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Effect of Exposure to Computer-Assisted Instruction with CD-ROM Technology on Nursing Students' Attitude Towards Computer-Assisted Instruction

by

Tracey Stephen

A Thesis Submitted to the Faculty of Graduate Studies and Research
In Partial Fulfillment of the Requirements for the Degree of
Master of Nursing

Faculty of Nursing

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled Effect of Exposure to Computer-Assisted Instruction with CD-ROM Technology on Nursing Students' Attitude Towards Computer-Assisted Instruction submitted by Tracey Stephen in partial fulfillment of the requirements for the degree of Master of Nursing.

Dr. D. Lynn Skillen, Supervisor

Dr. Rene Day

Dr. Ed Blackburn

April 14, 1998

Date

Abstract

Computer-assisted instruction (CAI) is one instructional method that is incorporated into overall teaching strategies. One area of CAI requiring further research is students' attitude towards CAI. In this thesis, the effect of exposure to CAI on nursing students' attitude toward CAI was examined using a two group, pretest-posttest, experimental design. Bloom's (1971) theory of mastery learning provided the theoretical foundation. Sixty-six third year nursing students at the University of Alberta volunteered to participate in this study and were randomly assigned to one of two groups: the control group ($\underline{n}$=37), who were not exposed to CAI, and the experimental group ($\underline{n}$=29), who were exposed to the DataStar CAI program for adult health assessment. Allen's (1986) Attitude Toward CAI Semantic Differential Scale was used. Results showed a significantly more favourable student attitude toward CAI after exposure to CAI. Information on effect size and instrument reliability was also obtained.

A paper format is used for this thesis: an introductory chapter, a chapter in the form of a paper for consideration as a publication, an overview chapter, and appendices are included.

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Chapter 1

INTRODUCTION

Many challenges face nurse educators in nursing education. Limited resources, rapid increases in knowledge and skills to be learned (Hamby, 1986), as well as demands for greater educational accountability (Hamby, 1986; Hebda, 1988) are a few of the factors affecting nursing education. Other challenges include declines in enrollment and retention of nursing students (Napholz & McCanse, 1994), demands for greater accessibility to education (Sheridan, 1995), and demands for increased computer technological competence. In 1995, the University of Alberta Senate Task Force recommended the incorporation of a "learner-centred instruction model which integrates multi-media and technology-based delivery methods with traditional classroom instruction to serve students who are locally, regionally, nationally, and globally based" (p. 3). This model of instruction is recommended to help meet the challenges of accessibility, changing student needs and populations, geographical diversity, cost-effectiveness, and time and space constraints associated with the educational needs of students. One instructional method used in nursing and other disciplines to meet these diverse demands is computer-assisted instruction (CAI). Although CAI is an appropriate strategy for meeting a number of these challenges, it is essential to examine aspects of this method in education and its effects on learning to ensure that it is an appropriate instructional method for students.

One aspect of CAI that requires further research is student attitude towards CAI in nursing education. Thomas (1988) reported that even though attitude change has been measured and "reported in several publications, change has been difficult to assess. . ." (p. 123). Many of the reports of students' attitude towards CAI are recorded using open-ended questionnaires or as part of the overall course evaluation. Another problem with inferring from the data and comparing results on attitude towards CAI is that many different measures have been used in the different studies (Thomas, 1988). As recently as 1994, Baldwin, Johnson, and Hill stated, "The ambiguity of findings regarding attitudes toward CAI and the projected increased use of CAI in future nurse education programs support the need for further exploration of student attitude toward CAI." (p. 189) It is evident that more rigorous research is required to examine student attitude towards CAI. As advances in computer technology and education continue, research on this instructional method needs to be ongoing.

In this thesis, students' attitude toward CAI was examined using a two group, pretest-posttest design with a reliable and valid attitudinal scale. Specifically, this study was conducted to examine the effect of exposure to CAI on nursing students' attitude toward CAI.

This introductory chapter includes a description of CAI, its purpose, and the definitions of relevant terms. A description of the theoretical framework used for this study, the purpose of the study, and an overview of the thesis are also presented.

COMPUTER-ASSISTED INSTRUCTION

Computer-assisted instruction is an instructional method that incorporates the use of computers into an overall teaching strategy. Allessi and Trollip (1985) identified four basic components of CAI: 1) information is presented or skills are modeled; 2) students are guided through the initial use of the information or skills; 3) students practice until familiarity or mastery is attained; and 4) students' learning is assessed. A review of the literature demonstrates that computers are used in education in the following ways: for practice only, in addition to other teaching methods, to complete practice exams and actual exams, to replace traditional lecture instruction, as a resource for students to access, or to provide simulations of 'real' situations the students may encounter. Incorporation of the computer into teaching methodology is varied, with many different applications being used. Also, factors such as content, graphics, and technological capability of different computer programs make research in this area difficult. It is important to consider the variability of these factors while reviewing the findings of the selected research articles. The many variables involved in these studies make it difficult to generalize the results.

Faculty members at the University of Alberta, Faculty of Nursing have collaborated with DataStar Education Systems and Services, Inc. to develop a series of health assessment computer modules designed to teach health assessment skills for use with adults. The modules include variations of normal findings, age related changes, and differentiation between normal and abnormal findings. This computer-based instructional program incorporates CD-ROM technology to provide for self-testing of current knowledge, identification of learning needs, and access to on-line learning resources for the acquisition of knowledge and skill in adult health assessment. The CAI modules incorporate text, coloured and rotatable visual graphic designs, audio, and running video to provide students with tutorial lessons and drill and practice exercises. The modules are interactive in nature and allow the student to control the pace of the program, select the order of progression through the lessons, determine the times of access to the program, and review previously viewed modules.

THEORETICAL FRAMEWORK

The theoretical framework that provided the foundation for this research is Bloom's theory of mastery learning. "The positive outcomes attributed to CAI and the incorporation of learning principles are congruent with Bloom's theory of mastery learning." (Reynolds & Pontious, 1986, p. 160) Bloom (1971) recognized that student attitude toward learning situations has a direct impact on learning and that student attitude is affected by the methods of instruction. A positive attitude increases learning while a negative attitude decreases learning. Bloom also identified that student attitude towards learning affects future learning.

Bloom's theory of mastery learning is based upon the assumption that there are faster learners and slower learners and that all learners, if given optimal learning conditions, can attain mastery of important objectives. As long as all students receive the same instruction at the same pace, their achievement will be normally distributed with the slower learners achieving a lower level of learning and the faster learners achieving a higher level of learning. Optimal learning conditions refer to students

being given sufficient time and help to learn, appropriate and varied methods of instruction, and frequent reinforcement and feedback. Bloom suggested that content be divided into smaller units with formative, ungraded evaluations designed to guide the learning process at the end of each unit.

Block (1971) identified five aspects of mastery learning. First, mastery is defined as the achievement of particular educational objectives (cognitive, psychomotor, and affective). Second, instruction is organized into units with appropriate, varied learning methods. Third, mastery of each unit is required before the student can proceed to the next unit. Fourth, a formative, ungraded, diagnostic evaluation test is completed at the end of each unit which provides the student with immediate feedback and helps the student identify areas needing more study. These frequent tests reinforce learning and correct errors immediately so that misunderstandings do not affect subsequent learning. Fifth, the student receives further directions to assist the review of areas not mastered and finally, time of instruction is individualized to meet students' needs.

LeFrancois (1994) recognized two advantages of mastery learning: individualization of instruction and increased student motivation. LeFrancois stated, "Whereas traditional approaches to instruction and evaluation almost necessitate that those who learn more slowly than their age/grade peers will often fail, these highly individualized approaches ensure that almost all students will eventually succeed." (p. 340)

Mastery learning is relevant to many areas of nursing education. Several aspects of nursing practice require that students "master" the content, for example, medication dosage calculations. It is essential that all students meet a certain level of competence in this area of nursing practice because errors would have serious implications. Health assessment is another area of nursing practice that requires mastery of the content. All nursing students must meet a certain level of mastery to ensure that safe, competent, accurate assessments are conducted.

Carroll's (1971) description of mastery learning identified five factors that affect the degree of learning which students attain: time allowed, perseverance, aptitude, quality of instruction, and ability to understand instruction. Perseverance is defined as the amount of time a learner is willing to spend learning. Bloom (1971) recognized that perseverance is directly related to students' attitude toward learning. Students with favourable attitudes toward learning are willing to spend more time learning than students with unfavourable attitudes. "A positive attitude and spaced successes with immediate feedback increase learner motivation and interest in future learning, thus improving overall achievement and performance." (Bloom cited in Reynolds & Pontious, 1986, p. 160) It is evident that students' attitude to learning methods has an effect on their learning and it is important that students' attitude to new technologies be researched. Bloom's theory of mastery learning provides a framework for this area of research.

PURPOSE OF THIS STUDY

One of the challenging aspects of research in the field of computer technology is the rapid advancement of available technology. Many research studies conducted in the early 1980s implemented CAI programs with limited capability for interaction,

graphics, design, and feedback. Even though research suggests that CAI is an appropriate method for instruction, new technologies need to be researched. Several authors suggested that experience with computers had a positive effect on students' attitude towards CAI. Examining this aspect further may give us insight into the planning and implementation of CAI in a nursing curriculum.

The purpose of this research study is to add to the current knowledge on students' attitude towards computer-assisted instruction in nursing education. More specifically, the objective of this study is to examine the effect of exposure to the DataStar CAI program for adult health assessment on third year nursing students' attitude toward CAI. The objectives of this study are: 1) to examine the effect of exposure to CAI on students' attitude to CAI; 2) to add to the information available on effect size; and 3) to add to the information on reliability of Allen's (1986) "Attitude Toward CAI Semantic Differential Scale".

This research study was conducted in the Clinical Sciences Building, Faculty of Nursing at the University of Alberta in Edmonton, Alberta.

DEFINITION OF TERMS

DataStar CAI program for adult health assessment is the computer program developed through a collaborative effort between faculty members of the Faculty of Nursing, University of Alberta and DataStar Education Systems and Services, Inc. The computer module uses CD-ROM technology and includes interactive video and audio instruction for teaching health assessment techniques. The CAI program includes modules on symptom analysis, physical assessment techniques (inspection, palpation, percussion, and auscultation), thorax and lungs assessment, and cardiovascular/peripheral vascular systems assessment. For this study, all students were asked to work with only one module selected by the researcher, cardiovascular and peripheral vascular systems assessment (Anderson, 1997). After the completion of the study, the students were given access to all four modules.

Attitude refers to the reaction or response of an individual to an experience or object; (Brudenell & Carpenter, 1990; Calderone, 1994; Conklin, 1983; Cropley, 1977; Dickinson, 1973; Hamby, 1986; & Wlodkowski, 1985), in this case, the students' reaction or response to CAI. Attitude is a learned predisposition to respond or react in a favourable or unfavourable way towards an experience, person, event, idea, or object (Calderone, 1994; Cropley, 1977; Dickinson, 1973; LeFrancois, 1994; Wlodkowski, 1985). In this study, attitude will be measured by the score of the students' responses on Allen's "Attitude Toward CAI Semantic Differential Scale". Students' responses on each of fourteen indicators indicated a number from one to seven. One represented a more unfavourable attitude and seven represented a more favourable attitude towards CAI.

Computer-managed instruction (CMI) "is an instructional strategy whereby the computer is used to provide learning objectives, learning resources, and assessment of learner performance" (Day & Payne, 1987). Computer-managed instruction aids the instructor without actually doing the teaching (Day & Payne, 1987).

Computer-based instruction (CBI) is the implementation of computers into an overall teaching strategy. Computer-based instruction is used to provided tutorial

lessons, drill and practice exercises, and computer simulations (Cohen & Dacanay, 1994). Specific applications and differences between CBI and CAI were not identified by Cohen and Dacanay.

Computer-managed learning (CML) "is an overall educational management system" in which students are assisted in self-learning through self-testing, diagnosing learning needs, selecting remedial learning resources, and keeping records of students' performance (Kot, Skillen, & Wales, 1986).

OVERVIEW OF THIS THESIS

The second chapter of this thesis has been prepared as a paper for publication. This paper includes a description of the research design and methods, a discussion of the data analysis and findings, and an outline of conclusions and implications for nursing education. The third chapter of this thesis includes an overall summary of the study and its limitations, considerations for future research in the area of students' attitude toward CAI, and future directions for research. The information letter, consent form, demographic information and pretest form, posttest form, instruction sheets, letters of permission, and review of the relevant literature are all included in the appendices.

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Chapter 2

Effect of Exposure to Computer-Assisted Instruction with CD-ROM Technology on Nursing Students' Attitude Towards Computer-Assisted Instruction

This chapter will be submitted for consideration as a publication in the journal Computers in Nursing

Abstract

Computer-assisted instruction (CAI) is an instructional method that incorporates the use of computers into an overall teaching strategy. Many advantages and disadvantages of CAI are documented in the literature and research into several aspects of this educational strategy has been conducted, however conflicting findings regarding students' attitude toward CAI are found. With the projected increase in the use of CAI in nursing education, further exploration of students' attitude toward CAI is essential (Baldwin, Johnson, & Hill, 1994).

This study involved examining the effect of exposure to CAI on nursing students' attitude toward CAI using a two group, pretest-posttest, experimental research design. Bloom's (1971) theory of mastery learning provided the theoretical foundation for this research. Sixty-six third year nursing students at the University of Alberta voluntarily completed this study and were randomly assigned to one of two groups: the control group (n=37), who were not exposed to CAI and the experimental group (n=29), who were exposed to CAI. All participants completed a pretest with demographic information and Allen's (1986) Attitude Toward CAI Semantic Differential Scale. The experimental group worked with the CAI program for one hour then all participants completed the attitude scale seven days after completing the pretest. The CAI program chosen for this study was the DataStar CAI program for adult health assessment series using CD-ROM technology. Results showed that students' overall attitudes to CAI were more favourable after exposure to CAI. Statistically significant differences in attitude toward CAI were found between the control and experimental groups. Information on effect size and reliability of the instrument was also obtained.

