FORMATIVE EVALUATION OF COMPUTER ASSISTED INSTRUCTION ON COMPUTER LITERACY

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

IN THE GRADUATE SCHOOL OF

TEXAS WOMAN'S UNIVERSITY

COLLEGE OF HEALTH SCIENCES

BY

LYNN L. MILLER, B.S., M.S.

DENTON, TEXAS

DECEMBER 1997

TEXAS WOMAN'S UNIVERSITY

10-20-97
(Date)

To the Associate Vice President for Research and Dean of the Graduate School:

I am submitting herewith a dissertation written by Lynn L. Miller entitled "Formative Evaluation of Computer Assisted Instruction on Computer Literacy." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Health Education.

Major Professor

We have read this dissertation
and recommend its acceptance:

Brad Doyle

Susan Ward

Roger Shipley

Susan Ward
Chair, Department of Health Studies

Accepted:

Dean, College of Health Sciences

Leslie M Thompson
Associate Vice President for Research and
Dean of the Graduate School

ACKNOWLEDGMENTS

The process of writing this dissertation was only possible with the encouragement and support of family, mentors, and friends. I am very grateful and would lie to acknowledge each of them.

Mike, my husband, deserves special recognition for listening to me when I needed a sounding board and for his support, both financially and emotionally, through the tough times while I worked toward this very important personal and professional goal. He was always there to provide a word of encouragement when I had my doubts.

Many faculty members provided the support and knowledge that I needed during this learning experience. I would lie to thank my committee chair, Dr. Judy Baker, for her support, her great ideas, and most of all for her expertise as a researcher, writer, and CAI developer. She made the writing aspects a positive experience. She provided encouragement and showed me what a good teacher is, beyond what goes on in the classroom. I would also lie to thank Dr. Susan Ward. She provided her support and her friendship. She told me of her struggles, giving hope that I too would succeed. Dr. Eva Doyle was there to joke with and to talk "shop." She rendered an excellent example of "what I want to be when I grow up." Dr. Roger Shipley provided the experience of guiding students to search and learn on their own, above what is furnished in the classroom.

ABSTRACT

COMPLETED RESEARCH IN HEALTH SCIENCES
Texas Woman's University, Denton, Texas

Miller, L. L. Formative Evaluation of Computer Assisted Instruction on Computer Literacy. Ph.D. in Health Education, 1997, pp. (J. Baker)

The purpose of this study was to conduct a formative evaluation of a computer assisted instruction (CAI) module on computer literacy among undergraduate community health majors. This was a qualitative study. Subjects utilized a CAI module on computer literacy for health educators, developed by the investigator using Authorware Star for Windows, Version 2.2.0 Academic. The subjects provided feedback on the module through investigator observation and in interviews. The subjects for this study comprised a convenience sample of 28 students enrolled in undergraduate Health Studies courses at Texas Woman's University (TWU), recruited as volunteers in the spring semester of 1997. The first five participants comprised the pilot test group. Evaluation criteria developed by Barker and King (1993) for interactive multimedia courseware were used by the subjects in this study as a checklist for evaluating the CAI module during use and the interview process. Content analysis was conducted on data collected in the interviews. Notes and transcripts were coded to identify consistent comments, then further analyzed to determine patterns in the responses. Pearson correlation coefficients were calculated to determine the relationship between time spent using the CAI module and the amount of topics chosen.

The relationships between the amount of time spent using the CAI module and previous computer experience or training and between topic selection and previous computer experience or training was determined by calculations using a 1-sample independent t-test and chi-square test, respectively. A significant difference was found between having previous computer training or not in terms of the amount of time spent using the module, $t(26) = 2.08$, $p < .05$. There was a direct relationship between time spent using the module and the amount of topics chosen ($r=0.813, p<.001$). A significant difference was found between having previous computer training or not in terms of the topics selected, $\chi^2(61) = 624.22$, $p < .01$. In general, the participants perceived the CAI module positively. Some of the participants expressed negative perceptions about the mechanics of navigating in the program. The negative perceptions seemed to have no relationship to previous computer experience or training, time on task, or topics viewed.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Computer literacy and computer skills are becoming increasingly important for the effective practice of health education in our technology-based society. While many of the technological skill requirements will change over time, basic computer literacy will remain essential.

Computers are tools for processing information. They provide a mechanism for locating, capturing, organizing, and disseminating information (Sternin, 1996). As such, the computer is an effective tool for health educators. Professional preparation of health educators must address the need for awareness of the role technology will play in the practice of health education.

Health education preparation programs can meet this need in several ways. One of the more efficient ways is through the use of computer assisted instruction (CAI). CAI is the use of computers and multimedia technology for instruction in a way that promotes both student interest and motivation. The computer's multimedia capability to show graphics, run simulations, and play sound, video, and animation greatly strengthens the learning experience. Multimedia creates a complete multi-sensory learning program, allowing students to interact with the material and to learn according to their own needs, pace, and learning styles (Infopoint, 1996).

Due to the lack of research examining the use of CAIs in health education and because of the ever increasing need for computer skills in our technologically growing society, this study focused on the evaluation of a CAI module on computer literacy.

Statement of the Problem

This was a formative evaluation of a CAI module on computer literacy as an instructional tool for undergraduate community health majors. Students enrolled in undergraduate Health Studies courses at Texas Woman's University (TWU) utilized a CAI module on computer literacy developed by the investigator. The students provided feedback on the module through investigator observation and interviews.

Purpose of the Study

The purpose of this study was to conduct a formative evaluation of a CAI module on computer literacy among undergraduate community health majors.

Research Questions

The following research questions were addressed:

1. How did undergraduate community health majors utilize a computer literacy CAI module in terms of time on task and topic selection?

2. What were the perceptions of undergraduate community health majors of a computer literacy CAI module following their use of the CAI module?

Definition of Terms

The following terms are operationally defined for this study:

1. Authoring language. Programming language that has been designed specifically for creating instructional software (Whiteside & Whiteside, 1987/88).

2. Authoring system. A software package that guides the author through the programming process by mediating between the author and a high-level programming language (Whiteside & Whiteside, 1987/88).

3. Authorware. A software package developed my MacroMedia (TM) for the development of instructional programs.

4. CD-ROM. Compact Disc Read Only Memory. Software is stored on the CD-ROM and can only be read and not modified.

5. Computer-assisted instruction. The use of computers and multimedia technology for instruction in a way that promotes student interest and motivation (Infopoint, 1996).

6. Computer literacy. The extent to which an individual has a general working knowledge of computers. Examples may include knowledge of hardware and software programs, as well as the skills to use them (Agho & Williams, 1995).

7. Disk. Software can be packaged on a floppy disk but it cannot hold as much information as a CD-ROM. Data can be modified on a disk.

8. Learning styles category. Views held by the learner and designer about the conceptual learning model and design aims of the product (Barker & King, 1993).

9. Programming language. Computer language used to create computer software. Examples are BASIC, Pascal, Forth, and C.

10. Sound card. A sound card improves the sound quality of a computer. Without a sound card, a computer can only produce beeps and muffled sound through an internal speaker (IDG's 3-D Visual Series, 1995).

Assumptions

For the purposes of this study, the following was assumed:

1. The subjects expressed their opinions honestly during the interviews.

Limitations

The study was limited by the following:

1. The sample is one of convenience and predominantly female, thereby limiting generalizability of the results.

2. The size of the convenience sample was determined by volunteers recruited from students enrolled in Health Studies undergraduate classes during spring 1997.

3. Subjects had a variety of prior cognitive and emotional experiences with CAI and computers which may have influenced the results.

Delimitations

The study was delimited by the following:

1. The sample used was one of convenience, consisting of TWU students enrolled in undergraduate Health Studies courses in the spring 1997 semester.

2. The subjects were able to read and operate a mouse in a Windows environment.

3. All subjects were at least 18 years of age.

Significance and Background

When it was recognized that computers were capable of more than mere calculations, educators considered the possibility of CAI as a means to improve human learning. Efforts to use CAI began as long ago as the 1960s (Jaffe & Lynch, 1995). The early CAI programs failed to gain popularity because the technology relied on costly mainframe computers. Professional programmers were needed for the complex computer operating systems, putting the educators out of the development process.

Educational and computer technologies have advanced tremendously during the last 20 years. These technologies serve as valuable health education tools, for instruction as well as for many other utilities. Computers may be used by the individual or by small groups, and in a variety of settings. They are used for applications such as health risk assessment, health education games, and statistical analysis. These applications may utilize multimedia, including sound, video, and animation. This can be done for a specific target population at relatively low cost if the hardware and software are available

(Gilbert & Sawyer, 1995). Computers are easier to use than previously, which enhances their use with children and intimidated adults. Computers can be fun to use and are valuable motivation tools in the classroom (Gold, 1991). Computers offer privacy and tailored programming for individual users. With the use of a modem and the Internet, the user can access a worldwide system of databases and expertise. Computers are also used for desktop publishing, enabling the user to develop low-cost, target-specific, high-quality publications.

Along with the benefits of the computer come disadvantages. Although greatly reduced in price compared to a few years ago, computers are still relatively expensive, limiting accessibility to many. One computer per person is often not possible, and having three or four individuals crowded around one monitor can disrupt learning (Gilbert & Sawyer, 1995). Computer equipment, both computer models and software, can vary greatly. This becomes a problem because not all people are familiar or comfortable with the same computer equipment and/or software. Learning may be hindered by the barrier of mismatch between resources and abilities.

A computer literacy policy, usually met through a required single course, has been put into effect by most colleges and universities (Butler, 1997). Because technology continues to change rapidly, much of the information students learn may be obsolete by the time they graduate. Teaching computer basics and technology assessment, both hardware and software, will prepare students to adapt to and learn new technology.

Internet applications and online services are constantly evolving. The future use of this technology is difficult to predict. Many individuals cannot stay competitive in the workforce if they don't stay educated on technological changes (Butler, 1997). One type of distance learning employs the Internet to increase instructional effectiveness and opportunities.

While many health educators will evaluate existing health education software in order to determine if it meets their standards and needs (Butler, 1997), others may develop their own educational software, possibly because they cannot find quality health education software to meet their needs. Both options require computer literacy and skills.

Health educators often have difficulty finding appropriate CAI programs that meet their objectives, setting, and available hardware. Under such circumstances, health educators may choose to develop their own CAI programs. Yet the costs can still be very high, both in money and time. Currently, CAI programs are used in school settings more often than in community settings (Gilbert & Sawyer, 1995). Many people have computer access at home and if the program could be distributed, this could be a major way to reach large numbers of people. Apple Macintosh and IBM and compatibles dominate the market and software would need to be compatible to support a large audience.

The advantages of CAI programs over other means of instruction are numerous. They can be fun, actively involving the users in the learning process. CAI programs

provide almost immediate feedback and allow for individualized, self-paced learning. Some applications such as simulations require higher-level thinking and can be used to reinforce other teaching strategies.

But with these advantages come disadvantages related to CAI program use. CAI programs can be expensive and intimidating to inexperienced computer users. They may require special equipment, software, and computer training.

CAI has existed for more than 30 years and can provide individualized, interactive, and guided learning experiences that are not possible with other media (Miller, 1995). CAI is perceived as individualized because the computer serves as a tutor for one individual. It is interactive because it involves two-way communication between the student and the computer.

CHAPTER II

REVIEW OF LITERATURE

This chapter will review literature concerning computers in health education, instructional software characteristics, CAI effectiveness, and health education CAI criteria and development.

Computers in Health Education

Many individuals, including college students, find themselves disadvantaged in the world that favors those with computer skills (Sternin, 1996). In coming years, an increasing proportion of students will already have a set of basic computer skills when they reach college, either through high school training or self-study. Many employers are anxious for their workers to have computer skills, because offices are less competitive without employees who are well versed in basic computer skills (The Internet Public Library, 1995). Manufacturers, who increasingly rely on automation, need workers with these skills. The service industry uses computers in many of their applications. According to Gold (1991), computer literacy will be a basic competency for all health educators. This competency is listed on the new advanced level list of core competencies (AAHE/SOPHE Joint Committee, 1996).

Gilbert (1991) examined the use of personal computers in instruction in the 50 largest undergraduate health education programs in the U.S. Gilbert found a significant number of CAI programs available mostly for Apple II series computers (n=188) and IBM compatibles (n=184). Because the equipment was outmoded, software programs

were difficult to purchase. Health risk appraisals and nutrition analysis programs were used most frequently. Most of the instructors wanted to obtain high quality software. They did not utilize CAI programs because they lacked access to hardware and software, knowledge of program sources, motivation, and adequate training.

Zannis (1992) researched the use of computers by graduate health education program faculty in the U.S. Five hundred fifty-six faculty members participated. Uses include word processing (92%), spreadsheets (51%), databases (46%), on-line databases (58%), electronic mail (44%), bulletin boards (23%), simulations (16%), health risk appraisals (39%), dietary analyses (30%), drill and practice (23%), mainframe statistics (64%), and personal computer statistical packages (47%).

Increasingly, health educators are realizing the potential of computers and are using them in a variety of applications (Sarvela & Karaffa, 1990). Integration of computer technology into curricula involves both hardware and software systems. Even though there has been an increase in the quantity and variety of software for health education, one of the biggest problems facing health educators who try to use CAI is the shortage of high quality educational software (Twigg, 1996). Therefore, health educators sometimes find it desirable to develop CAI programs to meet a specific need. Because many health educators do not have computer programming skills at the level necessary to develop high quality software, authoring systems can serve as an excellent alternative.

Authoring systems are software packages that are designed to create CAI programs through a process of mediation between the author and a high-level computer programming language. But before health educators can develop educational software they must become computer literate. One approach to meeting tailored computer literacy training needs is the development and evaluation of a CAI programs designed specifically for health educators.

Effectiveness of CAI

CAI may be beneficial in teaching students clinical reasoning skills (Raidl, Wood, Lehman, & Evers, 1995). Medical schools have developed CAI programs that teach students clinical reasoning skills needed when taking medical histories and treating patients. Nardone, Schriner, Guyer-Kelley, and Kositch (1987) found that CAI can be used effectively with medical students to teach them how to collect appropriate information from a medical chart and during a physical examination. CAI enables the instructors to document how students utilize medical information when evaluating a problem. Instructors can therefore gain insight into students' thought processes and clinical reasoning skills.

The software used to supplement college-level nutrition instruction includes both CAI and information databases. Most nutrition CAI has been used to supplement college-level introductory nutrition courses (Raidl et al., 1995). It has been found through research that students enjoy using CAI and have higher test scores (Byrd-Bredbenner & Bauer, 1991; Carew, Elvin, Yon, & Alster, 1985). But most of the

nutrition software are not CAI. They are aids for nutrient analysis and menu planning, not instructional programs that provide information on the concepts of nutrition science or diet counseling (Caster, 1984).

According to Carlton (1991), as reported in the JRCERT Handbook for Educational Programs, students in subject areas such as liberal arts may not benefit as well from CAI used to supplement traditional teaching methodologies as students in health professional programs. CAI provides students with information directly related to their discipline. CAI is competency-based, a familiar format for most students in allied health disciplines. Carlton suggests that CAI probably will not succeed if students are not computer literate and if there is no provision for providing assistance as problems arise.

In a meta-analysis of studies of CAI in the health professions, Cohen and Dacanay (1994) reviewed achievement effects and other factors such as long-term retention and attitudes toward content, instructional method and computers. They analyzed 47 studies, 10 of which were classified as allied health studies. A previous review of 65 studies showed an average effect size of 0.63, which favored CAI over traditional teaching methods. In 32 of the 47 studies, students using CAI had higher examination averages; their averages were significantly higher in 13 of the studies. In studies in which an effect size could be determined, students using CAI scored at the 66th percentile of the students in the conventional group.

Montelione (1984) examined the effectiveness of CAI in increasing knowledge concerning behavior management techniques for the physical education setting. The researcher compared the effectiveness of CAI and lecture instructional techniques.

A purposive sampling design was used to select the subjects. The subjects were 57 undergraduate students at Southwest Texas State University at San Marcos. The three-group experimental design was used with 19 subjects randomly assigned to each of three groups (CAI, lecture, and control). The experiment lasted 2 weeks with both treatment groups receiving a total of 4 class hr of instruction. Pretest and posttest data were collected by a multiple choice test on behavior management that was developed by Montelione (1984). A panel of five experts from five states was selected to evaluate the content validity of the test questions. To determine reliability, the test was administered twice within the same week to a group of 30 persons. Test-retest reliability was computed by use of the Pearson product-moment correlation, ($r = .87$, $p < .01$).

A one-way analysis of covariance was computed using the pretest scores as the covariate. The findings revealed that there was a significant difference among the adjusted posttest means of the test scores, $F(2, 36) = 15.57$, $p < .01$. The null hypothesis of no significant difference between the adjusted posttest means was rejected. The Scheffe' post hoc test was computed to determine where the differences were. Both the CAI and lecture groups' adjusted posttest means were significantly higher than those of the control group. Additionally, the CAI group's adjusted posttest mean was significantly higher than the lecture group's adjusted posttest mean.

Montelione (1984) concluded that a 4 hr program of instruction in behavior management techniques, using either CAI or a traditional lecture format, is effective in improving scores on a multiple choice test of knowledge of behavior management techniques. CAI is more effective than the traditional lecture method of instruction.

Paperny and Starn (1989) studied the use of CAI for the prevention of teenage pregnancy. The study was based on the assumption that adolescents enjoy animated-action computer games that capture and hold their attention. The CAI program used in this study is an interactive trial and simulates reality. Teenagers search and select alternatives and outcomes, and experience the results of their behavioral choices. Two games, The Baby Game! and Romance!, were developed and present the impact and cost of sexual behaviors and parenthood. The games also teach sexual survival skills.

Subjects were 718 teenagers in high school. Half of them used the CAI game programs and half served as the control group that did not use the programs. Tests were developed to measure the effectiveness of these games and were based on the content presented in the games. Nineteen factual and psychological factors related to pregnancy and parenting were measured for both control and treatment groups.

The students evaluated the games positively. The teenagers who played the games gained significantly more knowledge and positive attitude changes than the control group. The Baby Game! players increased their knowledge of the consequences of birth and the financial and time costs of raising a child. The students who viewed Romance! sought more professional help, understood the risks of pregnancy better,

learned more effective contraceptive methods, and used oral contraceptives more often. Both teachers and students felt the computer games were fun and acceptable. The games also reduced the counseling needed from physicians.

Paperny and Starn (1989) concluded that CAI is an effective way to provide health education, and is an especially useful means of adolescent pregnancy intervention and prevention. This was based on the positive results of the study.

McNeely (1989) examined the potential of CAI as a health education method with older adults. The study was designed to (a) evaluate the effectiveness of CAI and evaluate the effectiveness among three variations of interactive feedback within a computer lesson by measuring learner achievement, (b) determine older adult opinions about computers and computer learning before and after an experience with a computer lesson, and (c) describe the relationship between social and demographic factors and the use of computer instruction. The rationale for the study was that CAI is an accepted teaching strategy with a younger population but has not been utilized with the older adult learner. Previous studies have shown that older persons are receptive to technology when it supports or enhances their lives.

McNeely (1989) authored three versions of a CAI health lesson. The versions varied in the techniques used for interactive feedback. The different feedbacks included: (a) corrective feedback without remediation or reinforcement, (b) feedback utilizing drill and practice for remediation and reinforcement, and (c) feedback putting examples side by side for remediation and reinforcement. The subjects were randomly assigned to one

of the three versions. A pretest and posttest were part of the computer lesson. Three instruments were developed to collect data for this study. The investigator collaborated with testing experts, as well as curriculum and instruction design experts. Each instrument was field tested and revised according to relevant findings. The pretest and posttest measured learner achievement. Before and after the lesson, each subject was asked to fill out a 10-item computer opinion survey. Demographic information was obtained during the intake interview. The subjects (N = 120) ages ranged from 60 to 89 years and were a convenience sample residing in a Southern metropolitan area. The gender distribution was 81% female and 19% male. The ethnic origins were 89% European American and 11% African American. The education level of the subjects varied widely: (a) 23% had not graduated from high school; (b) 19% were high school graduates; (c) 46% had attended some college; and (d) 12% were college graduates. The study was conducted at six older adult meeting sites.

The data provided from the study included: (a) scores from the pretest and posttest knowledge on stroke, (b) computer opinion survey scores, and (c) demographic and social information. The difference in mean scores of the knowledge and opinion pretest and posttest was significant, $t(119) = -7.56$, $p < .05$. The ANOVA to test the change score among the three versions for knowledge was not statistically significant, $F(2, 117) = .6932$, $p < .05$. The computer opinion survey scores showed a significantly

positive increase after the lesson t (119) = -15.17, $p < .05$. There were no significant correlations between age, gender, education level, or previous computer use and gain in scores.

McNeely (1989) concluded that older adults can successfully use the computer and are able to improve their knowledge about health with a CAI lesson. The subjects' computer opinions indicated acceptance and enthusiasm for computer use. McNeely recommended further research and development of health education CAI for older adults.

In 1992, Kumar performed a study to determine which of three methods, traditional paper prose text, passive noninteractive computer presentation, and overt-interactive computer presentation, is most effective. Kumar also wanted to determine whether these methods affect behavioral change toward compliance based on medical community recommendations. The content promoted cancer prevention.

Subjects, 90 upper division university students with education majors from the University of South Florida, were assigned into groups to evaluate three different ways of presenting the basic principles of diet, nutrition, and cancer. The students were recruited from an undergraduate education psychology class. The subjects were 72% male and 28% female. The racial make-up of the subjects was 92% European American, 3% African American, and 5% Hispanic. The ages were grouped as follows: (a) 28% were <20 years of age; (b) 64% were 21-30 years of age; and (c) 8% > 30 years of age. The program instruction was incorporated into the course. The students were monitored

for knowledge gain using a single 50-item test and an application task which consisted of using a 4-day diet record, administered before and after the intervention. One group of students read a prose text of materials. A second group received computer-presented, programmed frames. There were no response blanks in either method. Students in the third group worked through the same programmed instruction but filled in missing blanks with corrective feedback.

The means of measured variables were compared between groups utilizing a one-way ANOVA. A multiple regression model using a backward stepwise technique for variable selection was used to predict the dependent variables that were fat intake and test scores from demographic independent variables such as experimental group membership, time taken to complete program, grade point average, age, race, and parent history.

Based on the results of the study, Kumar (1992) concluded that opportunities to construct answers to program blanks produce more knowledge than passive reading from a prose text or a computer frame series with no response blanks. The students who were able to respond to program blanks also lowered their group fat intake by 41.8% compared to 26.1% reduction in the noninteractive group and 18.6% in the passive prose text group. Kumar concluded that interactive, programmed, computer instruction can be a very important adjunct to health care and disease prevention programs.

Reichle (1992) examined the effect of a three topic CAI program, Looking Good, Feeling Good. The CAI 's intent was to provide information to adolescents

relative to understanding themselves, handling emotions and stress, and problem-solving. The effectiveness of this content was examined with measures of behavioral intent. The theory of reason action introduced by Ajzen and Fishbein (1980) claimed that overt behavior is a function of one's intention to perform the behavior. Attitudes and subjective norms were found to be important components in order to measure behavioral intent. The first topic was Understanding Yourself. The second was Handling Emotions and Stress and the third was Problem Solving.

A convenience sample of primarily 10th-grade students (N = 108), ranging in age from 15 to 18 years, were used for the study. Classrooms were randomly assigned to one control group and two treatment groups in a three group pretest, posttest design. The sample (n = 74) represented a cross section of socioeconomic strata with representation from high, low, and middle range income families and social class. The sample consisted of 50% female and 50% male students. Twenty-four of the students received CAI consisting of the three topics. Twenty-eight students received the same material as in the CAI but in a classroom instructional setting. Twenty-two students were the control group and they received classroom instruction not pertaining to mental health. The duration of the study was four class periods: (a) one class period for pretest, (b) two class periods for the instruction, and (c) one class period for posttest.

The pretest and posttest consisted of questions designed to assess behavioral intentions, attitudes, and subjective norms for specific health promoting actions. Analysis of covariance (ANCOVA) results indicated that student's behavioral intent to

enhance mental well-being did not increase significantly more in the group of students utilizing the CAI than those in the other two groups. There was an increased mean differences for all three groups between pretests and posttests. Multiple regressions found that the indices, consequence evaluation and motivation to comply, were significantly related to adolescents' behavioral design to understand self. The subjective norms, motivation to comply, and the evaluation of others were significantly related to adolescents' behavioral design to handle emotions and stress. Attitudinal indices, consequence evaluation, and consequence belief were significantly related to adolescents' behavioral design to problem solve.

Reichle (1992) concluded that the CAI, Looking Good, Feeling Good, has little or no effect upon adolescents' behavioral intent to enhance mental well-being. Reichle recommended that this study should be replicated with greater sample size, further developing CAI that would be used with all school age children in the promotion of mental health education. Reichle suggested that CAI should supplement teaching, yielding positive results. Reinforcement over longer intervals may enhance mental well-being as well.

Calderone (1994) provided a review of the literature from elementary through college levels including nursing programs regarding CAI, specifically the effectiveness of CAI and interactive video instruction (IVI) on learning, attitude, and their use with various modes of instruction. The reviewed literature, which spanned from 1978 to 1991, included 20 studies. The findings implied the following: (a) the effectiveness of

CAI on learning and attitude varies, (b) not much research is available in reference to learning effectiveness of computer technology with group instruction, and (c) a few findings suggest that group rather than individual instruction uses time more efficiently and without losing cognitive achievement.

Calderone concluded that health educators need to evaluate and determine which is the most effective mode of instruction because computer delivery systems are becoming more common among educational institutions. Learner preference is one way of determining the most effective mode. Many educators have limited knowledge of computer instruction and the different modes for its use. To overcome these limitations, research studies should be done in order to determine the effects of an instructional program on learning and attitudes about the CAI or IVI and if they are more effective with individuals, small groups, or large groups of students.

Napholz and McCanse (1994) conducted a study in order to determine whether or not interactive video could significantly help nursing students achieve course objectives. A software package with content similar to the concept of therapeutic communication was chosen. This concept is found throughout the nursing curriculum.

The study was conducted over two 18-week semesters on two campuses of a large midwestern urban university nursing school. The 65 subjects were male and female first-semester senior nursing student volunteers varying in ethnicity, ages, and computer experience. A pretest, posttest, retest, control group design was used. A two-part questionnaire was utilized. It included a 20-item therapeutic communication instrument

that measured progress in course communication objectives and a six-term information-about-yourself section that included four demographic items, one item about computer use, and one about IVI use.

All subjects were pretested. The treatment group viewed and used the therapeutic communication IVI, for a 4-week period after pretesting. Then the treatment group and the control group were posttested. Six weeks after the posttest, both groups were retested. The treatment group's pretest to posttest improvement in score was significantly greater than the control group's pretest to posttest improvement score, $X^2(1, \underline{N} = 65) = 3.74$, $\underline{p} < .05$.

Napholz and McCanse (1994) concluded that IVI can significantly help nursing students achieve therapeutic communication course objectives more effectively. The treatment group achieved objectives at a higher level and more quickly than the control group. The researchers also felt that IVI could be used for other competencies, such as decision-making, critical thinking, and psychomotor skills. Napholz and McCanse implied that students can learn competencies more quickly, therefore becoming more competent in patient communication earlier in the learning experience. This can then enhance patient care.

Park (1994) surveyed combinations of cognitive learning strategies and examined the extent that current computer-assisted instruction packages used the learning strategies. Three questions were raised before the research began: (a) what strategies

from the list of cognitive learning strategies are used currently for the development of commercially available CAI programs; (b) do CAI packages that professionals have evaluated to be effective contain more of the identified learning strategies than other CAI packages; and (c) can instructional software evaluators be easily trained to identify cognitive learning strategies in CAI packages.

Park (1994) reviewed major books and articles on learning strategies in order to identify a list of cognitive learning strategies. In order to examine the extent to which current CAI packages used the learning strategies, 30 CAI packages were selected. Ten of the software packages were selected from The 1990-91 Educational Software Preview Guide (Group A). Ten more software packages were selected that were not included in the Preview Guide (Group B). Finally, 10 packages that were published after the Preview Guide was written (Group C) were selected. The first research question was addressed by the review of the software and printed materials of the selected 30 CAI packages. The second research question was answered by the comparison of Group A with Group B in terms of learning strategies identified by the investigator. The third research question was addressed by having five people with formal training and experience with computers in education review six software packages in which learning strategies were used.

Park (1994) combined 13 learning strategies divided into three groups: (a) strongly effective, (b) weakly effective, and (c) and strategies that need more research. Strongly effective strategies included adjunct question, reflective question,

summarization, note taking, the keyword method, the method of loci, and the peg-word method. Weakly effective strategies were advanced organizers and underline. Strategies that need more research were signaling, concept maps, Vee diagrams, and matrix frames.

Park (1994) grouped learning strategies into four categories by their physical characteristics. The first category contained graphical learning strategies. These strategies included concept maps, Vee diagrams, and matrix frames. The second category had question-based learning strategies, adjunct questions, and reflective questions. The third category was composed of artificial memory aids, or mneumonics. These included the keyword method, the method of loci, and the peg-word method. The fourth category was general learning strategies, which included strategies commonly used among students and teachers. Strategies in this category were advance organizers, signaling, summarization, underlining, and note taking.

Park (1994) concluded that 7 out of the 13 learning strategies are used in at least one CAI package. CAI packages with favorable professional evaluations contained more of the identified learning strategies than other CAI packages in their software, but not in their printed material. Educational software evaluators could be easily trained to identify learning strategies used in CAI packages.

Benaloh (1994) performed an exploratory study based on teacher and student evaluations of different teaching styles utilized in CAI programs. Many other studies have researched whether or not CAI is effective and how the effectiveness varies with characteristics of the software. The studies have concentrated on group results but

researchers have not investigated for which teachers, for which students, and for which teacher-student combinations a particular aspect of software use is most effective.

Three teaching styles were used with each of three different CAI packages in three different fifth grade classes. The teachers and 18 students were selected based on their preferences of different learning styles. They were interviewed as to what they thought were the advantages and disadvantages of each style and software combination.

Benaloh discovered contradictions to the expectations. The effectiveness of the three styles did not depend on the primary instructional style of the teacher or on the preferred learning styles of the students. For optimal effectiveness, all three styles should be used with every CAI program. The reconciling style gives a demonstration of the software, allows the teacher to highlight the important concepts, and show the students what can be achieved. Activities that are coordinated with the CAI enable the students to spend additional time and to experience additional contexts in order learn the concepts more fully. The monitoring ability of CAI allows students to work with the material at their individual paces. Benolah concluded that teachers were more likely to use these styles themselves once they were demonstrated in their classrooms.

Shute and Gawlick-Grendell (1994) conducted a study based on the assumption that computerized instruction is better than traditional instruction, such as lectures and self-paced workbooks. They compared learning from a CAI to learning from a paper-and-pencil workbook. It was hypothesized that those utilizing the CAI would learn more and find the experience more enjoyable than the traditional method of workbooks.

The subject matter and instructional style were held constant between both approaches. The only variable that was different was the medium used for presentation of the material. The computer program used was based on the theoretical basis that learning is "a constructive process, fostered by an experiential learning environment, that is anchored (or situated) in real-world examples and problems" (Shute & Gawlick-Grendell, 1994, p. 177). Information is retained longer when the learner experiences rather than just receives information and when real-world problem-solving environments are involved.

Subjects were from local temporary employment agencies ($N = 311$) and were randomly assigned to one of three groups. One group ($n = 104$) used the Workbook, another group ($n = 107$) used the CAI, and the last group ($n = 100$) was the Control group. There was approximately an equal number of males and females in each group, with an age range of 17 to 28 years. All subjects were high school graduates or the equivalent.

All three groups took a 1 hr pretest (written) assessing statistical knowledge and skills. The same material was presented to the Workbook and the CAI groups. The Workbook group was provided with props such as dice and a calculator in order to simulate the same interactive items that are in the CAI. The CAI did offer positive feedback, graphics, and colors when presenting material in order to provide motivation. The instruction involved 4.5 hr of probability material. All subjects were administered the CAM-4 battery of computerized tests which required 8 hr to complete. This battery

assesses the following cognitive abilities: working-memory capacity, information processing speed, inductive reasoning, associative learning, and procedural knowledge and skill. A parallel posttest was administered following the instruction.

Shute and Gawlick-Grendell (1994) used a MANCOVA to control for differences in incoming knowledge. Based on the outcomes, there was no significant difference between the experimental groups for both declarative and procedural knowledge, $F(4, 291) = 2.60$, $p < .04$. The CAI group did perform significantly better on the declarative knowledge and slightly better on the procedural knowledge than the Workbook group, $F(2, 308) = 10.54$, $p < .001$. Both groups performed better than the Control group on the posttest. The CAI group did find the learning experience more enjoyable than the Workbook group.

Shute and Grawlick-Grendell (1994) concluded that students benefit from CAI when definitions and concepts are the outcome goal. Also, the majority of learners are very receptive to the interactive and entertaining nature of the CAI.

As the use of computers increases so does the use of CAI. The increase in this instructional method indicates a need for studies on the effectiveness of CAI. Most of the studies that have been performed indicate that CAIs are effective, either on knowledge or attitude toward instruction. Overall, the research literature indicates that CAI benefits outweigh the disadvantages (Merrill et al., 1992). The use of CAI, when compared to conventional instruction, has a moderate positive effect on students

achievement and attitudes toward computers and instruction, and it substantially reduces instructional time.

Instructional Software Characteristics

In order for CAIs to be effective, the instructional software needs to have certain characteristics. According to Price, March, and McFadden (1987), no matter how innovative and instructionally strong a CAI module is, there will be limited results if the content is weak. Price et al. also recommended that the purpose and objectives of the software and content outline be concisely stated. The consumer audience should be identified as well.

Petosa and Gillespie (1984) presented the most important characteristics that a health educator should look for when choosing instructional software. A high quality CAI will have these characteristics. The computer is not as valuable a tool without carefully selected software. An increasing number of health education instructional tools are available; therefore health educators can be more selective. The main problem with the use of computers in health education is the lack of quality CAI.

When evaluating CAIs, the health educator should be concerned about several characteristics of the software (Petosa & Gillespie, 1984). The software should be compatible with the computer and have proper documentation. This documentation should include instructions for the use of the software and the supportive literature. It would be wise for the health educator to run the program to verify that the program

actually does what the documentation says it will. The software should be user friendly. User friendly software makes the CAI easier and more enjoyable. The program needs to be accurate. The content should be correct and the sources of the content need to be considered reliable.

Depending on the use of the CAI, the instructional method will be an important consideration (Petosa & Gillespie, 1984). The CAI method should match the abilities or level of the students and should fit the educational objectives of the program. The most commonly used CAI methods are drill and practice, tutorial, problem-solving, simulations, and instructional games. Drill and practice programs give learners the opportunity to answer questions about material presented. The process is continued until a learner shows mastery of the material. Tutorials are used to present new information to a learner. Problem solving software in which the learner uses the computer as a tool to solve complex problems. Simulation represents real-world situations or problems. In health education, a scenario may be presented in which the student can change by altering important elements of the problem. Games are a special form of simulation used for recreation and learning. Usually there is competition between the learner and another learner or the computer.

Petosa and Gillespie (1984) concluded that the computer has not reached its full potential judging from the lack of quality CAI software. Health educators can play a critical role in the development of quality instructional programs by evaluating CAI

software effectively. The use of computers in health education will depend on the appropriate use of quality CAI programs.

The shortage of quality health education CAI is a problem for the health educator. Identification and use of appropriate criteria will aid the process of software selection.

Health Education CAI Criteria and Development

As with selecting existing health education software, the development of high quality health education CAI requires certain characteristics or criteria. The literature indicates that there are many considerations that the health educator must take into account in order to produce an effective and quality health education CAI.

According to Horne and Gold (1983) an increasing number of health educators are using computers for instruction. Quality software can make the computer a powerful and flexible educational tool. Software programs are also used as effective and efficient means for managing data.

There are no widely accepted set of criteria for identifying high quality educational software. Characteristics have been identified by various health educators and software developers in various literature. A list was developed by Horne and Gold (1983) from a composite of these characteristics. Similar criteria have been used by judges of the AAHE Computer Software Contest. All of these criteria may not apply to every software program.

Horne and Gold (1983) developed the criteria list to facilitate health educators in developing and selecting CAIs. The criteria were grouped into the following categories: (a) program content, (b) screen format, (c) program timing, (d) graphics, (e) program operation, (f) motivation and feedback, (g) program instructions, (h) program objectives, (i) program language, (j) instructional technique, and (k) documentation. By utilizing these criteria, the health educator will be able to obtain more effective CAI, enhancing the usefulness of computers in health education.

Whiteside and Whiteside (1987/1988) discussed the value of authoring systems for health educators. In order for educators to utilize the computer to its maximum potential, they need to have access to an authoring tool for developing CAI. Because there is a shortage of existing quality health education software, health educators can use authoring systems to develop their own software. But the time to develop a program and the cost of authoring systems are two considerations that must be taken into account.

There are three methods that can be used to develop CAIs. The first method is use of programming languages. These would be very time consuming for most health educators because it requires high level programming skills. The second method is use of authoring languages. These are programming languages that have been designed specifically for creating instructional programs. This is a simpler alternative, but it would still require a lot of the health educators time. The third method is use of authoring systems. These are software packages that take the educator through the programming

process by acting between the educator and a high-level programming language (Jonassen, 1985; Kearsley, 1984).

Health educators need to be aware of authoring systems' features. The main consideration in choosing an authoring system is what method or strategy of instruction is to be developed. The major features of authoring systems include: (a) instructional strategies, (b) questioning strategies, (c) answering judging capabilities, (d) feedback/response strategies, (e) frame display and design, and (f) student recording/performance tracking. Three other general features should be considered that enable the educator to use the system efficiently: (a) documentation/user support, (b) technical quality, and (c) ease of learning and using.

Whiteside and Whiteside (1987/1988) summarized that the use of an authoring system to write educational software combines the content expert with the power of the computer. Authoring systems have a integral instructional system that to some extent determines the design of the lesson. Time spent evaluating authoring systems before selection and purchase will payoff in terms of the educator's specific needs. CAI programs can be used in place of lectures and can present problem-solving situations before encountering them in real-life.

Sarvela and Karaffa (1990) described an educational technique that introduces and develops the skill needed in the use of authoring systems. Authoring systems enable health educators to develop CAI in an effective and efficient way. This technique was designed for students taking a basic computer applications course at Southern Illinois

University at Carbondale. The authoring system used in this course is Apple SuperPILOT.

The researcher recommended that the students learning how to develop CAI programs should be organized into groups of three or four. The lessons and activities take approximately 20 hr and include the following: (a) Introduce CAI (1 hr), (b) review Instructional Systems Design (1 hr), (c) discuss special curriculum development issues related to CAI (1 hr), (d) introduce basic SuperPILOT commands (1 hr), (e) demonstrate previously developed student or instructor-generated programs (1 hr), (f) student review of SuperPILOT tutorial (3 hr), (g) student design and development of CAI materials (8 hr), (h) pilot testing and revision of CAI materials (3 hr), (i) student demonstration of their projects to class (1 hr).

According to Sarvela and Karaffa (1990), this method is an effective way for teaching the use of authoring systems. Students previously enrolled in this class have produced high quality health education programs, integrating a variety of health education information from different content areas.

Sponder and Hilgenfeld (1994) presented cognitive guidelines for teachers developing CAI. The researchers offered a CAI course that prepared teachers in the use of Hypercard (Macintosh) and Toolbook (Windows). The course goal was to train teachers to author interactive multimedia presentations using cognitive objectives for lesson development and student assessment. These applications offer sophisticated

audio/visual capabilities but are considered user friendly because they are fairly easy to script and can be used effectively by both novice and expert programmers.

In order for teacher-developed CAI programs to have significant impact on students' basic skills, they must work in ways that take advantage of the unique capabilities of computer technology. These teacher-developed CAI programs also need to be based upon educational objectives that provide guidance for both creating and using instructional multimedia. For creating CAI software, Sponder and Hilgenfeld (1994) used a strategy described at Cognitively-Based Instructional Design (CBID). These methods integrate established learning theories with the special features of hypermedia programs. The teachers established cognitive objectives and then designed appropriate instructional activities that met their stated goals.

The design process started with the teachers choosing a familiar curriculum topic to develop into a CAI program. They determined cognitive objectives and then decided which activities will help their own students meet those objectives. The teachers then used large index cards to represent the different Hypercard or Toolbook screens, while on the reverse side they noted the program's functions, potential interactions, and links to other cards.

A taxonomy that provides basic guidelines for assessing cognitive learning was developed by Bloom (1956, 1976). The taxonomy identified six hierarchical and incrementally complex levels of intellectual activity which are knowledge, comprehension, application, analysis, synthesis, and evaluation. The taxonomy of

cognitive objectives was a starting point for understanding progressive developments in cognitive learning theory and the evolution of computer based learning strategies. Sponder and Hilgenfeld developed in chart form the relationship between the taxonomy of cognitive objectives and the hypermedia activities that can be used to achieve the related objective.

Sponder and Hilgenfeld (1994) concluded that many teachers start out with good intentions when developing CAI but often fall short because they lack direction at the beginning of the process and do not take the time to develop the cognitive objectives. Hypermedia programs offer exciting instructional opportunities but this does not guarantee educationally worthwhile activities. By taking the time initially to develop the objectives, the teacher will save time in the long run in the development of the CAI. This also helps teachers clarify the outcomes they expect.

The development of good health education CAI requires several considerations. Health educators developing CAI can benefit by using criteria for the authoring process.

Summary

Desktop computer technology has made it easier to develop course materials and more effective instructional strategies. For example, word processing, outline functions, and databases help organize information.

Now that CAI has the ability to provide multimedia, it can be an effective method for the individual to learn independent of the classroom. However, CAI programs cannot replace live instruction, but rather, provide effective supplemental educational

tools. CAI has the ability to provide individual learning paths and a self-paced environment. They must be carefully designed and use multimedia appropriately. A module should hold the learners interest by using suitable images. It should also reflect a philosophy of teaching. The CAI development process must be precise and organized.

The computer and CAI can provide a learning environment that is dynamic, less expensive, and more pathways to information than books and journals. CAI modules can provide a way for the individual to get feedback and assess their own progress. This allows for a successful educational strategy.

CHAPTER III

METHODOLOGY

The purpose of this study was to conduct a formative evaluation of a CAI on computer literacy among undergraduate community health majors. This chapter presents the methodology of this qualitative study in relation to its intervention, population, procedures used to sample the population, instruments used to measure the variables, procedures used to collect the data, and statistical analyses and descriptive techniques used to treat the data.

Intervention

The CAI module on computer literacy for health educators was developed by the investigator using Authorware Star for Windows, Version 2.2.0 Academic. The investigator is a doctoral candidate with several years of computer experience, including coursework in computers in education and computer-assisted instruction. This CAI module on computer literacy was the investigator's first attempt at developing CAI. The CAI module took approximately six months to develop during the fall semester 1996 and spring semester 1997. The CAI module consists of 726 icons and uses 6.16 MB of memory. The module was developed using the academic version of Authorware, which only allows 500 icons per file. This module required the use of three files, which were then combined by Judy Baker, Ph.D. using the professional version of Authorware. The CAI module was developed on a Packard Bell 486 desktop computer.

The content chosen for the CAI module should be that which many people need to learn (Burke, 1982). Basic skills are always a good choice. Content should be material that does not change often, is concrete, and is in accord with what is already out there. Computer technology continues to change but the basics tend to remain fairly constant.

Lesson size should be limited to that which can be accomplished in a reasonable period of time to prevent the developer from becoming discouraged (Burke, 1982). Originally, the investigator wanted to include several other computer basics, such as databases, to the module. The topics had to be reduced in number for the sake of time. Topic lists are one way to represent the content. They are favorable, because they are easily sequenced and resequenced. They also make it easier to determine what should be included and what should be excluded from the lesson.

A somewhat specific target population of students should be considered (Burke, 1982). If not much is known about the population, time should be spent learning as much as possible about them. The investigator is familiar with the undergraduate community health majors and also had access to this population for research purposes.

Instructional design is a major factor in CAI. The functional design of the lesson is chosen first (Burke, 1982). The functional design is the format of the CAI. This includes choices such as drill and practice, tutorial, or simulation. The physical design is chosen second. The physical design could be linear, branching, or spiral. Lastly, the

logical design is determined. This includes discovery, didactic, and EGRUL, an acronym which stands for example (EG) and rule (RUL).

Flow charts or storyboards can be grouped in terms of two levels: system flow charts and detailed flow charts (Burke, 1982; Tessler, Kimme-Smith, Marx, & Singh, 1995). A system flow chart shows the big picture, with a small amount of detail. It is used to represent the major components of the CAI lesson and to arrange them in the lesson sequence. A detailed flow chart is much more complete and shows the lesson design's every detail. Only extremely complex lessons require detailed flow charting.

The investigator developed the storyboard, including text, instructional design, and possible graphics. Resources for the text included Computers Simplified from IDG Books (1995) and 1,001 Komputer Answers by Kim Komando (1995). In order to allow the participant to choose topics according to previous experience and interest, the branching tutorial design was used. During the storyboard process, possible graphics to accompany the text were also noted.

The next step of the CAI development was the actual creation of the module. The first step was to learn how to use the Authorware™ software. The investigator self-taught the basics in a month's time, along with the help of Judy Baker, Ph.D. The text was written and entered first. While the text was entered, the technical aspects and flow of the module were also addressed so that the investigator could move about the module while developing it. Along with this navigating aspect came testing and evaluating the module during the process. Graphics, colors, and fonts were chosen next. This was the

most time-consuming aspect of the CAI module development. Appropriate graphics to accompany the text, colors, and fonts were selected in an attempt to make the CAI module more effective and attractive. Graphics were obtained from the Internet, and from various computer software programs (Coreldraw™, PowerPoint™, and Freelance™) found on the investigator's desktop computer. Multimedia (video, animation, and sound) were the last components added to the module. Video and sounds were obtained by downloading files from the Internet. After these components were added, tested, and evaluated, the module was packaged. Authorware software packages the CAI module so that it can be used on a computer, i.e. as a stand-alone, without the need for the Authorware software.

The CAI module consists of several computer topics: hardware, presentation software, word-processing and desktop publishing, the Internet, graphics, and CAIs. The hardware section contains information about 11 components: RAM, keyboard/mouse, monitor/videocard, modem, printer, processor, hard drive, CD ROM, sound card, scanner, and microphone. Each component selection embodies a description and utility. The presentation software branch contains suggestions for health education uses and features to seek when purchasing presentation software. The word-processing and desktop publishing section compares the two types of software and their uses. The Internet segment consists of information about Internet basics, e-mail, discussion groups, resources, the world wide web, and selecting a service provider. The graphics component includes information about animation, clip art, morphing, video, and draw

and paint programs. The CAI branch is made up of CAI formats, applications, evaluating health promotion software, ways of developing CAI, and guidelines for developing CAI.

The CAI module utilizes multimedia, including animation, sound, and video. The module follows a tutorial format, allowing the student to choose which pathway she wanted to pursue. Scenarios are presented with questions at the end of each pathway to assess the student's progress and to provide feedback on that progress.

Population and Sample

A pilot test was conducted with five volunteers taken from the same population as those for this study. The subjects for this study comprised a convenience sample of 23 additional students recruited as volunteers from those enrolled in undergraduate Department of Health Studies courses at Texas Woman's University in the spring semester of 1997.

Procedures

Students were notified verbally and in written form of the opportunity to participate in the study during the first ten minutes of a class period during spring of 1997 in all of the Health Studies undergraduate courses, except for Health Aspects of Aging and Perspectives on Women's Health, by the investigator, without the instructor present. The students in Health Aspects of Aging were not informed because all students but one were informed in previous classes. The one student was contacted individually, who declined. Students in Perspectives on Women's Health were excluded

from the study because they were all non-majors except for one. That one student had been notified in another Health Studies class. Students were informed that they could volunteer to participate in the study and that their participation would have no impact on their grade. Students who expressed an interest in volunteering were given a consent form to read and sign. They were scheduled to participate at a time most convenient to them and the investigator. The first five students on the schedule were used as the pilot test group. The CAI module and the interview process were altered according to the results of the pilot test. The morphing section included a video clip that took several seconds to download. This led to confusion and the participants clicked on buttons before the video clip could play. The investigator altered the clip so that it would run more quickly, thus reducing the possibility of early confusion. The questions asking the students about using the help system confused the students because there was no help system in the CAI module. These two questions were deleted. The category on tailorability was deleted because it was not applicable to the CAI module and confused the students.

The remaining 24 students made up the test group. One scheduled student dropped out of the study prior to any data collection, resulting in 23 participants. An average of two students were observed and tested daily, the minimum being one, and the maximum being four. The students interacted with the CAI in a room which assured privacy during the use of the CAI as well as during the interview process. In order to use the CAI module, students accessed a computer and zip drive available in the

Department of Health Studies office. Prior to using the CAI module students were given a consent form to read and sign. Each participant was asked if she knew how to use a mouse. Because all indicated they knew how to use a mouse, all participants were included in the sample. They were informed that they were not being evaluated in any way, had the option to view as many of the topics as they wanted, based on the tutorial format, and could quit at anytime. The investigator explained the sequence of events, which included viewing the module, completing the checklist, and being interviewed by the investigator. Participants were informed that the investigator was there to observe but not to answer questions. As they viewed the module, questions were asked of the investigator, who responded that they should do the best they could on their own. Each participant used the CAI module and was observed during the process of using the CAI, with the overall time spent on and the pathways taken in the module recorded by the investigator.

All participants were asked to self-report their age, gender, and prior computer training and experience. In addition, they completed a brief checklist consisting of ten questions from the criteria developed by Barker and King (1993) that helped them to evaluate the CAI module during the viewing (Refer to Appendix D). Students were interviewed immediately afterwards in order to determine the student's perceptions about the CAI module. The interview questions consisted of the remaining questions developed by Barker and King (1993; Refer to Appendix E). At the end of this questioning, the students were given the opportunity to add any other comments that

they wanted to make about the CAI module. Total participation by each student required no more than one hour, depending on prior computer literacy. Responses were recorded on audiotape and notes were taken during the interviews by the investigator. The data collection process, including the pilot test, took three weeks to complete. The questionnaires were coded to assure anonymity. Audiotapes were then transcribed by the investigator. Transcripts were analyzed for recurrent responses and coded for data analysis.

Instrumentation

Evaluation criteria developed by Barker and King (1993) for interactive multimedia courseware were used by the students in this study as a checklist for evaluating the CAI during use and as prompts during the interview process (Refer to Appendix D and Appendix E). The evaluation checklist included the following categories: engagement, interactivity, tailorability, appropriateness of multimedia mix, mode and style of interaction, quality of interaction, quality of end-user interfaces, learning styles, monitoring and assessment techniques, built-in intelligence, adequacy of ancillary learning support tools, outstanding strengths and attractive features, and outstanding limitations and weaknesses. One question from each of the ten categories comprised the checklist. The investigator added four demographic questions following the checklist. These questions included age, gender, computer experience, and computer training. Computer training and computer experience were differentiated because many individuals are self-taught. The remaining questions were used during the interview

process. These criteria were developed after the evaluation of 43 software products. The prompt questions for non-experts were used (Refer to Appendix E). These questions are directly related to the key expert questions developed by Barker and King but did not have the jargon that could have confused non-experts.

The tailorability category was omitted. They were considered "not applicable" after the pilot test. This category examines features which either enables the module to be personalized or to be adapted to different hardware environments and therefore be made more accessible to a group of users. Because this CAI module did not offer any of these features, the pilot test participants became confused by these questions.

The question about the help system was omitted because the module did not have a help system. This question confused those in the pilot test group.

Treatment of Data

Content analysis was conducted on data collected in the interviews. Notes and transcripts were coded to identify consistent comments, then further analyzed to determine patterns in the responses. The data were tabulated using descriptive statistics for frequencies and percentages. Also, the demographic data and critique checklist data were reported in terms of frequencies and percentages. Pearson correlation coefficients were calculated to determine the relationship between time spent using the CAI module and the number of topics chosen. The relationships between the amount of time spent using the CAI module and previous computer training and between topic selection and previous computer training were determined by calculations using a 1-sample

previous computer training were determined by calculations using a 1-sample independent t-test. Data were entered and compiled using the computer programs Biomedical Statistical Package (BMDP) and Statistical Signal Processing (SSP).

CHAPTER IV

FINDINGS

This chapter presents a descriptive statistical analysis of data collected regarding age, sex, computer training, and computer experience. A descriptive statistical analysis of data collected from the checklist and during the interview is presented as well.

Descriptive Characteristics of the Sample

The data collection instrument collected demographic data with four questions regarding the gender of the participant, the age of the participant, previous computer experience, and previous computer training.

All 28 of the participants were female. The age of the participants in this study ranged from 20 to 46 years with a mean age of 28 years.

All 28 of the participants had previous computer experience. Twenty of the participants (71%) had some type of previous computer training. The types of training included a high school course, college level courses (Introduction to Computers at Texas Woman's University [TWU], Information Delivery Systems at TWU), and seminar classes at the TWU library. Eight participants (29%) indicated that they had no previous computer training.

The time spent to view the CAI module ranged from 5 to 32 minutes, with an average of 18 minutes. The module's main menu offers two selections, or pathways. Within each pathway there is information about that topic. Each pathway may offer additional pathways or branches in which the user can select in order to obtain

information on that subtopic. Half of the sample (n=14) chose the hardware pathway first. Table 1 lists the hardware topics viewed. Table 2 lists the software topics viewed. The topics viewed by the least number of participants were compatibility, masters, charting, slide sorter, and transitions. All 28 participants viewed the Internet topic.

Table 1

Hardware Topics Selected for Viewing by Participants (N=28)

Topic	n	%
Basic components	19	67.9
RAM	11	39.3
Processor	9	32.1
Hard drive	7	25.0
CD-ROM	10	35.7
Monitor/Videocard	11	39.3
Keyboard/Mouse	8	28.6
Soundcard	11	39.3
Modem	18	64.3
Printer	5	17.9
Accessories	26	92.9
Scanner	21	75.0
Microphone	17	60.7

Table 2

Software Topics Selected for Viewing by Participants (N=28)

Topic	n	%
Presentations	26	92.9
Clip Media	4	14.3
Slide Sorter	1	3.6
Transitions	1	3.6
Drawing Tools	4	14.3
Speaker Notes	3	10.7
Compatibility	3	10.7
Masters	1	3.6
Charting	1	3.6
Word processing and Desktop Publishing	19	67.9
Word-processing	8	28.6
Desktop Publishing	17	60.7

Table 2 (cont.)

Software Topics Selected for Viewing by Participants (N=28)

Topic	n	%
Graphics	26	92.8
Animation	12	42.9
Clipart	14	50.0
Morphing	17	60.7
Video	13	46.4
Draw and Paint Programs	14	50.0
Computer Assisted Instruction	23	82.1
Formats	16	57.1
Tutorials	9	32.1
Games	12	42.9
Drill and Practice	5	17.9
Simulation	8	28.6
Problem Solving	5	17.9
Ways to Develop CAI	15	53.6
Programming Languages	9	32.1
Authoring Languages	9	32.1
Authoring Systems	10	35.7
Guidelines for Developing CAI	10	35.7

Table 2 (cont.)

Software Topics Selected for Viewing by Participants (N=28)

Topic	n	%
Applications	13	46.4
Training	12	42.9
Testing	10	35.7
Delivery of Programs	11	39.3
Evaluating CAI Software	8	28.6
The Internet	28	100.0
Internet Basics	12	42.9
Gopher	9	32.1
FTP	9	32.1
URL	9	32.1
IRC	7	25.0
WWW	14	50.0
E-mail	11	39.3
Discussion Groups	9	32.1
Selecting a Service	15	53.6
Resources	14	50.0

Analysis of Checklist Data

Table 3 lists the responses of participants to the items 1 through 6, 9 and 10 of the Computer Assisted Instruction (CAI) Checklist. All 28 of the participants indicated that the CAI tasks were at the right level and interesting (Item 1). The participants were almost evenly split in response to their certainty as to how to proceed through the CAI.

Table 3

Responses to CAI Checklist by Participants (N=28)

	Yes		No		No Response	
Item	n	%	n	%	n	%
1	28	100.0	0	0.0	0	0.0
2	28	100.0	0	0.0	0	0.0
3	16	57.1	10	35.7	2	7.1
4	25	89.3	3	10.7	0	0.0
5	26	92.9	2	7.1	0	0.0
6	16	57.1	12	42.9	0	0.0
9	18	64.3	8	28.6	2	7.1
10	12	42.9	16	57.1	0	0.0

The participants responded in a variety of ways when asked how they felt about the way in which information was presented to them.

These responses included: interesting, good, logical and clear, informative, user friendly, simple, organized, unclear, wanted feedback when something had already been viewed, and not enough cultural diversity of graphics.

Table 4 represents the responses of participants to item 8 about what the CAI module was trying to be. A large percentage of the participants indicated that the module was a tool.

Table 4

Responses to Item 8 (N=28)

Product	n	%
Book	1	3.6
Tutor	2	7.1
Reference book	6	21.4
Tool	11	39.3
Book and tutor	1	3.6
Tutor, reference book, and tool	2	7.1
Tool and reference book	1	3.6
Tutor and tool	1	3.6
No response	3	10.7

Analysis of Interview Data

Descriptive statistics and tabulations of the interview data collected from participants are listed in Tables 5 through 10. Table 5 shows the statistics from the engagement category of the interview tool. For item 1, one student responded that there were not enough cultures represented in the CAI module. For item 3, comments included that they did not know when they were finished and they were confused at times. For item 7, participants made several clarifying comments when asked if the module was challenging. The comments included "somewhat," "to a point," "informative," "would depend on the individual's literacy," and "the scenarios were."

Table 5

Responses to Engagement Category of Interview (N=28)

	Yes		No	
Item	n	%	n	%
Was there enough variety?	27	96.4	1	3.6
Did the product seem relevant to real life?	28	100.0	0	0.0
Was it always clear where you were in this product?	16	57.1	12	42.9
Was it always clear where you were going?	20	71.4	8	28.6
Was it enjoyable?	28	100.0	0	0.0
Was it interesting?	28	100.0	0	0.0
Was it challenging?	15	53.6	13	46.4
Did you feel that you had achieved or could achieve something with this product?	28	100.0	0	0.0
Would you want to use the product again?	25	89.3	3	10.7

Table 6 represents the descriptive statistics from the interactivity category of the interview tool. The participants were split when asked if they ever felt that they were making choices just for the sake of it. Yet, a majority of the participants felt that they

could decide what they wanted to do. For item 12, several participants indicated that they wanted to have the option to interact more with the module.

Table 6

Responses to Interactivity Component of Interview (N=28)

	Yes		No	
Item	n	%	n	%
Did the product give you enough opportunity to choose and enter things?	24	85.7	4	14.3
Did you ever feel that you were making choices just for the sake of it?	11	39.3	17	60.7
Did you feel that you could decide what you wanted to do?	25	89.3	3	10.7
Could you choose which route you wanted to take that was most relevant to you?	28	100.0	0	0.0
When you were using the product, did you feel that you were basically in control?	27	96.4	1	3.6
Did you get good feedback when needed?	25	89.3	3	10.7

Table 6 (cont.)

Responses to Interactivity Component of Interview (N=28)

	Yes		No	
Item	n	%	n	%
Was it easy to make choices with the equipment provided?	27	96.4	1	3.6

Table 7 shows the participants' responses to the items in the appropriateness of multimedia mix category. A majority of the participants indicated that graphics, video, and sound quality were of appropriate size and quality. Only one participant stated that the sound quality was not good enough. Comments in reference to the video and graphics included that they were too small if a group would be viewing, italics fonts were hard to read, and video played too early and distracted them from reading what was on the screen. A back button was requested by one participant in order to review a previous screen.

Table 7

Responses to Appropriateness of Multimedia Mix Component of Interview (N=28)

	Yes		No	
Item	n	%	n	%
Video and graphics, did the size seem OK?	28	100.0	0	0.0
Audio, was the sound quality good enough?	27	96.4	1	3.6
In this case, do you think that having extra features would help you learn?	20	71.4	8	28.6
Do you think that having extra features made the product more enjoyable and interesting?	28	100.0	0	0.0

Table 8 represents the participants' responses to the items of the mode and style interaction category. The participants responded positively to these items or indicated that the way they interacted made no difference to them.

Table 8

Responses to Mode and Style Interaction Component of Interview (N=28)

	Yes		No	
Item	n	%	n	%
Did the use of the mouse make using the product more enjoyable or interesting?	24	85.7	4	14.3
Did you like the way that you made choices?	28	100.0	0	0.0
Did the way choices were made alter how you felt about the software?	15	53.6	13	46.4

The participants (N=28) were asked how they felt about the screen displays. There were a variety of responses. These responses were as follows:

1. Software menu was hard to read.
2. Colorful, like graphics
3. Good and appropriate graphics
4. Very nice
5. Video clips were distracting
6. Not too complex
7. Liked videos
8. Cool

9. Unique
10. Liked animation
11. OK, except for the morphing
12. Very well done
13. Kept my interest
14. Clear
15. Like the movement
16. Captured my attention

Table 9 represents the remaining items in the quality of interaction category. Seven participants responded that at times they were confused while utilizing the CAI module. One participant indicated that the hardware section was too technical. Others (n=6) reported that the instructions weren't clear enough and "went in circles."

Table 9

Responses to Quality of Interaction Component of Interview (N=28)

	Yes		No	
Item	n	%	n	%
Was everything always clearly laid out?	24	85.7	4	14.3
Did you find enough help built into the product?	23	82.1	5	17.9
Did you get the sense of where this product might fit into your own personal educational scheme?	28	100.0	0	0.0
Did the software ever bother you or confuse you or just mystify you, perhaps because of the language or examples used?	7	25.0	21	75.0
Was it racist or sexist?	1	3.6	27	96.4

The quality of end-user interfaces category is represented in Table 10. A majority of the participants reported that they knew how to move from one part to another and that there was a regular way of moving about the CAI module.

Table 10

Responses to Quality of End-user Interfaces Category of Interview (N=28)

	Yes		No	
Item	n	%	n	%
Did you always know how to make important choices, like, moving from one part to another?	20	71.4	8	28.6
Did you feel that there was a regular way of moving about the package?	28	100.0	0	0.0
If icons were used, was it fairly obvious how to use each one?	26	92.9	2	7.1

Twenty-four (85.7%) of the participants responded that they utilized previous skills when using the CAI module. This item represented the learning style category.

The monitoring and assessment techniques category was assessed through the final interview question. Twenty-seven (96.4%) of the participants indicated that the CAI module would help them set goals.

The participants were asked for any additional comments. The comments are as follows:

1. Good size print
2. Not too much information on each screen
3. Liked it

4. Laid out well
5. Informative
6. Impressed with hardware portion
7. Good content
8. User friendly
9. Good information on purchasing
10. Should have this early in the health studies curriculum
11. Not multi-cultural
12. Professionally done but got lost a couple of times
13. Helpful
14. Wanted more interaction ability and to be able to do examples
15. Interesting
16. Good for beginners
17. Fun
18. Pretty cool
19. Liked the sound
20. Thought it would be more health oriented
21. Wasn't sure when she was done
22. Covered a lot of material
23. Gives good overall view
24. Guidelines to develop CAI was too long

25. Wanted to know if it would be in library to checkout to use again
26. Good, big fonts
27. Good explanations
28. Thought it would be harder since she isn't too computer literate
29. Easy to move around
30. Sound and visuals helped
31. Vague definitions
32. Should be used in the classroom
33. Wasn't sure what she was looking at in some components

A Pearson correlation coefficient was calculated to determine the relationship between time spent using the CAI module and the amount of topics chosen. There was a direct relationship between time spent using the module and the amount of topics chosen (r=0.813,p<.001). An independent t-test was calculated to determine differences between previous computer training with varying amount of times spent using the CAI module. A significant difference was found between having previous computer training or not in terms of the amount of time spent using the module, $t(26) = 2.08$, $p < .05$. A chi-square followed by a post hoc test run on SSP was calculated to determine differences between previous computer training with varying topic selections. A significant difference was found between having previous computer training or not in terms of the topics selected, $\chi^2(61) = 624.22$, $p < .01$. Because all of the participants

had previous experience, no analysis was conducted to determine differences between those with and without previous experience.

CHAPTER V

DISCUSSION, CONCLUSION, AND RECOMMENDATIONS

American society is increasingly technologically-dependent. The information technology revolution has finally reached a point where teachers and health educators must take heed (Chodorow, 1996). Technology has advanced to the point that the creation of new, powerful teaching software called multimedia packages is now fairly easy. These packages can do much more for education than just improve the way complex material is presented. Multimedia packages can change curricula and the way educators interact with students. Also, the Internet is now distributed and practical enough to change teaching practices. The new practices may not only embellish courses and exchanges with students, but may also challenge the foundations of our educational practices and institutions (Chodorow, 1996).

According to a leading health educator, Robert Gold, "Computer literacy is an understanding and recognition of the capabilities and limitations of computer technology, including hardware and software. For health educators computer literacy also implies a recognition of the potential applications of this technology to the practice of health education and the training of health educators" (1991, p. 105). Computer literacy can heighten the effectiveness of health education practice. To accomplish this, professional preparation programs need to acknowledge the role computers play in health education and provide the necessary training to utilize the technology.

Computer assisted instruction (CAI) is one way for health education preparation programs to meet this need. The literature indicates that CAI, through the use of multimedia, promotes student interest and motivation (Gold, 1991). Multimedia allows for multi-sensory learning, student interaction, and individual-based learning. Multimedia packages combine all forms of information: text, pictures, film, animations, and sound. These packages make it possible to get complex ideas and material across to students quickly and efficiently.

One effect of this combination of information resources is that it permits students to learn in a variety of ways (Chodorow, 1996; Gilbert & Sawyer, 1995). Students have different learning styles and modes and that traditional methods of teaching are effective for some students but not all. Multimedia packages therefore provide essentially all learners with ways to learn the concepts and information that is taught.

The ways in which people pursue their education should be considered when deciding whether CAI is beneficial (Glenn, 1996; Jaffe & Lynch, 1995). Reading textbooks and journals and attending lectures and formal courses are traditional teaching methods. Although printed materials have the convenience of portability and are simple to use, they have limitations. According to Jaffe and Lynch (1995), a 400-page book seldom has more than 1200 pictures and figures and cannot communicate sound and movement. Even in booklets with self-test modules, reading is a passive activity that cannot meet a user's need for demonstrated achievement. Although the organization of information in books is directed by the table of contents and the index, printed material

cannot provide automated word searches or the reordering of content placement, both of which are feasible with computerized text. Most important, books are primarily mediums of text, descriptions that lack the contiguousness provided by computers, which make active participation by the student feasible. Print is a static medium, not always compact, not always inexpensive, and certainly not dynamic. Formal courses require that specific time be set aside, may require travel, and are not easily tailor-made for the various educational levels of the participants. These limitations can be addressed by well designed CAI.

The present qualitative study was designed to evaluate a CAI module on computer literacy created by the investigator. Undergraduate community health majors utilized the CAI module. A total of 28 undergraduate community health majors used the computer literacy CAI module, completed the CAI checklist, and were interviewed by the investigator. Time on task, topic selection, and student perceptions of the CAI module were determined. Other variables of interest included age, previous computer experience, and previous computer training. This chapter is organized to provide the following: discussion, conclusions, and recommendations and directions for future research.

Discussion

Although studies have compared CAI to other more traditional methods and use of CAI for a variety of topics, the literature failed to provide documentation of students'

perceptions of a CAI module on computer literacy. The results of this study provide a formative evaluation of a computer literacy CAI module provided by undergraduate community health majors.

Time on Task and Topic Selection

Time on task ranged from 5 to 32 minutes, with a mean of 18 minutes. There was a significant difference between the amount of time spent using the CAI module by those with previous computer training and those without. Those with previous training utilized the module for a mean of 18.15 minutes, while those without previous training utilized the module for a mean of 20.88 minutes.

Topic selection was diverse and the amount of topics chosen seemed to be related to time on task. In general, the longer the time spent using the CAI module, the more topics that were selected. Software and hardware topics were equally chosen first. The software pathway or topic was selected the most, with several participants returning to this portion of the module for a second time. As a component of the two main topics, hardware and software, the Internet was viewed the most. Perhaps this was due to all of the recent media focus about the Internet. There appeared to be a relationship between topic selection and previous computer training, as indicated by the chi-square test, and the post hoc test.

Perception of CAI Module

The questionnaire's engagement category can be used to assess whether the product engages the user's interest, or involves the user because of factors which are

especially motivating, enjoyable, or challenging. In general, the participants' perceptions were positive for this category. Some participants reported that the mechanics dealing with where they were in the program were confusing at times. Participants expressed this confusion regardless of previous computer experience or training. Those who reported confusion tended to repeat topics but did not necessarily spend more or less time on task.

In the interactivity category, the module was assessed on whether it offered both passive and active interactions with the user and whether it provided the means by which a high degree of user involvement could be achieved. The participants generally responded positively to this category. Some of the participants believed that they were making choices "just for the sake of it." There appeared to be no relationship between this belief and previous computer training and experience, topics viewed, or time spent on task.

Questions in the appropriateness of the multimedia mix category assessed whether various multimedia features worked well in relation to the educational aims of the module and in relation to one another. On the whole, participants perceived the multimedia mix positively. Several participants said that the video clips added to the learning experience but needed to play a little later, allowing the participants to finish reading the accompanying text. A majority of the participants indicated that having extra features would help them learn. The participants who said no to this question reported that the module was "fine the way it was." Several of the participants asked for

clarification of this question; asking if the question meant that the multimedia feature helped them learn or whether additional features would help them learn. Once again, the perceptions of this category seemed to have no relationship with previous computer experience or training,

time on task, or topics viewed. The participants who did not view all of the topics did not see or hear many of the multimedia features and, therefore, had no basis on which to respond to the question.

The mode and style of interaction category sought comment on the nature of the interface in terms of the mode of interaction and the style of interaction, such as, the way choices were made or options selected. All except one of the participants reacted positively to the items in this category. When one participant responded with no, she clarified that the mode or style of interaction made no difference in her perception of the CAI module.

The quality of interaction category assessed the quality of the participants' interactions with the system. The nature of the control that is given to the participant, and the ease of use of the module in terms of the help and support systems and their general level of accessibility were considered. The category also permitted possible comment on the capacity of the module to offer participants the opportunity to make real decisions about her route through the module, thereby enhancing a sense of ownership in relation to the learning process. Observation and interview responses indicated that not all participants knew how to proceed while using the module. There seemed to be no

relationship between not knowing how to proceed and previous computer experience or training, time on task, and topics viewed. A few participants reported that the instructions were not clear or that more were needed. Navigation problems may have been due to several factors, including: (a) lack of proper instruction and guidance throughout the module; (b) inexperience of participants with this type of media and format; (c) more time was needed to adjust and learn how to navigate; and (d) previous computer experiences, training, and attitudes may have influenced the participant. Some believed that the hardware section was too technical. Again, there did not seem to be any relationship between these perceptions and the participants' previous computer experience and training, the topics viewed, and time on task.

The quality of end-user interfaces category addressed the issue of the type of interface that is presented to the participant and with which the participant will have to interact. Type of interface or features might include the use of color and graphics, windowing, the design of icons and the positioning of information. The question about knowing how to use the help system was not included in the instrument or interview because the CAI module did not have a help system. Participants who indicated they had problems with the mechanical aspects of the CAI reported negative perceptions about knowing how to move from one part to another and about using the icons and how to use them.

In the learning styles category, comments were made on the learning style chosen for the subject content under consideration, and the views held by the learner and

designer about the conceptual learning model and the design aims of the product. In this category, participants could also comment on whether the learning material recognized their existing skills and encourages the transfer of these skills into the new learning situation. A majority of the participants considered the learning style of the CAI module to be a tool or a combination of a tool and another learning style. Most of the participants believed that they brought previously acquired skills to this module. No relationship between this belief and previous computer experience and training, time on task, or topics chosen was apparent.

The monitoring and assessment techniques category assessed whether the module monitored the progress of its users, offered formal assessment, or provided the means for self-assessment. This category also addressed whether the module had features that can utilize user information in order to provide support or enhance engagement. A majority of the participants believed that their progress was assessed but eight did not believe that there was adequate feedback. Twenty-seven of the participants did indicate that the module would help them set goals. One student reported that she wanted feedback when she had already viewed a topic, possibly by that topic button changing in some way. There appeared to be no relationship between these perceptions and previous computer experience and training, time on task, or topics chosen.

The last category addressed was built-in intelligence. This category was concerned with whether the module included features of an intelligent tutoring system, used artificial intelligence techniques with knowledge bases, used an expert system, or

used monitored information to provide user support such as advisement strategies or prompting. The participants were divided on their perceptions about "getting extra help from the module because it seemed to remember what they did in the past." There seemed to be no relationship between this perception and previous computer experience or training, time on task, or topics chosen.

The investigator asked the participants for any additional comments or observations about the CAI module. Responses to this question were fairly consistent with responses to prior questions. A few participants asked where the module would be available for their future use. Others recommended adding the use of the module in the undergraduate community health curriculum, especially in the Information Delivery Systems course.

Questionnaire and Presence of Investigator

Two factors that may have contributed to the results of the present study were the questionnaire and the presence of the investigator. The questionnaire was developed by Barker and King (1993) to evaluate interactive multimedia courseware. The questions for non-expert users were applied but many of the participants asked for question clarification. Some of these participants even responded differently once the question was explained. Possibly those who did not ask for clarification interpreted the question in different ways.

The presence of the investigator, both during the observation and the interviewing processes, may have influenced the results. One participant specifically

stated that she would have spent more time on the module if the investigator had not been present, while others indicated that they spent more time on task because the investigator was present. Many participants asked the investigator if they had viewed all of the topics. The investigator instructed the participants that questions could not be answered during the viewing of the module. Because of the investigator's response, participant frustration may have resulted, possibly leading to a shortened or lengthened time on task. Before the interview, the participants were instructed to answer the questions as honestly as possible. However, the participants may have answered the questions in an effort to appease the investigator.

Conclusions

This study attempted to answer two research questions. The following conclusions were drawn from the findings:

Research Question 1. How will undergraduate community health majors utilize a computer literacy CAI module in terms of time on task and topic selection? The participants used the CAI module for 5 to 32 minutes, indicating a relationship between previous computer training and time spent on task, $t(26) = 2.08$, $p < .05$. There seemed to be a relationship between time on task and the number of topics viewed ($r = 0.813$, $p < .001$). There appeared to be a relationship between the topics viewed and the participants' previous computer training, $\chi^2(61) = 624.22$, $p < .01$.

Research Question 2. What were the perceptions of undergraduate community health majors of the computer literacy CAI module following their use of the CAI? In general, the participants perceived the CAI module positively. Some of the participants expressed negative perceptions about the mechanics of navigating in the program. The negative perceptions seemed to have no relationship to previous computer experience or training, time on task, or topics viewed.

Recommendations

Suggestions for the CAI Module

Based on the results in this study, recommendations can be made for the CAI module. During the observation process, the investigator noticed that one of the choices in the word-processing and desktop publishing scenario had an incorrect feedback response. This error needs to be changed to the correct affirmative feedback.

The module should include more instruction throughout. More guidance may alleviate the confusion about the mechanics of navigating in the module. There was evidence during observation and the interviews that some of the participants had difficulty navigating in the CAI module. During the observation process, some participants hesitated or often repeated material. The participants often did not know how to proceed with the scenarios. The participants could make several selections and would return to the scenario after the appropriate feedback. A "Done" button was available for the participant to select once she was finished. Many of the participants

used a menu button instead. During the interviewing process many of the participants reported being confused about navigating the module and suggested more instructions. One way the investigator could address this problem is through different levels of difficulty in the module. There could be a beginner's section which would contain more detailed instructions. But as the user advanced through the intermediate level and into the advanced level, there would be fewer instructions.

Feedback, such as highlighted buttons, may alleviate some of the confusion about the module's mechanics. During the interview process, one participant suggested just this idea. Menu buttons could change color after the topic has been viewed. This would help the participant realize that the topic was viewed and reduce unnecessary repetition. More quizzing or interactions should be included in order for the users to self-assess their progress. The most important untapped aspect of CAI is its capacity to generate interactive quizzes and to guide self-assessment, including remedial exercises, without embarrassment to the learner (Jaffe & Lynch, 1995). All goal-oriented learning needs feedback so that the student knows when the learning objective has been achieved.

A back arrow that allows participants to view previous screens would provide more individual interaction. During the interviewing process, a participant indicated that the menu buttons provided insufficient interaction and control. She wanted a button that would allow her to see the previous screen.

The CAI module could be set up by levels, such as, beginners, intermediate, and advanced. This would allow for more appropriate individual interactions. For those

participants who wanted more advanced features, such as practicing the use of drawing tools, different levels would allow for the inclusion of these types of interaction. Several participants tried clicking on a variety of graphics, wanting to interact and practice some of the tools described in the module. During the interviewing process, these same participants expressed a desire for more interaction in order to learn more about these specific applications. In order to accomplish this, more opportunities would need to be created. This would allow the user to click on graphics or text, allowing her to branch to an application.

When videos are involved, a play button should be added in order for the user to start the video after reading the text. Animation could be played in the same way. Several participants indicated during the interviewing process that they were distracted from reading and missed part of the videos and animations because they started playing before the participants were finished reading. A play button would also enable the user to play the video or animation as frequently as she wanted.

The overall appearance of the CAI module should be changed in order to give it a more professional appearance. Multicultural aspects of graphics should be added to the module. The investigator attempted to represent a variety of ethnic groups but because of the limitations of available software and graphics, this was not accomplished to the satisfaction of both the participants and the investigator. Time was a factor in the development of the module, not allowing for all the special touches needed for a

professional look. For example, more multimedia could be added, including more sound and animation.

One major navigational problem should be addressed. The scenarios are linked to the last button of the various topic menus and return the participant to the previous menu once the "Done" button was selected. If the participant viewed this topic first or at any time other than last, she would not view all of the topics. This technical problem needs to be addressed so that the user can return to the current topic menu if she wants to view more of these topics.

More computer topics should be added to the CAI module. Because of time restraints during module development, several topics were not included in the module. Additional topics would include databases, statistical programs, and spreadsheets.

Record-keeping capabilities would be added to the CAI module for future research purposes. This would involve tracking the user's pathways through the module, time spent on the module as a whole and on individual topics, and correct and incorrect responses to questions asked in the module. Once again, because of time constraints, this aspect was not included in the current module but would help alleviate problems associated with data collection via investigator observation.

Suggestions for Future Research

Based on this study, the following are some of the directions proposed for future research:

1. Replicate the study with more variables, including quality of previous computer experience (positive or negative) and attitudes about using computers. It is estimated that as many as one out of three adults suffer from aversive reactions to computers and computer-related technology (Weil & Rosen, 1990). These aversive reactions vary from feelings of being threatened to having an actual physical fear of even touching computers. In the educational setting, where computers are becoming pervasive, computer resistance may be a real obstacle to academic progress.

2. Modify the questionnaire, making some questions more clear.

3. Avoid the possibility of Hawthorne effect by collecting data via unobstructive videotape or additional programming rather than by direct observation.

4. Instead of the investigator conducting the interview, have the interview questions included in the CAI module.

5. Make the appropriate changes to the CAI module and compare it to a traditional teaching method in order to determine the module's instructional effectiveness.

References

AAHE/SOPHE Joint Committee for the Development of Graduate Level Preparation Standards. (Sept. 30, 1996). Final committee report. Unpublished document.

Agho, A.O., & Williams, A.M. (1995). Actual and desired computer literacy among allied health students. Journal of Allied Health, 24(2), 117-126.

Ajzen, I., & Fishbein, M. (1980). Understanding attitude and predicting social behavior. Englewood Cliffs, NJ: Prentice-Hall.

Barker, P., & King, T. (1993). Evaluating interactive multimedia courseware-a methodology. Computer Education, 21(4), 307-319.

Benaloh, L.A. (1994). Teachers, students, and instructional software: What works well when and why. Unpublished doctoral dissertation, University of Toronto, Toronto.

Bloom, B.S. (Ed.). (1956). Taxonomy of educational objectives. Handbook 1: Cognitive domain. New York: David McKay.

Bloom, B.S. (1976). Human characteristics and school learning. New York: McGraw-Hill.

Burke, R.L. (1982). CAI sourcebook. Englewood Cliffs, NJ: Prentice-Hall.

Butler, J.T. (1997). Principles of health education and health promotion (2nd ed.). Englewood, CA: Morton Publishing Company.

Byrd-Bredbenner, C., & Bauer, K. (1991). The development and evaluation of computer-assisted instruction modules for an introductory, college-level nutrition course. Journal of Nutrition Education, 23, 275-283.

Calderone, A.B. (1994). Computer assisted instruction: Learning, attitude, and modes of instruction. Computers in Nursing, 12(3), 164-170.

Carew, L.B., Elvin, D.W., Yon, B.A., & Alster, F.A. (1985). Using computer-assisted instruction to teach nutrition. Physiologist, 28, 425-427.

Carlton, R. (1991). Computer-assisted instruction. In M. Fay, M . L. Herda, B. L. Huffer, & K. J. Zurla (Eds.), Handbook for educational programs - A guide for radiologic technology educators. Chicago, IL: Joint Review Committee on Education in Radiologic Technology.

Caster, W.O. (1984). Computer use for nutrition majors. Journal of Nutrition Education, 16, 76G.

Chodorow, S. (1996). Educators must take the electronic revolution seriously. Academic Medicine, 71(3), 221-226.

Cohen, P.A., & Dacanay, L.S. (1994). A meta-analysis of computer-based instruction in nursing education. Computers in Nursing, 12(3), 89-97.

Gilbert, G.G., & Sawyer, R.G. (1995). Creating strategies for school and community health. Boston: Jones and Bartlett Publishers.

Gilbert, L.K. (1991). A survey of computer assisted instruction in selected undergraduate health education programs. Unpublished Masters Thesis. University of Maryland.

Glenn, J. (1996). A consumer-oriented model for evaluating computer-assisted instructional materials for medical education. Academic Medicine, 71(3), 251-255.

Gold, R. (1991). Microcomputer applications in health education. Dubuque, IA: Brown.

Horne, D.A., & Gold, R.S. (1983). