any questions, please do not hesitate to call me at 407-823-2901.

Please accept our best wishes for the success of your endeavors.

Cordially,

Joanne Muratori

Joanne Muratori
(FWA00000351 Exp. 5/13/07, IRB00001138)

Copies: IRB File

JM:jt

12201 Research Parkway • Suite 501 • Orlando, FL 32826-3246 • 407-823-3778 • Fax 407-823-3299

LEE MEMORIAL HEALTH SYSTEM

Cape Coral Hospital
Gulf Coast Hospital
HealthPark Care Center
HealthPark Medical Center
Lee Convenient Care
Lee Memorial Hospital
Lee Physician Group
Southwest Florida Regional Medical Center
The Children's Hospital
The Rehabilitation Hospital

Institutional Review Committee

636 Del Prado Boulevard
Cape Coral, Florida 33990

Phone: 239-772-6383
Fax: 239-772-6388
Email: pam.fowler@leememorial.org

February 9, 2007

Patricia Anzalone, MSN, RN, CCRN
Doctoral Candidate, University of Central Florida
School of Nursing
4001 Gulf Shore Boulevard North #1102
Naples, Florida 34103

RE: **A Comparison of Computer and Traditional Face to Face Classroom Orientation for Beginning Critical Care Nurses**

Dear Ms. Anzalone:

The Lee Memorial Health System Institutional Review Committee has reviewed the above-mentioned protocol and has determined that the study listed above is exempt from Institutional Review Committee review as stated in the following guidance:

45 CFR 46 .101(b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as: research on regular and special education instructional strategies, or research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods. And information obtained is recorded in such a manner that human participants cannot be identified.

You may conduct your study without further reporting to Lee Memorial Health System Institutional Review Committee. However, the committee requires that you provide updates for this project to the Lee Memorial Health System Nursing Research Council. The committee also requires that during your consent process for participants recruited from Lee Memorial Health System, that they be informed of the following: 1) they will not be paid by LMHS for their participation in this research, their participation is on their own time 2) if they choose to participate or not to participate it will have no effect on their employment status at LMHS 3)Lee Memorial Health System does not sponsor or provide support for this research project.

Thank you for keeping the committee informed of your activities.

Sincerely,

Pam Fowler, RN, BS, CIM
Administrator
Lee Memorial Health System
Institutional Review Committee

Cc: Anne Nolan, RN, Ph.D
Chair, Lee Memorial Health System

Nursing Research Council

November 27, 2006

To: Ms. Patti Anzalone, MSN, RN, CRN, CNRN

Proposed Study:

A Comparison of Computer and Traditional Face-to-Face Classroom Orientation For Beginning Critical Care Nurses

PI: Patti Anzalone, MSN, RN, CRN, CNRN

This project is exempt from NCH IRB review as it involves research conducted in established or commonly accepted educational settings, involving normal education practices such as:
Research on regular or special educational instructional strategy, or
Research on the effectiveness of, or the comparison among institutional techniques, curricular, or classroom management.

Also, any research which will involve the use of educational test (cognitive, diagnostic, aptitude, achievement) if information taken from these sources is to be recorded in such a manner that its subjects cannot be identified directly or through identifiers linked to subjects, is exempt from NCH IRB review.

If you have any further questions, please contact Kim Thorp, at 436-4517.

Thank you,

Kimberly Thorp, RPh., MBA
Director – Pharmacy Services
IRB Secretary
NCH Healthcare System

APPENDIX I: INFORMED CONSENT

University of Central Florida

APPROVED BY
University of Central Florida
Institutional Review Board
12/4/06
IRB Designated Reviewer

School of Nursing

Informed Consent

Read this document carefully before you decide to participate in this study.

Study Title: A Comparison of Computer and Traditional Face-to-Face Classroom Orientation for Beginning Critical Care Nurses

Purposes of the research study: The purpose of this research study is to compare learning and satisfaction in the cardiovascular module of the Essentials of Critical Care Orientation (ECCO) on-line computer program with traditional classroom teaching. Learning styles of participants will also be assessed.

What you will be asked to do in this study: You must be at least 18 to participate in this study. If you agree to participate, you will be randomly assigned to either a complete a computer class or a face-to-face class covering the same cardiovascular nursing content.

If you are assigned to the **computer group**, you will be given instruction and an access code to sign onto the ECCO cardiovascular module. You will then have three weeks to complete the module on any computer with Internet access. You will attend a two-hour case study discussion at the end of the study.

If you are assigned to the **face-to-face class**, you will attend five four-hour classes within a three-week period taught by a Clinical Nursing Specialist. Classes will be conducted at local hospitals.

All participants will complete two multiple-choice pretests and a 12-question learning styles profile at the beginning of the study. All participants will complete two multiple-choice posttests and a short satisfaction survey at the completion of the program.

Time required: Approximately 20 hours of time within a three-week period will be required of participants.

Risks: There are no anticipated risks associated with this study.

Benefits/Compensation: There is no financial compensation offered. Participants in this study may benefit with the acquisition of increased knowledge of cardiovascular nursing. Additionally, participants will receive 20.5 continuing education contact hours.

Initials____

College of Health and Public Affairs
P.O. Box 162210 • Orlando, FL 32816-2210 • 407-823-2744 • FAX 407-823-5675

Confidentiality: Your identity will be kept confidential. Your information will be coded and the list connecting this code to your name will be kept under lock and key and accessible only to the principal investigator. When the study is complete and the data has been analyzed, the list will be destroyed. Your name or any identifying information will not be used in any report or publication.

Voluntary participation: Your participation in this study is voluntary and you may withdraw at any time without consequence.

Whom to contact with questions related to the study: Patricia Anzalone, Doctoral Candidate, University of Central Florida, School of Nursing, PO Box 162210, Orlando, Florida, 32816-2210. Telephone: (239) 436-5092
Dr. Mary Lou Sole, Faculty Supervisor, College of Nursing. Telephone number: (407) 823-5133

Whom to contact about your rights in this study: UCFIRB Office, University of Central Florida Office of Research, Orlando Tech Center, 12201 Research Parkway, Suite 501, Orlando, FL 32826. Telephone: (407)823-2901. This research study has been reviewed and approved by the UCF Institutional Review Board.

_____I have read the procedure described above and voluntarily agree to participate in this research.

_____/_____
Participant Signature Date

_____/_____
Principal Investigator Date

APPROVED BY
University of Central Florida
Institutional Review Board
12/4/06
IRB Designated Reviewer

College of Health and Public Affairs
P.O. Box 162210 • Orlando, FL 32816-2210 • 407-823-2744 • FAX 407-823-5675

APPENDIX J: DEMOGRAPHIC DATA COLLECTION TOOL

NAME: _____**SUBJECT #**_____

AGE_____**GENDER**_____**MARITAL STATUS**_____

ETHNICITY: (Caucasian**) (**African-American**) (**Hispanic**) (**Asian**)**

(Native American**) (**Other_____**)**

HIGHEST DEGREE IN NURSING: **(**Diploma**) (**Associate**) (**Baccalaureate**) (**Masters**)**

(Doctorate**)**

OTHER DEGREES:_____

YEARS OF EXPERIENCE IN NURSING_____

SPECIALTY (if applicable)_____

CERTIFICATIONS: (if applicable)_____

If given the choice, which mode of learning would you prefer?

(ECCO computer program**)** (Face-to-face classes**)**

LSI LEARNING STYLE:_____

APPENDIX K: PERMISSION TO USE LSI

-----Original Message-----
From: Abby_Geller@haygroup.com [mailto:Abby_Geller@haygroup.com]
Sent: Monday, August 21, 2006 1:40 PM
To: Anzalone, Patricia
Subject: Your LSI for Research Approval

Hi Patricia,

Congratulations! Your research request regarding use of the Learning Style Inventory (LSI) has been approved. Attached you will find two documents (.pdf files—Adobe Acrobat 4.05):

- LSItest.pdf - This is a copy of the LSI test. You may print or copy this document as needed for your research.
- LSIprofile.pdf - The profile sheet contains the answer key for the test as well as the profiling graphs for plotting scores. This document may also be reproduced as necessary for your research. The AC-CE score on the Learning Style Type Grid is obtained by subtracting the CE score from the AC score. Similarly, the AE-RO score = AE minus RO.

These files are for data collection only. This permission does not extend to including a copy of these files in your research paper. It should be sufficient to source it.
We wish you luck with your project and look forward to hearing about your results. Please email a copy of your completed research paper to Abby_Geller@Haygroup.com or mail it to the following address:
LSI Research Contracts
c/o Abby Geller
HayGroup
116 Huntington Avenue, 4th floor
Boston, MA 02116

If you have any further questions, please let me know.
Regards,
Abby Geller
Hay Resources Direct (See attached file: MCB 200C.PDF) (See attached file: Mcb200d.pdf)

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