Effect of Exposure to Computer-Assisted Instruction with CD-ROM Technology on Nursing Students' Attitude Towards Computer-Assisted Instruction

Nurse educators are facing many challenges in nursing education. Limited resources, rapid increases in knowledge and skills to be learned (Hamby, 1986), as well as demands for greater educational accountability (Hamby, 1986; Hebda, 1988) are a few of the factors affecting nursing education. Other challenges include declines in enrollment and retention of nursing students (Napholz & McCanse, 1994), demands for greater accessibility to education (Sheridan & LeGros, 1995), and demands for increased computer technological competence. One method of instruction used in nursing and other disciplines to meet these diverse demands is computer-assisted instruction (CAI). Although CAI is an appropriate strategy for meeting a number of these challenges, it is essential to examine aspects of this instructional method and its effects on learning to ensure that it is appropriate for learners. One aspect of CAI that requires further research is student attitude towards CAI in nursing education.

REVIEW OF THE LITERATURE

Attitude and Learning

Attitude refers to the reaction or response of an individual to an experience or object; (Brudenell & Carpenter, 1990; Calderone, 1994; Conklin, 1983; Cropley, 1977; Dickinson, 1973; Hamby, 1986; Wlodkowski, 1985). Attitude is a learned predisposition to respond or react in a favourable or unfavourable way towards an experience, person, event, idea, or object (Calderone, 1994; Cropley, 1977; Dickinson, 1973; LeFrancois, 1994; Wlodkowski, 1985). "A useful functional definition of an attitude is that it is a combination of a perception with a judgement that often results in an emotion that influences behaviour." (Wlodkowski, 1985, p. 73) LeFrancois (1994) added that attitudes have important motivational components.

Several authors identified attitude as an influencing factor affecting learning (Allen, 1986; Bloom, 1971; Conklin, 1983; Cropley, 1977; Dickinson, 1973; LeFrancois, 1994; Hamby, 1986; Knowles, 1984; Wlodkowski, 1985). Wlodkowski (1985) stated, "Attitudes are powerful influences on human behaviour and learning." (p. 46) Attitude towards the subject and learning situation will directly influence learning (Wlodkowski, 1985). A positive attitude enhances learning (Clark, 1984). Calderone (1994) stated, "A relationship is suggested between cognitive learning and attitude toward instructional media." (p. 166) Both Conklin (1983) and Hamby (1986) suggested that attitude towards an instructional strategy are crucial to achievement and the learning process

Attitude has also been identified as a potential deterrent to participation in learning (Merriam & Caffarella, 1991). "The learner's attitudes towards the general learning environment, instructor, subject matter, and self" are essential components of a learning sequence (Wlodkowski, 1985, p. 61). If a learner develops a negative attitude to any one of these four components, learning can be impaired. Also, students who have an unfavourable attitude to the learning environment may not even attend the classes or make use of the learning experiences available (Wlodkowski, 1985).

Other factors, in addition to attitude, affect student learning. Several authors identified the importance of the environment, method of instruction, and learning situation for learning (Davis, Alexander & Yelon, 1974; Cross, 1981; Daines, Daines, & Graham, 1993; Knowles, 1984; Merriam & Caffarella, 1991; Rogers, 1989; Rogers, 1996; Wlodkowski, 1985). Cross (1981) and Scanlan and Darkenwald (1984) identified unsatisfactory methods of instruction as possible deterrents to participating in learning. Pacing, encouraging active involvement of students, utilizing different instructional techniques, conducting interesting classes (Rogers, 1989) and allowing students to control the speed of the instruction improve the learning atmosphere and learning (Cross, 1981, Rogers, 1989, Wlodkowski, 1985). These aspects of learning, as well as, method of instruction and learning environment, are important to consider when examining students' attitude towards instructional methods.

Student Attitude Toward Computer-Assisted Instruction

Computer-assisted instruction is an instructional method that incorporates the use of computers into an overall teaching strategy. Allessi and Trollip (1985) identified four basic components of CAI: 1) information is presented or skills are modeled; 2) students are guided through the initial use of the information or skills; 3) students practice until familiarity or mastery is attained; and 4) students' learning is assessed. A review of the literature reveals that computers are used in education in the following ways: for practice only, in addition to other teaching methods, to complete practice exams and actual exams, to replace traditional lecture instruction, as a resource for students to access, or to provide simulations of 'real' situations the students may encounter. Incorporation of the computer into teaching methodology is varied, with many different applications being used. Also, factors such as content, graphics, and technological capability of different computer programs make research in this area difficult. It is important to consider the variability of these factors while reviewing the findings of the selected research articles.

Numerous research studies include reports of students' attitude to CAI, however, it is difficult to analyze the findings. Many of the students' attitudes are reported as responses to open-ended evaluation questions which have not been subjected to validity or reliability tests. Several studies reported students' responses to CAI, after using CAI, obtained through course evaluations and through written feedback from the students. Examples of specific questions and responses, and attitudinal measures were not included in some of the articles. Although valuable and useful information may have been obtained from these reports, it is difficult to generalize these findings. Of the researchers who did examine students' attitude toward CAI using specific attitudinal measures, many used single group or posttest-only designs which further complicate generalizability and analysis. Positive and negative student attitudes toward CAI are found in the literature.

Positive attitudes towards CAI. Goodman, Blake, and Lott (1990, p. 40) reported that students provided written feedback and evaluations that were "overwhelmingly positive" to CAI following the use of the CAI modules. This information was obtained from students' feedback during evaluation of the CAI modules. Reynolds and Pontious (1986) examined CAI and medication dosage calculation competency with a sample of 143 nursing students. They reported that

students chose to use CAI more frequently than other instructional methods which indicated that students "believed that learning by CAI was helpful, useful, and enjoyable" (p. 163). Specific attitudinal measures and statistics were not reported in this article. Halloran (1995) compared computer-managed instruction (CMI) to traditional instructional methods in a medical/surgical nursing course. Students' attitudes were assessed through course evaluations and were reported to be favourable toward the use of CMI. Halloran reported that students felt that CMI made the class "more interesting" and "highly organized" (p. 287). For learning drug dosage calculations, Thiele (1988) reported that students' attitude toward CAI were "overwhelmingly positive". Comments such as "It was fun and it went fast.", and "I like being able to do it at my own pace", were reported on open-ended evaluation forms after the students had completed the CAI program. Gee, Peterson, Martin, and Reeve (1998) reported that CAI was "well received" by students using CAI to learn pharmacology. They used a two group, pretest-posttest design with 52 third year nursing students. Some authors suggested that students had a more positive attitude towards CAI when they had previous experience working with computers (Schwirian, Malone, Stone, Nunley, & Francisco, 1989; Wong, 1990) and that students' attitudes shift positively after computer use is initiated (Hamby, 1986; Reynolds & Pontious, 1986; Thiele, 1988).

Using measures different from open ended questions and course evaluations to measure attitude to CAI, other researchers found that students' attitude toward CAI was positive. Russell, Miller, and Czerwinska (1994) used Allen's Attitude Toward CAI Semantic Differential Scale (Allen, 1986) to measure students' attitude toward CAI. Using a single-group, posttest research design, they examined the use of CAI for teaching epidemiology to a sample of 106 baccalaureate nursing students. They reported that student attitude toward CAI was positive, but did not report statistical significance of these findings. McFarland (1993) used a modified version of Allen's Attitude Toward CAI Semantic Differential Scale (Allen, 1986) to measure students' attitude towards CAI and also reported that students' attitudes were positive. Similarly, the significance of their findings was not reported. Students did, however, recommend that CAI not be a required component of the course. This latter information was collected through qualitative methods. Wong (1990) also used a modified version of Allen's scale and reported positive attitudes of students towards CAI for learning drug calculations. Wong utilized a two group, posttest design and reported significant findings in the attitudinal measures of comfort and function. The students reported that CAI was "useful, valuable, time-saving, meaningful, appropriate and motivational" (p. 279).

Gaston (1988) used a two group posttest design to study knowledge, retention, and attitude effects of CAI for learning nursing research and reported that students' attitude toward CAI was positive. Students who used CAI had significantly higher scores on the attitudinal measure than students not using CAI.

Bratt and Vockell (1986) studied the use of CAI to teach basic facts in nursing and utilized a two group design to examine effectiveness of CAI. They administered a 15 item Likert scale to the experimental group to "determine their subjective reactions toward the CAI programs" (p. 249) and reported that students' reactions to CAI were "overwhelmingly positive". In their open-ended comments, students indicated they

liked the programs because of their convenience and feedback, and because they were different from traditional instructional methods. Students also enjoyed getting experience with the computers.

Lowdermilk and Fishel (1991) developed a 36 item, Likert type, attitudinal and evaluative questionnaire to assess students' attitude toward CAI. They also used an open ended "best aspects" and "worst aspects" of CAI questionnaire to determine students' attitude towards CAI. The responses of the students were "varied" (p. 38), but the majority of the students who used CAI found the experience to be enjoyable and helpful. The researchers cautioned that the "novelty effect of using computers for learning may account for some of the positive attitudes about the experience" (p. 38).

Cohen and Dacanay (1994) found only four studies in their meta-analysis of computer-based instruction (CBI) in nursing education that examined student attitude toward CBI. "In all four of these studies, CBI students had more positive attitudes toward their instructional method than students taught conventionally." (Cohen & Dacanay, 1994, p. 91) One of these studies demonstrated a statistically significant difference between groups in favour of CBI. Specific measures and methods used in the studies were not reported in this meta-analysis. Belfry and Winne (1988), in their meta-analysis of 11 studies, found just two studies that measured student attitude towards CAI. They reported that nursing students tended to have positive attitudes toward CAI, "although no statistically significant differences were found between treatment and comparison groups in the two studies" (p. 82). The specific measures used were not reported in this article.

Only Hamby (1986) used a two group, pretest-posttest design to study the effects of CAI on the attitude and achievement of 64 vocational nursing students. Hamby reported a significant difference in attitude toward CAI between control (students not using CAI) and comparison (students using CAI) groups. Also, Hamby reported that students using CAI had higher posttest attitude measures but that these differences were not statistically significant.

Negative attitudes towards CAI. Conflicting findings related to student attitude to CAI were also reported. Day and Payne (1984, 1987) reported that students' attitude to CMI for learning health assessment were negative. They used a 7-point semantic differential scale with 17 attitudinal measures to determine students' attitude toward CMI. Both studies were a two group, posttest design and indicated that students' attitude toward CAI were negative. These findings were supported by Brudenell and Carpenter (1990) and Baldwin, Johnson, and Hill (1994). Brudenell and Carpenter (1990) used a one group, pretest-posttest design to see if there was a relationship between learning style and attitude toward CAI. They measured students' attitudes using a 24-item adjective scale and reported that subjects had significantly less favourable attitudes toward CAI at the posttest measurement. Baldwin, Johnson, and Hill (1994) used a 12-item Likert scale and a qualitative questionnaire to measure students' attitude toward CAI for learning basic psychomotor skills. The researchers administered the scale to 39 nursing students after completion of the CAI modules and reported that students were "overall dissatisfied" with CAI (p. 191).

Paulanka (1986) used a 4-point Likert-type scale and reported that the overall attitudes of students towards working with CAI for psychopharmacologic lessons were negative. One of the contributing factors to the students' negative attitude to CAI was

the lack of interaction with faculty members. Students preferred faculty demonstrations when learning basic psychomotor skills (Baldwin, Johnson, & Hill 1994). Farabaugh (1990) suggested that students seem to be becoming bored with CAI and that attention to maintaining interest in CAI is needed.

THEORETICAL FRAMEWORK

"The positive outcomes attributed to CAI and the incorporation of learning principles are congruent with Bloom's theory of mastery learning." (Reynolds & Pontious, 1986, p. 160) Bloom (1971) recognized that student attitude toward learning situations has a direct impact on learning and that student attitude is affected by the methods of instruction. A positive attitude increases learning while a negative attitude decreases learning. Bloom also identified that student attitude towards learning affects future learning.

Bloom's (1971) theory of mastery learning is based upon the assumption that there are faster learners and slower learners and that all learners, if given optimal learning conditions, can attain mastery of important objectives. As long as all students receive the same instruction at the same pace, their achievement will be normally distributed with the slower learners achieving a lower level of learning and the faster learners achieving a higher level of learning. Optimal learning conditions refer to students being given sufficient time and help to learn, appropriate and varied methods of instruction, and frequent reinforcement and feedback. Bloom suggested that content be divided into smaller units with formative, ungraded evaluations designed to guide the learning process at the end of each unit. Bloom's theory of mastery learning provided the theoretical foundation for this research study.

STATEMENT OF THE PROBLEM AND RESEARCH QUESTION

Numerous studies support the use of CAI as an appropriate medium for nursing education, but conflicting results in many areas of the use of CAI require that further research be conducted. Thomas (1988) reported that even though attitude change has been measured and "reported in several publications, change has been difficult to assess. . ." (p. 123) It is essential to note that many reports of students' attitude towards CAI are recorded using open-ended questionnaires or as part of the overall course evaluation. Another problem with inferring from the data and comparing results on attitude towards CAI is that many different measures have been used in the different studies (Thomas, 1988). As recently as 1994, Baldwin, Johnson, and Hill stated, "The ambiguity of findings regarding attitudes toward CAI and the projected increased use of CAI in future nurse education programs support the need for further exploration of student attitudes toward CAI." (p. 189)

Another challenge of research in this field is the rapid advancement of available technology. Many research studies conducted in the early 1980s implemented CAI programs with limited capability for interaction, graphics, design, and feedback. Even though research suggests that CAI is an appropriate method for instruction, new technologies need to be researched. Several authors suggested that experience with computers had a positive effect on student's attitude towards CAI. Examining this aspect further was expected to provide insight into the planning and

implementation of CAI in a nursing curriculum. From this review of selected literature, the following research question was proposed. What effect does exposure to CAI have on students' attitude toward CAI? In order to answer this question, a two group, pretest-posttest, experimental research study using a valid and reliable attitudinal scale was conducted.

METHODS

Population and Sample

The subjects in this study consisted of undergraduate nursing students enrolled in third year courses in the Faculty of Nursing at the University of Alberta. Adult health assessment is taught to nursing students in their first year. After giving informed consent, 103 nursing students who volunteered to participate in the study completed the pretest. During the week of data collection, which followed immediately, several students contacted the researcher to withdraw from the study due to illness, conflicts with scheduling time to work with the CAI program, illness of family members, and heavy workloads. Also, the students who were not in attendance at class seven days later to complete the posttest were excluded from the study. This resulted in a final sample size of 66 students (29 students in the experimental group and 37 students in the control group). The students were randomly assigned to the two groups and the similarity of the groups was compared using demographic information obtained in the pretest. The characteristics of the groups are presented in Table 1.

Table 1

Characteristics of Students by Group

Variable	Control Group	%	Experimental Group	%
Age in years (mean)	23.54 (n=37)	–	23.14 (n=28)	–
Years of computer use (mean)	7.88 (n=34)	–	8.2 (n=28)	–
Previous CAI course	6 (n=37)	16	5 (n=28)	18
Feel comfortable using computers	27 (n=37)	73	17 (n=28)	61
Year of university* (mean)	3.95 (n=37)	–	3.62 (n=29)	–
Use of computers in grade school	27 (n=37)	73	23 (n=29)	79
Use computers with CD-ROM	19 (n=37)	51	12 (n=29)	41
Have computer at home	31 (n=37)	84	24 (n=29)	83
Have computer at work/school	33 (n=35)	94	23 (n=29)	79
Have computer at parents'/friends'	22 (n=35)	63	17 (n=25)	68
Use e-mail	30 (n=36)	83	23 (n=28)	82
Use internet	26 (n=36)	72	17 (n=28)	61
Use computers for wordprocessing	36 (n=37)	97	28 (n=28)	100
Play computer games	24 (n=36)	67	23 (n=28)	82

*Students were asked to include years of university in other programs

Statistical analysis (t-tests) of the variables age, years of computer use, and year of university showed no significant differences in the means of the two groups. The control and experimental groups were very similar in the characteristics: previous CAI course, use of computers in grade school, use e-mail, have computer at home/parents'/friends', and use computers for wordprocessing based upon the percentages of the students' responses. Almost all of the students have used computers for wordprocessing which is expected with this population of third year nursing students. The characteristic, have computer at work/school differed between the two groups. Computers are available to all nursing students in the computer lab at the Faculty of Nursing yet eight of the students responding to this question reported that they did not have a computer at school. It is difficult to interpret these findings without further information from these subjects. The students may not be aware that the computer lab is for their use or they may have computers available to them at home and have not tried to access a computer at school. Further clarification of this characteristic is required. The characteristics: play computer games, use internet, feel comfortable with computers, and use computers with CD-ROM appear different for the two groups based upon the percentages of the students responding positively to these questions. Further analysis of the demographic characteristics and their effect on attitude was not completed due to the amount of missing data in the demographic information responses. Several of the questionnaires were not fully completed resulting in missing values for ten out of the fourteen characteristics. Also, more specific information about these characteristics, such as, number of hours spent in previous CAI course, type of computer games played, and number of hours per week using the computer, is required for accurate analysis.

Instrument

To measure students' attitude toward CAI, Allen's (1986) Attitude Toward CAI Semantic Differential Scale was chosen. This 7-point semantic differential scale is composed of 14 bipolar adjective pairs describing responses to CAI. Subjects indicate their response to CAI by selecting a point located between the bipolar adjective pairs. These points are scored from one to seven. To ensure validity of the scale, 26 bipolar adjective pairs were submitted to a panel of five expert judges. Four of the judges were considered to be experts in the field of computer applications in nursing and the fifth judge was a psychometrician with expertise in the development of semantic differential scales (Allen, 1986). Of the 26 bipolar adjective pairs, 14 met the content-validity criteria of 80% agreement among the judges and were retained by Allen in the scale.

The reliability of the scale was assessed using Cronbach's alpha coefficient of internal consistency reliability. The reliability coefficient alpha was 0.853 for a sample of 107 baccalaureate nursing students and 0.759 for a sample of 67 graduate nursing students (Allen, 1986). Allen reported, "All item-to-total correlations were positive, and ranged from 0.308 to 0.634, supporting the contention that the tool possesses an acceptable level of internal consistency reliability in the samples studied." (p. 148). Allen also reported that the reliability of the scale was greater for undergraduate students than for graduate students.

In this study, attitude was measured by the scores of the students' responses on Allen's "Attitude Toward CAI Semantic Differential Scale". Students' responses on each of 14 indicators indicated a number from one to seven. On the scale, one represents a more unfavourable attitude and seven represents a more favourable attitude towards CAI. As an example, three bipolar adjective pairs are described.

Rigid	:_1_:_2_:_3_:_4_:_5_:_6_:_7_:	Flexible
Useful	:_7_:_6_:_5_:_4_:_3_:_2_:_1_:	Useless
Stimulating	:_7_:_6_:_5_:_4_:_3_:_2_:_1_:	Boring

Allen listed the 14 indicators and alternated the bipolar adjectives so that the positive adjectives were not all on one side of the scale. This avoids an acquiescent response set. The students completed the scale by marking an 'X' in the blank that best described their feeling or impression toward a certain concept. The scale given to the students did not show the numbers assigned to the blanks.

Procedures

To determine if exposure to CAI has an effect on students' attitude toward CAI, a two group experimental design was used. Students were approached in their classes to voluntarily participate in the study. The students who volunteered were given a pretest to complete which included demographic information and the attitude to CAI semantic differential scale. Before submitting the completed pretest, the subjects were randomly assigned to one of two groups: either the control group, who were not exposed to the CAI program as an intervention, or the experimental group, who were exposed to the CAI program. The program selected for this study was the DataStar CAI program for adult health assessment on cardiovascular and peripheral vascular systems assessment (Anderson, 1997). This computer-based instructional program incorporates CD-ROM technology to provide for self-testing of current knowledge, identification of learning needs, and access to on-line learning resources for the acquisition of knowledge and skill in adult health assessment. The modules include variations of normal findings, age related changes, and differentiation between normal and abnormal findings. The CAI modules incorporate text, coloured and rotatable visual graphic designs, audio, and running video to provide students with tutorial lessons and drill and practice exercises. The modules are interactive in nature and allow the student to control the pace of the program, select the order of progression through the lessons, determine the times of access to the program, and review previously viewed modules. The DataStar adult health assessment series also includes CAI programs on symptom analysis, physical examination techniques (inspection, palpation, percussion, and auscultation), and thorax and lungs assessment.

Subjects in the experimental group were then asked to work with the CAI program for one hour during the following week. Times to work with the computer modules were scheduled immediately following the completion of the pretests. Subjects were given access to the program and their time on the computer was

monitored. The program was started for all the students and specific verbal instructions were given on how to access the help section and use the computer mouse. No other instructions were given to the students. All subjects in the experimental group spent one hour on the program. Subjects not able to complete this requirement were excluded from the study. Seven days after the pretest, all control and experimental group participants completed the attitude to CAI semantic differential scale as the posttest. Subjects who were unavailable to complete the posttest at the scheduled time were also excluded from the study. Data collection was completed on January 29, 1998 at the University of Alberta using classroom and lab facilities in the Faculty of Nursing. Following the posttest, all participants were offered the opportunity to study using all four of the DataStar CAI modules on adult health assessment.

RESULTS

In determining the effects of experimental treatments and the differences between groups, repeated measures multivariate analysis of variance (MANOVA) and univariate analysis of variance were used. The statistical analysis program, SPSS 6.1.2 for windows, was used. High reliability coefficients, Cronbach's alpha, were obtained for the combined results of the pretest (.809) and posttest (.898). One pretest scale was missing a score for one of the 14 indicators. This missing value was replaced using the mean score of the pretest scores for both groups (grand mean). One experimental group posttest scale was missing a score for one of the 14 indicators and this value was replaced using the experimental group mean for the indicator. This method of managing missing data is outlined by Tabachnik and Fidell (1996). Repeated measures multivariate analysis of variance (MANOVA) completed on the results of the 14 item semantic differential scale showed statistically significant differences for the effect of group by time $p = 0.03$ and for the effect of time $p < 0.04$. These results are shown in Table 2.

Table 2

Repeated Measures MANOVA for Test Item Score by Time and Group

Source of Variance	Wilks Lambda	F	p
Effect – Time by Group Multivariate Results	.640	2.04	.03*
Effect – Group Multivariate Results	.776	1.05	.42
Effect – Time Multivariate Results	.647	1.99	<.04*

*Significant at $p < 0.05$

In Table 3, results of univariate analyses are presented. Statistically significant differences ($p < 0.05$) for the experimental group were obtained for the indicators "stimulating versus boring", "nonthreatening versus threatening", and "easy to control versus overpowering". The statistical analysis showed that the indicator "meaningful versus meaningless" approached statistical significance ($p \leq 0.055$). None of the indicators were statistically significant for any differences between the pretest and the posttest in the control group.

Table 3

Mean Scores for Pretest, Posttest, and Difference Scores by Group

Control group (n=37)
Experimental group (n=29) (1 = unfavourable, 7 = favourable)

	Pretest (mean scores)	Posttest (mean scores)	Time 2 – Time 1 (difference)	F	Significance
Flexible-Rigid					
Control	4.62	4.65	.03		
Experimental	3.97	4.07	.10	.033	.857
Useful-Useless					
Control	5.86	5.89	.03		
Experimental	5.76	5.90	.14	.155	.695
Stimulating-Boring					
Control	5.30	5.19	-.11		
Experimental	4.97	5.62	.65	5.822	.019*
Meaningful-Meaningless					
Control	5.51	5.59	.08		
Experimental	5.14	5.83	.69	3.817	.055****
Pleasant-Unpleasant					
Control	4.92	4.84	-.08		
Experimental	4.93	5.24	.31	1.181	.281
Valuable-Worthless					
Control	5.92	5.84	-.08		
Experimental	5.79	5.86	.07	.445	.507
Creative-Unimaginative					
Control	5.57	5.59	.02		
Experimental	5.69	5.90	.21	.352	.555
Personal-Impersonal					
Control	2.86	3.08	.22		
Experimental	2.97	3.72	.75	2.132	.149
Efficient-Inefficient					
Control	5.76	5.49	-.27		
Experimental	5.41	5.52	.11	1.425	.237
Appropriate-Inappropriate					
Control	5.49	5.54	.05		
Experimental	5.21	5.62	.41	1.361	.248
Comfortable-Uncomfortable					
Control	4.89	4.92	.03		
Experimental	4.86	5.45	.59	2.112	.151
Nonthreatening-Threatening					
Control	4.95	4.70	-.25		
Experimental	4.62	5.34	.72	7.343	.009**
Easy to control-Overpowering					
Control	4.86	4.95	.09		
Experimental	4.17	5.45	1.28	14.483	.000***
Time saving-Time consuming					
Control	4.65	4.62	-.03		
Experimental	4.59	4.28	-.31	.385	.537

*Significant at $p < 0.05$
**Significant at $p < 0.01$
***Significant at $p < 0.001$
****Borderline significance at $p \geq 0.05$

Analysis of variance was then used to analyze the total scores on the attitude measurement scale. The total score was calculated by adding the value of all 14 items. The findings from this analysis are included in Table 4.

Table 4

Repeated Measures Analysis of Variance for Attitude Toward CAI Total Scores

Source	SS	df	Mean Square	F	p
Between Subjects					
Group (A)	.30	1	.30	.00	.969
Error	12863.67	64	200.99		
Within Subjects					
Time (B)	241.79	1	241.79	4.76	.033*
A x B	292.09	1	292.09	5.75	.019*
Error	3249.55	64	50.77		

*Significant at $p < 0.05$.

The analysis demonstrates an overall more positive attitude toward CAI, based upon the subjects' total scores, in the experimental group. The differences between experimental and control groups were statistically significant.

The interaction effect of the intervention is demonstrated in Figure 1. It is evident from the results shown in Table 4 and Figure 1 that the differences between the experimental and control groups' total scores are statistically significant.

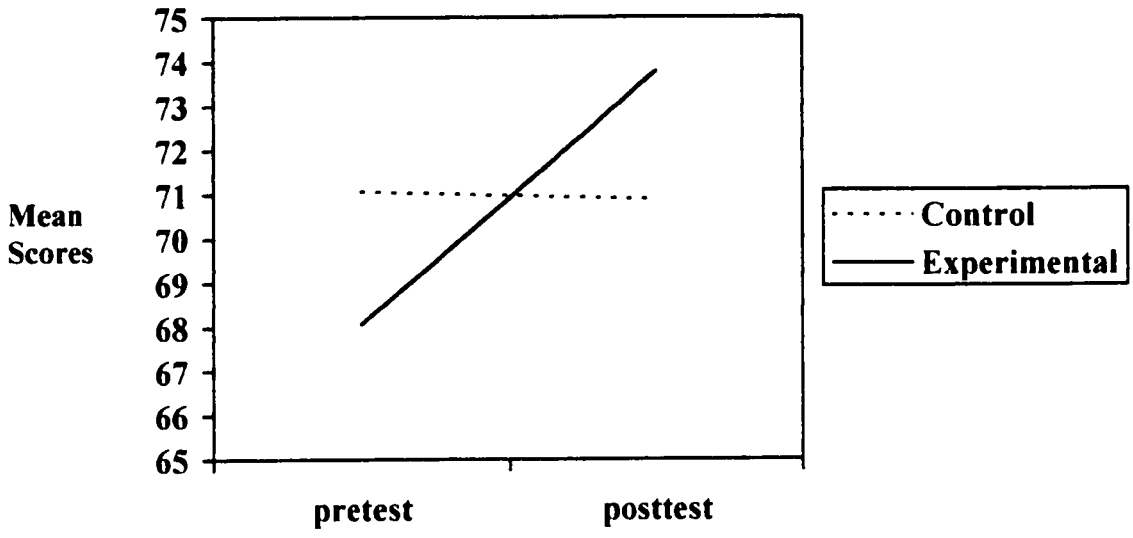

Figure 1. Interaction effect: Means of total scores.

The posttest total score mean of the control group was lower than the pretest total score mean. The experimental group's posttest total score mean was higher than the pretest total score mean. Interpretation of the analysis of the subjects' total scores requires caution. The interaction effect, demonstrated in Figure 1, shows that the total scores of the subjects may have been influenced by the three indicators that were statistically significant and not from a difference in all 14 indicators on the semantic differential scale. The difference in the experimental group's attitude after exposure to the CAI program, may be reflective of the change in the three indicators "stimulating versus boring", "nonthreatening versus threatening", and "easy to control versus overpowering" and not from the change in the other 11 indicators.

Although there was no formal qualitative component in this study, students' informal and unsolicited reports about the CAI program were recorded. Examples of the students' comments included: "This is really good. It would be great to use for assessment.", "This is so cool.", "I'm impressed; This is really neat.", "The hour went by really fast", and "This was really fun." Three of the students reported that for one of the drill and practices it was difficult to maneuver the computer mouse and they found this "frustrating". No other negative reports were made to the researcher. All of these reports were from students as they were finishing work with the CAI program or as they were leaving the computer lab.

DISCUSSION OF FINDINGS

The findings of this study suggest that students' overall attitude to CAI are more favourable after exposure to CAI which is congruent with suggestions by Hamby (1986), Reynolds and Pontious (1986), and Thiele (1988). These findings are

consistent with results from studies by Bratt and Vockell (1986), Hamby (1986), Gaston (1988), Goodman, Blake, and Lott (1990), Wong (1990), Lowdermilk and Fishel (1991), McFarland (1993), and Russell, Miller, and Czerwinska (1994). Of these studies, only Hamby used the same two group, pretest-posttest design. The findings from this study are in conflict with results from Brudenell and Carpenter (1990), Baldwin, Johnson, and Hill (1994), and Paulanka (1986). These results also conflict with the findings from Day and Payne (1984, 1987) who found that students' attitude toward CMI were negative. Day and Payne (1987) reported that students found CMI less stimulating, more disturbing, less enjoyable, less accurate, less satisfying, more frustrating, less convenient, and ineffective but statistical significance of these indicators were not reported. Although, in this study, statistically significant data were found for only 3 of the 14 indicators of the semantic differential scale, analysis of the subjects' total scores demonstrated that exposure to CAI resulted in a more favourable attitude to CAI than no exposure. It is evident from the analysis that students in the experimental group rated their attitude toward CAI higher on posttest measures than those in the control group.

The indicator "stimulating versus boring" was significantly higher on the posttest for the experimental group which indicates that students found CAI more stimulating after they had been exposed to the program. These results are congruent with suggestions by Burns and Bozeman (1981) that CAI provides a stimulating, multisensory environment for learning. The use of coloured and rotatable graphic designs, motion video, and audio for the presentation and testing of the content provide a multisensory program for the students to follow. Halloran (1995) reported that students felt the use of computers made classes "more interesting". It is important to recognize that the positive shift in this indicator may be related to the use of a different instructional method, which adds variety to the learning process rather than exposure to the CAI program. Lowdermilk and Fishel (1991) cautioned that the novelty effect of using computers may account for the differences in students' attitude. In this study, fewer students in the experimental group reported using the internet and computers with CD-ROM technology than students in the control group. This may contribute to the novelty effect suggested by Lowdermilk and Fishel; however, more students in the experimental group reported playing computer games than in the control group. More specific information about these characteristics, such as number of hours per week and type of computer games played, is required to accurately assess the potential novelty effect. The findings from this study conflict with findings from Day and Payne (1987) and with suggestions by Farabaugh (1990) who reported that students seem to be becoming bored with CAI; however, the students in this study were exposed to CAI for only one hour which may account for this difference.

Students in the experimental group scored the indicator "nonthreatening versus threatening" significantly higher on the posttest which suggests that students found CAI less threatening after exposure to the program. These findings are congruent with suggestions by Napholz and McCanse (1994) who reported increased comfort with computers as a positive outcome of CAI. Goodman and Blake (1996) found that students who used CAI in their nursing program felt less anxious when writing their NCLEX-RN exams on computers.

Significant differences for the indicator "easy to control versus overpowering" were also found in the experimental group. Although, several studies reported that students found CAI easy to use (Gee, Peterson, Martin, & Reeve, 1998; Neafsey, 1997; Thiele, 1988) it is difficult to interpret these results without more specific information. The indicator "easy to control" may not accurately reflect easy to use.

Both Wong (1990) and Reynolds and Pontious (1986) found CAI "useful" which is not evident in the results from this study. Wong reported that students found CAI "useful, valuable, time-saving, meaningful, appropriate, and motivational" (p. 279). The findings in this study showed that the indicator "meaningful versus meaningless" approached statistical significance which is consistent with the findings from Wong. Although students in the experimental group scored the indicators "useful versus useless", "valuable versus worthless", and "appropriate versus inappropriate" higher on the posttest, the results were not statistically significant. These findings conflict with results from Day and Payne (1987) who reported that students found CMI less useful and less appropriate. Students in the experimental group actually scored the indicator "time-saving versus time-consuming" lower on the posttest than the pretest which is congruent with findings from Day and Payne (1987) who reported that students found CMI "slower". Decreased learning time is one of the advantages of CAI identified in the literature (Billings, 1986; Lancaster & Willis, 1994; Lassan, 1989; & Quinn, 1986). The results from this study conflict with findings from Wong (1990), as well as, findings from Larson (1981), Reynolds and Pontious (1986), Nyamathi, Chang, Sherman, and Grech (1989), and Napholz and McCanse (1994) who reported decreased time for student learning. Nyamathi et al. (1989) reported that students using CAI learned range of motion content "in about one half as much time" as the students taught by lecture (p. 500). Thede, Taft, and Coeling (1994) reported that time was an obstacle in encouraging students to use CAI which is consistent with the findings of this study. It is difficult to interpret the data for the indicator "time-saving versus time-consuming" without further information from the subjects in the experimental group.

The one indicator that was rated low by both groups was "personal versus impersonal" which is congruent with findings from Day and Payne (1987), Paulanka (1986), and Baldwin, Johnson, and Hill (1994), and suggestions from Billings (1986), Kilmon (1996), and Parker (1984). Baldwin, Johnson, and Hill (1994) reported that students preferred faculty demonstrations when learning basic psychomotor skills which is a concern when using CAI for teaching health assessment. It is difficult to identify methods that may decrease the impersonal nature of the computer but it is an area requiring further consideration as we expand the use of technology in teaching. Possibly having students work in groups or having an instructor present when the students are working with the CAI programs would decrease the impersonal nature of this instructional method. Using CAI in addition to the traditional teaching methods of lecture and demonstration may alleviate the impersonal nature of CAI.

The indicator "comfortable versus uncomfortable" was addressed specifically because of the differences noted between the demographic characteristics of the control and experimental groups. Seventy-three percent of the control group and sixty-one percent of the experimental group responded yes to the pretest question "Do you feel comfortable using computers?" The measure on the specific indicator

"comfortable versus uncomfortable" in Allen's semantic differential scale showed no significant differences between the groups on the pretest and posttest measures.

It is essential to identify the limitations of this study. A small sample size was used for this research which limits the generalizability of these results and also results in a lower power for this study. It is important to note that even with a low power of study, statistically significant differences were found which suggests a large effect size (Cohen, 1988). Another factor to consider is that the sample was a convenience sample taken from students in one year of the nursing program at one university. This also limits the generalizability of this study. A further consideration common to most research in this field is that this study involved students' attitude to a particular CAI program. The results of this study demonstrate the students' attitude after exposure to one module (cardiovascular and peripheral vascular assessment) of the DataStar CAI program for adult health assessment. This CAI program is a newly developed, interactive program incorporating text, coloured and rotatable visual graphic designs, audio, and running video to provide students with tutorial lessons and drill and practice exercises. The results of this study are not generalizable to other CAI programs.

IMPLICATIONS FOR NURSING EDUCATION

As we strive to meet the changing demands of nursing education, CAI may be one of the answers to meet some of these challenges. Computer-assisted instruction can be used to instruct students at off-campus sites, at the students' own pace, and at convenient times for the students' schedules. Students can use the CAI programs independently and can further develop familiarity with computers.

From this research, it is suggested that exposure to CAI improved students' attitude towards CAI. Davis, Alexander, and Yelon (1974) stated, ". . . a student is more likely to continue learning if instructional conditions are more pleasant" (p. 208). This idea is supported by other authors (Cross, 1981; Daines, Daines, & Graham, 1993; Knowles, 1984; Merriam & Caffarella, 1991; Rogers, 1989; Rogers, 1996; Wlodkowski, 1985). It appears that students are more likely to continue learning with CAI once they have been exposed to CAI. If exposure to CAI increases students' positive attitude toward CAI, it may be beneficial to incorporate CAI throughout a nursing curriculum rather than in single courses. Also, it may be beneficial to ensure that students are given supervised initial orientations to the CAI programs so that they are exposed to the programs. This initial exposure may result in increased and continued use of the programs by the students and result in students feeling less threatened by the computer.

Several aspects of CAI are congruent with educational research to improve student learning. The CAI modules used in this study are interactive in nature and allow the student to control the pace of the program, select the order of progression through the lessons, determine the times of access to the program, and review previously viewed modules. Rogers (1989) reported that classes that are interesting, paced appropriately, encourage active involvement, and utilize different instructional techniques promote learning. Cross (1981), Rogers (1989), and Wlodkowski (1985) add that situations which allow the learner to control the pace of the instruction

improve the learning atmosphere and learning. Computer-assisted instruction reflects many of these educational principles and may be a beneficial instructional method.

The use of CAI is consistent with Bloom's (1971) theory of mastery learning and the assumption that there are faster and slower learners and that all learners, if given optimal learning conditions, can attain mastery of important objectives. Mastery learning is relevant to many areas of nursing education. Several aspects of nursing practice require that students "master" the content, for example, medication dosage calculations. It is essential that all students meet a certain level of competence in this area of nursing practice because errors would have serious implications. Health assessment is another area of nursing practice that requires mastery of the content. All nursing students must meet a certain level of mastery to ensure that safe, competent, accurate assessments are conducted. Computer-assisted instruction allows students to work at their own pace with varied methods of instruction. It also provides frequent reinforcement and feedback from the drill and practice exercises.

Finally, the rapid advancement of technology, expanded use of computers in institutional settings, increased demands for nursing practice, and increased complexity of patient care require continuous updating of knowledge and skills for nursing students and nurses. Neafsey (1997) found significant gains in knowledge for nurses using CAI to learn pharmacokinetics at home. Nurses using CAI for home study cited convenience and simplicity of use as two advantages of the program. Computer-assisted instruction may serve as a method for nursing students and nurses in practice to review and update their knowledge and skills which learners can access independently.

Further research into CAI is necessary to examine all aspects of this instructional method. Research in areas such as effectiveness, effect of learner characteristics on CAI, impact on student and faculty time, faculty and student attitude, and retention of knowledge is essential to ensure appropriate, effective methods of instruction are utilized. As well, research into the cost-effectiveness of CAI would be beneficial in these times of educational cutbacks and reduced government spending. With the increased use of computers in education and all areas of society, further study in this field is required.

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Chapter 3

SUMMARY

The purpose of this study was to examine the effects of exposure to CAI on nursing students' attitude towards CAI. The researcher examined the differences in attitude between students who worked with a CAI program and those who did not. The findings from this study suggest that students have a more favourable attitude to CAI after exposure to CAI based upon the differences of their scores on an attitudinal scale.

Research in the area of CAI is significant to nursing education. Nursing education, as well as post-secondary educational institutions, is faced with new challenges in education to meet the changing needs of society. In order to meet the needs of the students, new, learner-centred, instructional methods that are accessible to students locally, regionally, and internationally are required. The University of Alberta Senate Task Force (1995) recognized the need to meet the challenges of accessibility, changing student needs and populations, geographical diversity, cost-effectiveness, and time and space constraints associated with educational needs. Computer-assisted instruction is one method of instruction that meets these recommendations. At the same time, rapid advancement of technology, multi-skilling, and increased complexity of patient care requires continuous updating of knowledge and skills. With increasing constraints on nurses and nursing students' time, CAI may serve as a method for nursing students and nurses to review and update their knowledge and skills. Many nursing students and nurses have family and work responsibilities which limit their ability to attend regularly scheduled classes. Shift work is another major factor that affects participation in scheduled classes. Computer-assisted instruction may be an appropriate mode of education that nurses and nursing students can access independently, at their own convenience, and in an accessible location.

OVERVIEW OF THE STUDY

Before proceeding with this research study, permission was granted by the Dean, Faculty of Nursing, University of Alberta to access the third year students as study participants (see Appendix A). Also, ethical permission to conduct the study was given by the Health Research Ethics Board at the University of Alberta (see Appendix B). Several attempts were made to obtain written permission from the developer of the attitudinal scale used in this study, before proceeding with the study, but the developer did not respond to telephone messages or to written correspondence. A letter was sent to the developer requesting that any concerns about the use of the scale for this research study be conveyed to the researcher by January 21, 1998. No response was received and the study was initiated.

Prior to approaching the students in class, the researcher prepared the pretest forms. Each pretest had a detachable paper labeled with the students' names and the pretests were numerically coded. The students' names and numerical codes were listed in alphabetical order.

Students from four sections of the two core third year nursing courses were approached to participate in this study and given an information letter about the study (see Appendix C). This method was an attempt to access as many third year nursing students as possible. Out of 185 students registered in the core courses, approximately 135 students were in attendance at these classes on the day that information about the study was presented and informed consent was obtained for participation. This resulted in many students being missed. Other third year nursing students, not currently registered in either of the core courses, were missed. Of the approximate 135 students in attendance, 103 students gave consent to participate (see Appendix D). Twenty subjects in the experimental group did not or were not able to complete the required hour with the computer program. Three subjects in the experimental group who did work with the CAI program were not in attendance at class for the posttest and 14 subjects in the control group were also not in attendance at class for the posttest. Conflicts with schedules, illness, heavy workloads, and family illness were reported by some students as contributing to their absence from class and not being able to work with the CAI program. This resulted in the withdrawal of 37 subjects for a final sample size of 66 participants. It is difficult to determine how representative the sample is of the target population. The sample reflects students who regularly attend classes and are willing to volunteer their time to participate in research. The potential for bias that a particular "type" of student participates in research is a common issue in all research projects requiring volunteer participants.

Before the students completed the pretest, the researcher collected the consent forms from all participants. While the participants were completing the pretest, the researcher, using a previously prepared class list, highlighted the names of the students who had given consent to participate. The students' names on the class list were numerically coded before the students were approached in class to participate. Once all the participants' names were highlighted, the researcher alternately assigned the numbers one and two beside the students' coded names. A random starting point on the class list was chosen using a random numbers table. The students assigned number one were the control group and the students assigned number two were the experimental group. Completion of the pretest (see Appendix E) took approximately 10 minutes. After completing the pretest, the students gave their pretests to the researcher. The researcher identified the code number on the pretest form, looked for the code number on the class list, and determined which group the student had been assigned to. When the students handed in their pretest, they were given an instruction sheet for their assigned group (see Appendix F). One student in the experimental group explained that she did not understand the instruction sheet and did not realize that she was supposed to come and work on the computer program. She did report to the researcher after the study that once she read the instruction sheet again, it was clear.

The participants were given times to access the computer lab (see Appendix F). These times were based upon the students' schedules and the researcher's availability. Three computers were set up in a research area in the Clinical Sciences Building. On four occasions, there were more than three students wanting to access the computer program. Two of the subjects were unable to return at another time

therefore withdrew from the study. The researcher was present in the computer lab at all times to ensure only students in the experimental group used the computer program, to monitor their time with the program, and to record their attendance. All participants were given the same verbal instructions before working with the program. The program was started for the students and instruction about accessing the "help" feature of the program was given. The students were informed that the computer mouse was used for the entire module and that they did not need to use the keyboard. All subjects were reminded that this was not a test and that they could proceed through the module in any order they would like. At the end of one hour, the researcher informed the students that they had completed their time and reminded all subjects not to talk about the study until completion of data collection.

The researcher returned to the four class sections, seven days after the subjects completed the pretest. Posttests (see Appendix G) were distributed to the students who had completed the pretest and worked with the computer program for one hour. All control group participants who were in attendance completed the posttest. Completion of the posttest required approximately 5 minutes. Lecture time for the explanation of the study, discussion and questions, participant consent, and pretest and posttest measurements was given by the four section leaders. Students in three of the four sections were credited one hour towards their clinical hours for their participation in the study. Data collection was conducted from January 22 to 29, 1998.

DATA ANALYSIS

Following the completion of data collection, analysis was conducted using the SPSS 6.1.2 for windows statistical program. Data were entered and checked three times. Frequency distributions were run for all variables to ensure the data were clean. Figure 2 demonstrates the design and basis for this analysis.

	Pretest	Posttest	
Control Group	$\bar{X}_1$. $\bar{X}_{14}$	$\bar{X}_1$. $\bar{X}_{14}$	$\bar{X}_{Grand}$
Experimental Group	$\bar{X}_1$. $\bar{X}_{14}$	$\bar{X}_1$. $\bar{X}_{14}$	$\bar{X}_{Grand}$
	$\bar{X}_{Grand}$	$\bar{X}_{Grand}$	

Effect of Group

Effect of Time

Figure 2. Dummy Table.

Repeated measures multivariate analysis of variance (MANOVA) were used to determine differences between the experimental and control group on the pretest and posttest measures. Repeated measures were used to determine the effect of time since the instrument was completed on two occasions (pretest and posttest). Multivariate analysis of variance was completed to determine the effect of group since there were two groups. Repeated measures MANOVA determines whether there are statistically significant differences between the two groups and the two measures. The results of this analysis are included in Chapter 2, Table 2.

Univariate analysis of variance (ANOVA) was used to determine the differences in the group means on each of the 14 indicators. The results of this analysis are included in Chapter 2, Table 3. These statistical analyses have a lower combined error rate than t-tests. The error for each t-test is set at 0.05 which results in a large combined error rate for an instrument with 14 indicators (14 x 0.05).

LIMITATIONS OF THIS STUDY

There are several limitations to this study. A small sample size was used for this research which limits the generalizability of these results and also results in a lower power for this study. It is important to note that although this study had low

power, statistically significant data were demonstrated which is consistent with a large effect size (Cohen, 1988).

Another limitation of this study is that the sample was a convenience sample of students from one year of a nursing program at one university. Also, one consideration common to most research in this field is that this study involved students' attitude to a particular CAI program. Therefore, these results are not generalizable to use of other CAI programs.

CONSIDERATIONS FOR FUTURE RESEARCH

There are several considerations to make in regards to this study and its possible replication in order to overcome some of the identified limitations of the study and reduce the threats to external and internal validity. First, a larger group of students should be approached to participate in such a study. Ideally, all nursing students enrolled in the collaborative nursing program at all five educational sites could be approached to participate. This would address the limitations resulting from the use of one year of nursing students at one site. In addition, it would be possible to obtain a much larger sample size. For the purposes of this research, a large scale study was not feasible. This study could, however, serve as a pilot study for a larger research project.

Second, the practical aspects of this study need to be considered. All attempts were made to ensure that student access to the computer program was as convenient as possible. Having more available computers and more available times to access the computers may have resulted in fewer students withdrawing from the study. The third year nursing students have clinical components to their core classes which require many of the students to be off-campus for two days a week. Increasing the availability of the computer may have helped meet the scheduling needs of the students.

A third consideration is the time that the students worked with the computer program. Possibly having varied amounts of time and repeated exposure for groups of subjects would add more insight into this area of research. A factorial design such as this would require a large sample size. In this study, having the students work with the program for one hour was determined in consideration of the following factors. One factor was the workloads of students and their limited amount of time to participate in research. By requiring students to work with the modules for one hour and not longer, the issues of respondent burden and promoting participation in the study were addressed. Another factor was that most undergraduate classes at the University of Alberta are 50 or 80 minutes in length. Using one hour for the intervention was congruent with the typical class length.

Fourth, this study did not include any formal, qualitative data collection. The inclusion of open-ended questions for the subjects in the experimental group to complete may have added to the richness of the data collected in this area and given a clearer direction for future research.

Another consideration for this research is a secondary analysis of the data collected for this study. Due to the number of subjects withdrawn from this study, much data were lost for this project. Cross-tabulations and correlational analyses

could be conducted to determine the effect of learner characteristics on attitudes toward CAI using only the demographic and pretest measures. Secondary analysis could be conducted to determine if specific learner characteristics and exposure to CAI have an impact on students' attitudes toward CAI.

Finally, the issues of contamination of the groups and length of time between measures need to be considered. Although the subjects were asked not to discuss the study until data collection was completed, it is recognized that some contamination of the groups may have occurred. The students spend large amounts of time together and could easily forget not to mention any aspect of the study to their classmates. The length of time between the pretest and posttest measures is another consideration. Although the use of a control group helps control for the effects of history and maturation (Burns & Grove, 1993), the amount of time between these measures might be decreased to eliminate the effects of extraneous variables. Also, the length of time between the intervention and the completion of the posttest may affect the students' responses. Having the subjects complete the posttest immediately after working with the program may increase the accuracy of their responses and be more reflective of their attitude toward CAI after exposure to the program. In order to address these concerns in a research design, it would be ideal to approach the students, obtain consent, assign the students to groups, have the experimental group work with the computer program while the control group were elsewhere, then have all participants return for the posttest. Ideally, this would all occur within a time span of about two hours. This would decrease the effects of the identified extraneous variables. However, this design would be very difficult to implement due to the schedules of students. If class time were used for the research then nonparticipants in the study would lose class time.

FUTURE DIRECTIONS FOR RESEARCH

It is evident that further research into CAI in nursing education is required. A complete literature review on attitude and learning and CAI in nursing education is included in Appendix H. This research study involved examining nursing students' attitude towards CAI using a two group, rigorous, experimental design. The results of this study add to the available information on nursing students' attitude to CAI and effect size and may provide direction for future research. Further research into areas such as effectiveness, impact on student and faculty time, cost-effectiveness for institutions, faculty and student attitude, effect of learner characteristics on CAI, and retention of knowledge is essential to ensure appropriate, effective methods of instruction are utilized. With the increased use of computers in education and all areas of society, further study in this field is required. A complete reference list for this thesis is included in Appendix I.

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Appendix A

University of Alberta
Edmonton
Canada T6G 2G3

Faculty of Nursing
3rd Floor Clinical Sciences Building

MEMORANDUM

Date: November 18, 1997

To: Tracey Stephen
MN Student, Faculty of Nursing
University of Alberta

From: Dr. Marilynn J. Wood
Dean and Professor
Faculty of Nursing
University of Alberta

Re: Permission to access undergraduate students for research purposes

I am pleased to grant your request for access to the Nursing 302 and 303 undergraduate students for the purpose of conducting the research project titled, "Effect of Exposure to Computer-Assisted Instruction with CD-ROM Technology on Nursing Students' Attitude Towards Computer-Assisted Instruction" as specified in your letter of November 17, 1997. Permission to access the undergraduate nursing students is granted pending ethics approval.

Appendix B

University of Alberta
Edmonton
Canada T6G 2G4

Faculty of Rehabilitation Medicine
Rehabilitation Research Centre
3-48 Corbett Hall
Director (403) 492-7856 Telephone (403) 492-2903
Fax (403) 492-1626

UNIVERSITY OF ALBERTA HEALTH SCIENCES FACULTIES,
CAPITAL HEALTH AUTHORITY, AND CARITAS HEALTH GROUP

HEALTH RESEARCH ETHICS APPROVAL

Date: December 1997

Name(s) of Principal Investigator(s): Tracey Stephen

Organization(s): University of Alberta

Department: Graduate Studies, Faculty of Nursing

Project Title: Effect of Exposure to Computer-Assisted Instruction with CD-ROM Technology on Nursing Students' Attitude Towards Computer-Assisted Instruction

The Health Research Ethics Board has reviewed the protocol for this project and found it to be acceptable within the limitations of human experimentation. The HREB has also reviewed and approved the patient information material and consent form.

The approval for the study as presented is valid for one year. It may be extended following completion of the yearly report form. Any proposed changes to the study must be submitted to the Health Research Ethics Board for approval.

Sharon Warren

Dr. Sharon Warren
Chair of the Health Research Ethics Board (B: Health Research)

File number: B-031297-NSG

Appendix C

INFORMATION AND INFORMED CONSENT TO PARTICIPATE IN RESEARCH

Effect of Exposure to Computer-Assisted Instruction with CD-ROM Technology on Nursing Students' Attitude Towards Computer-Assisted Instruction

Researcher:
Tracey Stephen
MN Candidate
Faculty of Nursing
University of Alberta
Phone: 492-5531

Thesis Supervisor:
Dr. D. Lynn Skillen
Associate Professor
Faculty of Nursing
University of Alberta
Phone: 492-2648

Purpose of the study

I am an MN student at the University of Alberta seeking your assistance for the research study titled, "Effect of Exposure to Computer-Assisted Instruction with CD-ROM Technology on Nursing Students' Attitude Towards Computer-Assisted Instruction". This research study is part of my Master's thesis.

This study is being conducted to find out if exposure to computer-assisted instruction using CD-ROM technology has an effect on students' attitude toward computer-assisted instruction. This study will also add to the current information on specific measurement tools.

As a third year nursing student enrolled in Nursing 302 or 303, I am asking you to be a part of this study. All students participating in this study will be asked to complete a form with questions about their current use of computers and questions relating to what they think about computers in education. This will take about 10 minutes. You will then be asked to either wait for a week and do nothing related to this study or you may be asked to work on the new, interactive, CD-ROM, adult health assessment computer modules for 1 hour. You will have a 50/50 chance of being in the group that completes the computer modules or the group that is not required to do any computer activity. After a week, you will then be asked to complete a form with some questions related to computers in education. This will take about 10 minutes to complete. The study will take place during a period of 7 days. Time to complete the computer modules will be scheduled outside of your regular class time but you will receive credit for one hour towards your clinical hours. If your instructor agrees to credit the hour you spend participating in the project towards your clinical time, the hour will be credited to you only upon the successful completion of the project. Once the second set of questions are completed (late January), the computer modules will be made available to all the study participants.

Voluntary participation

Your participation in this study is voluntary. You may withdraw your consent to participate at any time and your decision will not place you in any kind of risk. Your participation will not affect your assigned grade. If you wish to withdraw your consent, please tell Tracey by contacting her at 492-5531.

There are no known personal risks to you if you take part in this study. There may be benefits associated with the use of advanced technology for reviewing adult health assessment and your participation may provide you with additional insight into the research process.

Confidentiality

All information that is obtained in this study will be treated in confidence. Your name will be coded with a number to ensure confidentiality. The results and findings from this study may be used in public presentations or in written reports or publications, but at no time will you be named or identified. The data from this study will be kept in a locked filing cabinet. Only Tracey will have access to the code list and it will be kept in a locked cabinet separate from the questionnaires. Other researchers may review the data collected in this study but your name and identity will be kept confidential. The data will be kept for seven years after the completion of this study and then it will be destroyed. If you would like access to the results of the study, please contact Tracey at 492-5531.

If at any time you have any questions, you can contact Tracey or her supervisor, Dr Lynn Skillen. If you have any concerns about any aspect of this study, you may contact June Anonson, Student Advisor, Undergraduate Education at 492-6314. The Student Advisor has no affiliation with this research project.

Appendix D

CONSENT TO PARTICIPATE IN RESEARCH

Title of Project: **Effect of Exposure to Computer-Assisted Instruction with CD-ROM Technology on Nursing Students' Attitude Towards Computer-Assisted Instruction**

Researcher: **Tracey Stephen**
MN Candidate
Faculty of Nursing
University of Alberta
Phone: 492-5531

Thesis Supervisor: Dr. D. Lynn Skillen
Associate Professor
Faculty of Nursing
University of Alberta
Phone: 492-2648

Please answer the following questions. Circle your answer.

Do you understand that you have been asked to be in a research study?	Yes	No
Have you read and received a copy of the attached Information Letter?	Yes	No
Do you understand the benefits and risks involved in taking part in this research study?	Yes	No
Have you had an opportunity to ask questions and discuss this study?	Yes	No
Do you understand that you are free to refuse to participate or withdraw from the study at any time? You do not have to give a reason and it will not affect your education.	Yes	No
Has the issue of confidentiality been explained to you?	Yes	No

This study was explained to me by: _____

I agree to take part in this study.

_____ _____ _____
Signature of Research Participant Date Witness

_____ _____
Printed Name Printed Name

I believe that the person signing this form understands what is involved in the study and voluntarily agrees to participate.

_____ _____
Signature of Investigator Date

Appendix E

Demographic information sheet Code:_____

Please complete the following questions.

All information will be kept confidential. Do not write your name on this sheet.

1. Did you use computers in grade school? Yes ___ No ___

   If yes, check all the answers that apply.
   Elementary school __ Junior high school __ Senior high school __

2. Have you previously completed a course using computer-assisted instruction?
   Yes ___ No ___

   If yes, where? (check all the answers that apply)

   University of Alberta ____ NAIT/SAIT ____
   Grant MacEwan Community College ____ University of Calgary ____
   Athabasca University ____ Red Deer College ____
   Concordia College ____ Other ____

3. Have you previously used computers with CD-ROM technology for learning?

   Yes___ No____ Not Sure_____

4. Do you have a computer at home? Yes ___ No ___
   Do you have a computer at work/school? Yes ___ No ___
   Do you have a computer that you use at your parent's/friend's home? Yes__ No_

If yes, how often do you use a computer for the following things: Check in all the appropriate boxes.

	Never	Seldom (1-3 times/ month)	Regularly (1-3 times/week)	Frequently (4-5 times/week)	Always (6-7 times/week)
e-mail					
Word processing (papers/ assignments)					
Internet					
Course using computers for learning					
Leisure/games					

5. How long have you been using computers? _____ years

6. Do you feel comfortable using computers? Yes___ No ___

7. What is your age? ___ years

8. Which year of university are you in? (including years in programs other than nursing)

   Year _____

9. Please read the following:

"This is not a test; there are no right or wrong answers. The purpose of the scales is to measure the meaning that certain concepts have for individuals. On the next two pages you will find a concept to be rated and beneath it a set of adjective scales like the one shown in the example below. Here is how you use these scales.

Example: **Nursing**

Powerful:___:___:___:___:___:___:___: Weak

If you feel that the concept is **very closely** related to one end of the scale, you should place you mark as follows:

Powerful:_x_:___:___:___:___:___:___: Weak

or

Powerful:___:___:___:___:___:___:_x_: Weak

If you feel that the concept is **quite closely** related to one end of the scale, you should place your mark as follows:

Powerful:___:_x_:___:___:___:___:___: Weak

or

Powerful:___:___:___:___:___:_x_:___: Weak

If you feel that the concept is **only slightly** related to one end of the scale, you should place your mark as follows:

Powerful:___:___:_x_:___:___:___:___: Weak

or

Powerful:___:___:___:___:_x_:___:___: Weak

If you feel that the concept is **neutral, equally associated** with both sides of the scale, or is **completely irrelevant**, you should place your mark in the middle space as follows:

Powerful:___:___:___:_x_:___:___:___: Weak

Make an independent judgment on each descriptive scale. Do not try to remember how you marked similar items. Work at a fairly high speed, recording your first impression or feeling about an item. Do not skip any items. Do not put more than one mark on a single adjective scale."

(Allen, 1986)

Please complete the following scale.

Computer-Assisted Instruction

Rigid	:___:___:___:___:___:___:___:	Flexible
Useful	:___:___:___:___:___:___:___:	Useless
Stimulating	:___:___:___:___:___:___:___:	Boring
Meaningless	:___:___:___:___:___:___:___:	Meaningful
Pleasant	:___:___:___:___:___:___:___:	Unpleasant
Valuable	:___:___:___:___:___:___:___:	Worthless
Creative	:___:___:___:___:___:___:___:	Unimaginative
Impersonal	:___:___:___:___:___:___:___:	Personal
Efficient	:___:___:___:___:___:___:___:	Inefficient
Inappropriate	:___:___:___:___:___:___:___:	Appropriate
Comfortable	:___:___:___:___:___:___:___:	Uncomfortable
Nonthreatening	:___:___:___:___:___:___:___:	Threatening
Overpowering	:___:___:___:___:___:___:___:	Easy to control
Time-saving	:___:___:___:___:___:___:___:	Time-consuming

(Allen, 1986)

Thank you. Once you have completed these questions and this scale, please return this to Tracey before you leave.

Appendix F

Instruction Sheet (Control Group)

Thank you for your participation in this research study. You have been randomly assigned to the group of participants that is not required to complete any computer activity related to this study.

It is essential that you do not share this information or talk about anything related to the study with anyone else until you have completed the second questionnaire. Please be in class on to complete the second set of questions and your participation in this study. This is not a test and you will not receive a grade for your participation. After the second set of questions is completed by all participants, the computer modules will be made available for your use.

Thank you.

Instruction Sheet (E)

Thank you for your participation in this research study. You have been randomly assigned to the group of participants that works with the computer modules for adult health assessment skills. The following are the necessary instructions to access and complete the computer modules. You will be given a password. It is essential that you not give this password to anyone else, especially during the course of the research study. Please work with the computer modules for 1 hour during one of the scheduled lab times before you complete the second set of questions in class in one week. This is not a test and you will not receive a grade for your participation. Since this is research, it is important that you complete the assigned computer modules before returning to class to complete the questions.

The computer lab is located on the 5th floor of the Clinical Sciences Building in room 5-112. It is located to your left as you get off the elevators. The computer lab is available for your use during the following hours:

Wednesday, January 21, 1998	1300-1800 hours
Thursday, January 22, 1998	1200-1800 hours
Friday, January 23, 1998	0900-1700 hours
Saturday, January 24, 1998	1000-1400 hours
Sunday, January 25, 1998	1000-1400 hours
Monday, January 26, 1998	1400-1800 hours
Tuesday, January 27, 1998	1200-1800 hours
Wednesday, January 28, 1998	1300-1700 hours

If you are not able to attend the computer lab during these hours, please contact Tracey at 492-5531. Tracey will be at the computer lab during these hours and will give you a password when you arrive. Remember, you will only be working with the computer for 1 hour during this study. After the second set of questions is completed by all participants, more time with the computer modules will be made available for your use.

It is essential that you do not share this information or talk about anything related to the study with anyone else until your participation is completed. Please be in class on to complete the second set of questions and your participation in this study.

Thank you.

Appendix G

Code: _____

Please complete the following questions. All information will be kept confidential. Do not write your name on this sheet.

Please read the following:

"This is not a test; there are no right or wrong answers. The purpose of the scales is to measure the meaning that certain concepts have for individuals. On the next two pages you will find a concept to be rated and beneath it a set of adjective scales like the one shown in the example below. Here is how you use these scales.

Example: **Nursing**

Powerful:___:___:___:___:___:___:___: Weak

If you feel that the concept is **very closely** related to one end of the scale, you should place you mark as follows:

Powerful:_x_:___:___:___:___:___:___: Weak

or

Powerful:___:___:___:___:___:___:_x_: Weak

If you feel that the concept is **quite closely** related to one end of the scale, you should place your mark as follows:

Powerful:___:_x_:___:___:___:___:___: Weak

or

Powerful:___:___:___:___:___:_x_:___: Weak

If you feel that the concept is **only slightly** related to one end of the scale, you should place your mark as follows:

Powerful:___:___:_x_:___:___:___:___: Weak

or

Powerful:___:___:___:___:_x_:___:___: Weak

If you feel that the concept is **neutral, equally associated** with both sides of the scale, or is **completely irrelevant**, you should place your mark in the middle space as follows:

Powerful:___:___:___:_x_:___:___:___: Weak

Make an independent judgment on each descriptive scale. Do not try to remember how you marked similar items. Work at a fairly high speed, recording you first impression or feeling about an item. Do not skip any items. Do not put more than one mark on a single adjective scale."

(Allen, 1986)

Please complete the following scale:

Computer-Assisted Instruction

Rigid	:___:___:___:___:___:___:___:	Flexible
Useful	:___:___:___:___:___:___:___:	Useless
Stimulating	:___:___:___:___:___:___:___:	Boring
Meaningless	:___:___:___:___:___:___:___:	Meaningful
Pleasant	:___:___:___:___:___:___:___:	Unpleasant
Valuable	:___:___:___:___:___:___:___:	Worthless
Creative	:___:___:___:___:___:___:___:	Unimaginative
Impersonal	:___:___:___:___:___:___:___:	Personal
Efficient	:___:___:___:___:___:___:___:	Inefficient
Inappropriate	:___:___:___:___:___:___:___:	Appropriate
Comfortable	:___:___:___:___:___:___:___:	Uncomfortable
Nonthreatening	:___:___:___:___:___:___:___:	Threatening
Overpowering	:___:___:___:___:___:___:___:	Easy to control
Time-saving	:___:___:___:___:___:___:___:	Time-consuming

(Allen, 1986)

Thank you again for your participation in this study. Once you have completed these questions and this scale, please return this to Tracey before you leave. You will be contacted with the arrangements to use the computer modules.

Appendix H

LITERATURE REVIEW

Effect of Exposure to Computer-Assisted Instruction with CD-ROM Technology on Nursing Students' Attitude Towards Computer-Assisted Instruction

There are many challenges facing nurse educators in nursing education today. Limited resources, rapid increases in knowledge and skills to be learned (Hamby, 1986), as well as demands for greater educational accountability (Hamby, 1986; Hebda, 1988) are a few of the factors affecting nursing education. Other challenges include declines in enrollment and retention of nursing students (Napholz & McCanse, 1994), demands for greater accessibility to education (Sheridan, 1995), and demands for increased computer technological competence. The University of Alberta Senate Task Force (1995) recommended the incorporation of a "learner-centred instruction model which integrates multi-media and technology-based delivery methods with traditional classroom instruction to serve students who are locally, regionally, nationally, and globally based" (p. 3). This model of instruction is recommended to help meet the challenges of accessibility, changing student needs and populations, geographical diversity, cost-effectiveness, and time and space constraints associated with the educational needs of students. One method of instruction used in nursing and other disciplines to meet these diverse demands is computer-assisted instruction (CAI). Although CAI is an appropriate strategy for meeting a number of these challenges, it is essential to examine aspects of this instructional method and its effects on learning to ensure that it is an appropriate instructional method for students. One aspect of CAI that requires further research is student attitude towards CAI in nursing education. As advances in computer technology and education continue, research on this instructional method needs to be ongoing. The following is a review of selected literature from the disciplines of nursing and education. Attitude, learning, and CAI in nursing education are reviewed in terms of the literature and research. An overview of the outcomes for students, faculty, and organizations is included and directions for further research are proposed. Bloom's (1971) theory of mastery learning is also reviewed and described in relation to attitude and learning.

ATTITUDE AND LEARNING

Vast information on attitude and learning is identified in the literature. A review of literature from adult education and nursing was conducted. This review was limited to one specific focus: examination of attitude and learning in adult and nursing education.

Attitude refers to the reaction or response of an individual to an experience or object; (Brudenell & Carpenter, 1990; Calderone, 1994; Conklin, 1983; Cropley, 1977; Dickinson, 1973; Hamby, 1986; & Wlodkowski, 1985). Attitude is a learned predisposition to respond or react in a favourable or unfavourable way towards an experience, person, event, idea, or object (Calderone, 1994; Cropley, 1977; Dickinson, 1973; LeFrancois, 1994; Wlodkowski, 1985). "A useful functional definition of an attitude is that it is a combination of a perception with a judgement that often

results in an emotion that influences behaviour." (Wlodkowski, 1985, p. 73) LeFrancois (1994) added that attitudes have important motivational components.

Learning is described extensively in the literature. For the purposes of this literature review, learning is defined as a unique, internal, individual process which results in a change in behaviour in any or all of three domains: cognitive, affective, and psychomotor (Dickinson, 1973). Learning is not directly observable but the results of learning are (Dickinson, 1973).

Several authors identified attitude as an influencing factor affecting learning (Allen, 1986; Bloom, 1971; Conklin, 1983; Cropley, 1977; Dickinson, 1973; LeFrancois, 1994; Hamby, 1986; Knowles, 1984; Wlodkowski, 1985). Wlodkowski (1985) stated, "Attitudes are powerful influences on human behaviour and learning." (p. 46) Attitude towards the subject and learning situation will directly influence learning (Wlodkowski, 1985). A positive attitude enhances learning (Clark, 1984). Calderone (1994) stated, "A relationship is suggested between cognitive learning and attitude toward instructional media." (p. 166) Conklin (1983) and Hamby (1986) suggested that attitudes towards an instructional strategy are crucial to achievement and the learning process. Hamby (1986) further noted that because attitude influences learning rate, motivation, retention, and application, it is significant to the learning process.

Attitude has also been identified as a potential deterrent to participation in learning (Merriam & Caffarella, 1991). "The learner's attitudes towards the general learning environment, instructor, subject matter, and self" are essential components of a learning sequence (Wlodkowski, 1985, p. 61). If a learner develops a negative attitude to any of these four components, learning can be impaired. Also, students who have an unfavourable attitude to the learning environment may not even attend the classes or make use of the learning experiences available (Wlodkowski, 1985).

Other factors, in addition to attitude, affect student learning. Several authors identified the importance of the environment, method of instruction, and learning situation for learning. Davis, Alexander, and Yelon (1974) stated, ". . . a student is more likely to continue learning if instructional conditions are more pleasant" (p. 208). This idea is supported by other authors (Cross, 1981; Daines, Daines, & Graham, 1993; Knowles, 1984; Merriam & Caffarella, 1991; Rogers, 1989; Rogers, 1996; Wlodkowski, 1985). "Adults expect to enjoy their learning. They are unlikely to give up their time and money when the whole learning experience is dour, unexciting, and unenjoyable." (Daines, Daines, & Graham, 1993, p. 8) Cross (1981) and Scanlan and Darkenwald (1984) identified unsatisfactory methods of instruction as possible deterrents to participating in learning. Classes that are interesting, paced appropriately, encourage active involvement, and utilize different instructional techniques promote learning (Rogers, 1989). Cross (1981), Rogers (1989), and Wlodkowski (1985) add that situations which allow the learner to control the pace of the instruction improve the learning atmosphere and learning. These aspects of learning, as well as, method of instruction and learning environment, are important to consider when examining students' attitudes towards instructional methods.

COMPUTER-ASSISTED INSTRUCTION AND NURSING EDUCATION

Computer-assisted instruction is an instructional method that incorporates the use of computers into an overall teaching strategy. Allessi and Trollip (1985) identified four basic components of CAI: 1) information is presented or skills are modeled; 2) students are guided through the initial use of the information or skills; 3) students practice until familiarity or mastery is attained; and 4) students' learning is assessed. A review of the literature demonstrates that computers are used in education in the following ways: for practice only, in addition to other teaching methods, to complete practice exams and actual exams, to replace traditional lecture instruction, as a resource for students to access, or to provide simulations of 'real' situations the students may encounter. Incorporation of the computer into teaching methodology is varied, with many different applications being used. Also, factors such as content, graphics, and technological capability of different computer programs make research in this area difficult. It is important to consider the variability of these factors while reviewing the findings of the selected research articles. The many variables involved in these studies make it difficult to generalize the results.

Faculty members at the University of Alberta, Faculty of Nursing have collaborated with DataStar Education Systems and Services, Inc. to develop a series of health assessment computer modules designed to teach health assessment skills for use with adults. Variations of normal findings, age related changes, and differentiation between normal and abnormal findings are included. The computer instructional method incorporates CD ROM technology to "test current knowledge, identify learning needs, and direct the learner to learning resources for the acquisition of skill in health assessment" (information sheet, DataStar). The CAI modules incorporate text, coloured and rotatable visual graphic designs, audio, and running video to provide students with tutorial lessons and drill and practice exercises. The CAI modules are interactive in nature and allow the student to control the pace of the program, select the order of progression through the lessons, determine the times of access to the program, and review previously viewed modules. No research articles related specifically to the study of interactive CD ROM technology in nursing education were located. The absence of research may be due to the relative "newness" and availability of this technology.

Numerous advantages and disadvantages of CAI have been documented in the literature (Belfry & Winne, 1988; Cohen & Dacanay, 1992, 1994). Support for some of the positive aspects of CAI are included in the research reports, however, research findings on all proposed benefits of using CAI were either not found or not evident in the research studies examined. A review of the literature published between 1980 and the present was conducted to provide an overview of relevant research findings and descriptive information and to identify aspects of CAI which require further research. These articles were located through a computerized search of CINAHL and ERIC databases which was supplemented by a manual search. The research articles chosen for this review include studies conducted to examine the effects of CAI on education for nursing students with the following exceptions. Three of the articles include meta-analyses of a total of 87 studies. Two of these meta-analyses were conducted on the effects of CAI in education for nursing students and

the third meta-analysis involved studies examining the effects of CAI on education for students in health professions. One research article by Stoy (1991) included the effects of CAI when used for teaching paramedic and medical students.

Outcomes for Students

Achievement

Belfry and Winne (1988) conducted a meta-analysis of 11 research studies of computer assisted instruction in nursing research. Reports of student achievement on examinations were included in 10 of the 11 studies analyzed. All ten studies included reports that student achievement results on examinations were better with CAI; however, only four studies had statistically significant results. From this analysis, Belfry and Winne suggested that CAI is as effective for student achievement as traditional methods of instruction. Several other studies also support the finding that CAI is as effective as other traditional methods of instruction for student achievement on examinations (Day & Payne, 1984; Day & Payne, 1987; Hamby, 1986; Gaston, 1988; Larson, 1981; Kot, Skillen, & Wales, 1986; Schmidt, Arndt, Gaston, & Miller, 1991). Other researchers reported no significant differences in student achievement between students using CAI and students using traditional instructional methods when learning medical/surgical nursing content (Halloran, 1995), medication dosage calculation (Gilbert & Kolacz, 1993), fetal heart monitoring (Murray & Higgins, 1996), range of motion content (Nyamathi, Chang, Sherman, & Grech, 1989), or psychiatric nursing content (Perciful & Nester, 1996). In contrast, Stoy (1991) studied the use of CAI for teaching advanced airway management techniques to 91 paramedic and medical students and reported that students receiving traditional methods of instruction had a statistically higher mean on the results of their written examinations than students receiving CAI. These findings do not support the finding that CAI is as effective as traditional methods of instruction. Burns and Bozeman (1981) and Reynolds and Pontious (1986) suggested that CAI is more effective when used as a supplement, rather than as a replacement, to other instructional methods.

Cohen and Dacanay (1992, p. 264) reported that computer-based instruction (CBI) had a "relatively strong advantage" over conventional instruction methods in relation to the results of students on written examinations. This finding was generated from the meta-analysis of 47 studies examining the use of CBI in health profession education. These findings are the same as the findings reported in another meta-analysis of 29 studies conducted by Cohen and Dacanay (1994) comparing CBI with conventional teaching methods in nursing education. In 22 of the studies, students receiving CBI had higher examination averages with statistically significant results favoring CBI reported in six of the studies. Other studies in nursing which include reports that students using CAI have increased knowledge when compared to students exposed to other teaching methods are Conklin (1983), Goodman and Blake (1996), Pogue (1982), and Bratt and Vockell (1986). However, Conklin reported that the results in her study may have been due to design factors, although these factors were not specified.

Three research articles related to student achievement on psychomotor skills were reviewed. In experimental research, Kot, Skillen, and Wales (1986) studied the effectiveness of computer-managed learning (CML) compared with lecture when

teaching health assessment skills to post-RN students. They studied 46 students and reported that no significant differences were found between the CML (experimental) and lecture (control) groups on performance of psychomotor skills. Day and Payne (1987) reported similar findings when comparing the effectiveness of computer-managed instruction (CMI) (with laboratory demonstration) to lecture (with laboratory demonstration) on the performance of health assessment skills. They studied 99 first year baccalaureate nursing students and reported that no significant differences were found between the CMI and lecture groups on performance of psychomotor skills. Both studies included reports that CML/CMI were as effective as lecture when measured by students' performance of psychomotor skills. However, the effectiveness of the computer learning modules was not assessed independent of other teaching methodologies (laboratory demonstration). Stoy (1991) also studied the effectiveness of CAI on the performance of psychomotor skills. Stoy reported that students using CAI outperformed students using traditional teaching methods and that the results were statistically significant. It is important to note that the CAI module used in Stoy's study was an interactive video disc which provided actual simulations for student learning. This advanced technology may account for the differences in the results of these studies.

Other aspects of student achievement that CAI may improve include: problem-solving skills (Kilmon, 1996), critical thinking skills (Billings, 1984; Lowdermilk & Fishel, 1991; Napholz & McCanse, 1994), and clinical decision-making skills (Lowdermilk & Fishel, 1991). No relevant research could be found on the use of CAI and problem solving skills. When Lowdermilk and Fishel (1991) examined the effectiveness of CAI in the development of clinical decision-making skills, they found no significant differences in clinical decision-making skills or clinical grades between nursing students using CAI and those not using CAI. They also reported that their findings were limited by the use of a sample from one school of nursing. Perciful and Nester (1996) reported no significant differences in student achievement on critical thinking measures for students using CAI and students using traditional methods of learning. Napholz and McCanse (1994) suggested that improved critical thinking skills for nursing students using CAI may result from faculty having more time to spend interacting with students individually rather than the actual use of CAI.

Overall, the findings from the research studies that involved the effects of CAI on student achievement are varied. The effects of CAI on achievement factors such as acquisition of knowledge, performance of psychomotor skills, development of critical thinking skills, and retention of knowledge require further research to examine and establish the effectiveness of this instructional methodology.

Student Time Required for Learning

Several researchers have studied the impact of CAI on student learning time with varied results. Decreased learning time is one of many advantages of CAI identified in the literature (Billings, 1986; Lancaster & Willis, 1994; Lassan, 1989; Quinn, 1986). Reynolds and Pontious (1986) reported that CAI modules were found to be time and cost efficient for both students and faculty. Cohen and Dacanay (1992) reported the findings from a meta-analysis of nine research studies related to CBI and student learning time. Five of the nine studies included reports that students using

conventional instruction methods required more time to learn than those using CBI; however, only two of the studies reported statistically significant differences. Cohen and Dacanay caution that these significant findings were identified in "instructor-paced implementations of CBI" (p.268).

Other studies have shown a decrease in student learning time when CAI is used. Napholz and McCanse (1994) reported that nursing students using CAI met the course objectives for therapeutic communication more efficiently than those students not using CAI. They reported that the students using CAI had achieved the course objectives at a higher level within the first month of the semester when compared with the control group. Larson (1981) also reported that students who used CAI learned in less time than students using other learning methods. Nyamathi, Chang, Sherman, and Grech (1989) reported that students using CAI learned range of motion content "in about one half as much time" as the students taught by lecture (p. 500).

Other findings reported in the literature showed no significant differences in student learning time when comparing CMI/CML and lecture methods of instruction (Day & Payne, 1984; Kot, Skillen, & Wales, 1986). Thede, Taft, and Coeling (1994) reported that time was actually an obstacle in encouraging students to use CAI. Students did not want to use their time working with CAI unless they were assured that their time spent working with CAI was credited for their course.

Retention of Knowledge

The effect of CAI on the retention of knowledge has been examined in very few studies. Cohen and Dacanay (1994) reported, in their meta-analysis of 29 research studies, that only six of the studies addressed retention of knowledge following CAI and no significant results were found. This was congruent with their findings in the meta-analysis of 47 research studies reported in 1992. Eight of the 47 studies addressed retention of knowledge and CAI, but no significant results were found. Gaston (1988), Stoy (1991), and Nyamathi et al. (1989) reported that no significant differences were found between students using CAI or lecture in the area of knowledge retention.

Student Attitude to CAI

Numerous research studies include reports of students' attitude to CAI, however, it is difficult to analyze the findings. Many of the students' attitudes are reported as responses to open-ended evaluation questions which have not been subjected to validity or reliability tests. Several studies reported students' responses to CAI, after using CAI, obtained through course evaluations and through written feedback from the students. Examples of specific questions and responses, and attitudinal measures were not included in some of the articles. Although valuable and useful information may have been obtained from these reports, it is difficult to generalize these findings. Many of the researchers who examined students' attitude toward CAI using specific attitudinal measures used single group or posttest only designs which complicate generalizability and analysis.

Positive attitudes towards CAI. Goodman, Blake, and Lott (1990, p. 40) reported that students provided written feedback and evaluations that were "overwhelmingly positive" to CAI following the use of the CAI modules. This

information was obtained from students' feedback during evaluation of the CAI modules. Reynolds and Pontious (1986) examined CAI and medication dosage calculation competency with a sample of 143 nursing students. They reported that students chose to use CAI more frequently than other instructional methods which indicated that students "believed that learning by CAI was helpful, useful, and enjoyable" (p. 163). Specific attitudinal measures and statistics were not reported in this article. Halloran (1995) compared computer-managed instruction (CMI) to traditional instructional methods in a medical/surgical nursing course. Students' attitudes were assessed through course evaluations and were reported to be favourable toward the use of CMI. Halloran reported that students felt that CMI made the class "more interesting" and "highly organized" (p. 287). Specific examples of the questions asked and the students' responses were not included in this article. For learning drug dosage calculations, Thiele (1988) reported that students' attitudes toward CAI were "overwhelmingly positive". Comments such as "It was fun and it went fast.", "I like being able to do it at my own pace.", and "It was fun and easy to do; it also tested me so I knew if I really learned the material.", were reported on open-ended evaluation forms after the students had completed the CAI program. Gee, Peterson, Martin, and Reeve (1998) reported that CAI was "well received" by students using CAI to learn pharamacology. They used a two group, pretest-posttest design with 52 third year nursing students. Stoy (1991) reported that student attitude toward CAI were positive; however, specific measures and statistical significance were not reported. Some authors suggested that students have a more positive attitude towards CAI when they have previous experience working with computers (Schwirian, Malone, Stone, Nunley, & Francisco, 1989; Wong, 1990) and that students' attitudes shift positively after computer use is initiated (Hamby, 1986; Reynolds & Pontious, 1986; Thiele, 1988).

Other researchers have also measured attitude to CAI using measures different from open ended questions and course evaluations and found that students' attitudes toward CAI were positive. Russell, Miller, and Czerwinska (1994) used Allen's Attitude Toward CAI Semantic Differential Scale (Allen, 1986) to measure students' attitude toward CAI. Using a single-group, posttest research design, they examined the use of CAI for teaching epidemiology to a sample of 106 baccalaureate nursing students. They reported that students' attitude toward CAI was positive; however, did not report statistical significance of these findings. McFarland (1993) used a modified version of Allen's Attitude Toward CAI Semantic Differential Scale (Allen, 1986) to measure students' attitude towards CAI and reported that students' attitudes were positive. The significance of these findings was not reported. Students did, however, recommend that CAI not be a required component of the course. This latter information was collected through qualitative methods. Wong (1990) also used a modified version of Allen's scale and reported positive attitudes of students towards CAI for learning drug calculations. Wong utilized a two group, posttest design and reported significant findings in the attitudinal measures of comfort and function. The students reported that CAI was "useful, valuable, time-saving, meaningful, appropriate and motivational" (p. 279)

Gaston (1988) used a two group posttest design to study knowledge, retention, and attitude effects of CAI for learning nursing research. Gaston used a 7-point

semantic differential scale with 17 attitudinal measures and reported that students' attitude toward CAI was positive. Students using CAI had significantly higher scores on the attitudinal measure than students not using CAI.

Bratt and Vockell (1986) studied the use of CAI to teach basic facts in nursing and utilized a two group design to examine effectiveness of CAI. A 15 item Likert scale was administered to the experimental group to "determine their subjective reactions toward the CAI programs" (p. 249). Bratt and Vockell reported that students' reactions to CAI were "overwhelmingly positive". In the students' open-ended comments, they indicated they liked the programs because of their convenience and feedback, and because they were different from traditional instructional methods. Students also enjoyed getting experience with the computers.

Lowdermilk and Fishel (1991) developed a 36 item, Likert type, attitudinal and evaluative questionnaire to assess students' attitude toward CAI. They also used an open ended "best aspects" and "worst aspects" of CAI questionnaire to determine students' attitude towards CAI. The responses of the students were "varied" (p. 38) but the majority of the students who used CAI found the experience to be enjoyable and helpful. The researchers cautioned that the "novelty effect of using computers for learning may account for some of the positive attitudes about the experience" (p. 38).

Cohen and Dacanay (1994) found four studies in their meta-analysis of computer-based instruction in nursing education that examined student attitudes toward CBI. "In all four of these studies, CBI students had more positive attitudes toward their instructional method than students taught conventionally." (Cohen & Dacanay, 1994, p. 91) One of these studies demonstrated a statistically significant difference between groups in favour of CBI. Specific measures and methods used in the studies were not reported in this meta-analysis. Belfry and Winne (1988), in their meta-analysis of 11 studies, found two studies that measured student attitude towards CAI. They reported that nursing students tended to have positive attitudes toward CAI, "although no statistically significant differences were found between treatment and comparison groups in the two studies" (p. 82). The specific measures used were not reported in this article.

Only Hamby (1986) used a two group, pretest, posttest design to study the effects of CAI on the attitude and achievement of 64 vocational nursing students. Hamby reported a significant difference in attitude toward CAI between control (students not using CAI) and comparison (students using CAI) groups. Also, Hamby reported that students using CAI had higher posttest attitude measures but that these differences were not statistically significant.

Negative attitudes towards CAI. Conflicting findings related to student attitude to CAI were also reported. Day and Payne (1984, 1987) reported that student attitudes to CMI for learning health assessment were negative. They used a 7-point semantic differential scale with 17 attitudinal measures to determine students' attitudes toward CMI. Both studies were a two group, posttest design and indicated that students' attitude toward CAI was negative. These findings were supported by Brudenell and Carpenter (1990) and Baldwin, Johnson, and Hill (1994). Brudenell and Carpenter (1990) used a one group, pretest-posttest design to see if there was a relationship between learning style and attitude toward CAI. They measured students' attitude using a 24-item adjective scale and reported that subjects had significantly

less favourable attitudes toward CAI at the posttest measurement. Baldwin, Johnson, and Hill (1994) used a 12-item Likert scale and a qualitative questionnaire to measure students' attitudes toward CAI for learning basic psychomotor skills. The researchers administered the scale to 39 nursing students after completion of the CAI modules and reported that students were "overall dissatisfied" with CAI (p. 191).

Paulanka (1986) reported that the overall attitude of students towards working with CAI for psychopharmacologic lessons were negative. These data were collected through questionnaires using a 4-point Likert-type scale which measured students' agreement or disagreement with attitudinal statements about the system (Paulanka, 1986). One of the contributing factors to the students' negative attitude to CAI was the lack of interaction with faculty members. Students preferred faculty demonstrations when learning basic psychomotor skills (Baldwin, Johnson, & Hill 1994). Farabaugh (1990) suggested that students seem to be becoming bored with CAI and that attention to maintaining interest in CAI is needed.

Other Outcomes for Students

Other positive outcomes identified in the literature for students using CAI include: convenience (Breckon & Pennington, 1986; Kilmon, 1996; Lancaster & Willis, 1994; Schmidt & Fisher, 1993; Seigel, 1993), privacy for learning (Billings, 1986; Kilmon, 1996; Lancaster & Willis, 1994), opportunity for immediate feedback (Criddle, 1995; Lancaster & Willis, 1994; Lassan, 1989; Thede et al., 1994), individualized instruction (Billings, 1986; Breckon & Pennington, 1986; Criddle, 1995; Goodman, et al., 1990; Lassan, 1989; Quinn, 1986), increased motivation to learn (Billings, 1986; Brown, 1986), variety of instruction (Criddle, 1995; Thede et al., 1994), increased comfort with computers (Napholz & McCanse, 1994), and opportunity to interact with the computer (Bruder, 1991; Bosco, 1984; Breckon & Pennington, 1986; Cordell & Greaf, 1988; Rothrock, 1985; Thede et al., 1994). Burns and Bozeman (1981) suggested that CAI provides a stimulating, multisensory environment for learning. Another advantage of CAI identified is that the learner controls the pace (Billings, 1986; Breckon & Pennington, 1986; Quinn, 1986).

Disadvantages identified in the literature for students using CAI include: impersonal method of instruction (Billings, 1986; Kilmon, 1996; Parker, 1984), lack of interaction with other students (Lassan, 1989; Simpson, 1986), difficulty in accessing a hard copy to work with (Thede et al., 1994), and the effects of machine-human relations in learning (Quinn, 1986). However, Simpson (1986) and Johnson and Johnson (1985) reported that interactivity between students increases when small groups of students work at one computer terminal. Research studies examining these specific advantages and disadvantages could not be located for this review.

Overall, the findings from the research studies related to student outcomes are varied, specifically the research findings on student attitude toward CAI. It is evident from the literature that attitudes toward instructional methods affect learning and it is imperative that student attitude toward CAI be further researched. Thomas (1988) reported that even though attitude change has been measured and "reported in several publications, change has been difficult to assess because the authors either did not use pretests or used posttest-only designs" (p. 123). It is essential to note that many reports of students' attitudes towards CAI are recorded using open-ended

questionnaires or as part of the overall course evaluation. Another problem with inferring from the data and comparing results on attitude towards CAI is that many different measures have been used in the different studies (Thomas, 1988). As recently as 1994, Baldwin et al. stated, "The ambiguity of findings regarding attitudes toward CAI and the projected increased use of CAI in future nurse education programs support the need for further exploration of student attitudes toward CAI." (p. 189) In summary, it is evident that more rigorous research is required to examine student attitudes towards CAI. A two group, pretest-posttest design with a reliable and valid attitudinal scale is required to advance knowledge about student attitudes toward CAI in nursing education.

Outcomes for Faculty

Faculty Time for Teaching

More efficient use of faculty time has been identified in the literature as an advantage to using CAI (Billings, 1986; Kilmon, 1996; Lancaster & Willis, 1994; Gleydura, Michelman, & Wilson, 1995; Schmidt et al., 1991). Few studies actually examined the impact of CAI on the use of faculty time. Kot, Skillen, and Wales (1986) reported that faculty time expenditures were less for the CML group than for the lecture group. These findings were supported by Day and Payne (1984, 1987) and Perciful and Nester (1996). Other researchers addressed this potential outcome in terms of decreased student learning time resulting in reduced instructor time but no specific measures were reported.

Other Outcomes for Faculty

Additional positive outcomes reported for faculty members using CAI include consistency of instruction (Billings, 1986; Bosco, 1984; Lancaster & Willis, 1994), rapid calculation of marks, and decreased record keeping time (Bolwell, 1988; Criddle, 1995). However, research on these specific outcomes was not located in this literature search.

Outcomes for Institutions

Cost Efficiency

Many authors suggested that CAI is more cost-effective than traditional instructional methods (Billings, 1986; Criddle, 1995; Gleydura et al, 1995; Hamby, 1986; Hebda, 1988; Paulanka, 1986; Reynolds & Pontious, 1986), but actual cost analyses would need to be conducted to determine if this is a real advantage of CAI. Some of the advantages and positive outcomes affecting students and faculty would have overall inferential benefits to the institution. Also, increasing the availability of instruction to students in varying locations and at varying times may be beneficial to educational institutions in the areas of recruitment and retention of students; however, actual research studies into the organizational outcomes for CAI have not been located. The possible organizational benefits of CAI could be researched further, especially considering recent funding reductions.

In summary, the use of CAI in nursing education needs further research to address its effects on students, faculty, and educational institutions. With the many challenges in nursing and nursing education today, it is essential to ensure that

appropriate methods of instruction are utilized to deliver effective education programs for nursing students.

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Appendix I

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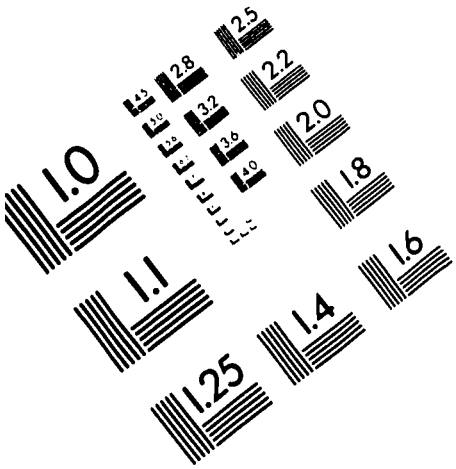
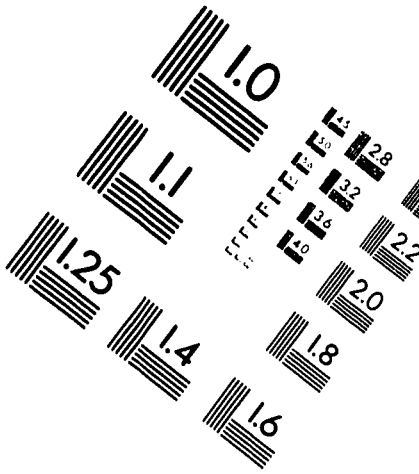
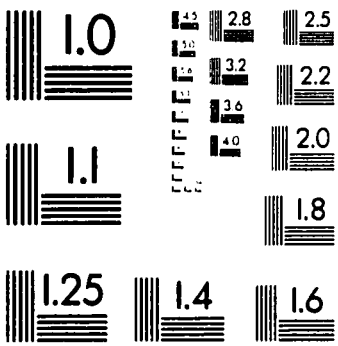
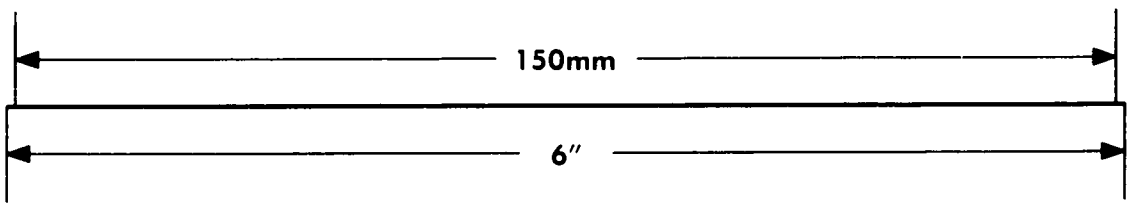
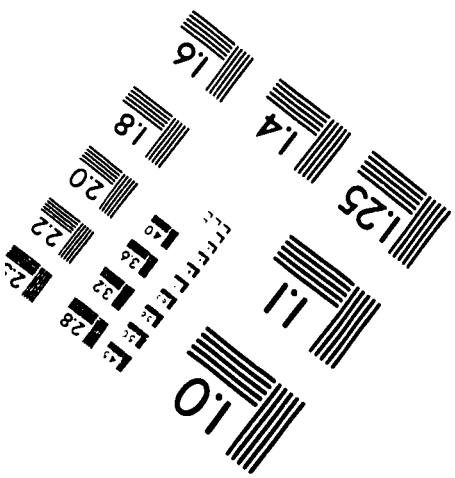
IMAGE EVALUATION
TEST TARGET (QA-3)

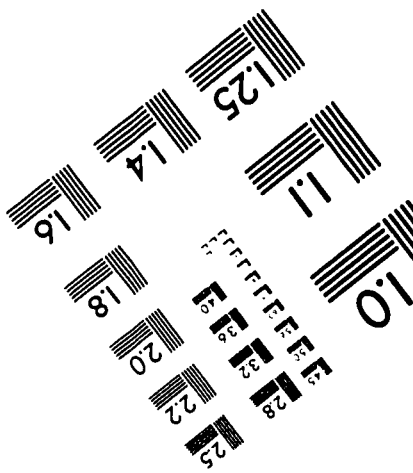












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1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
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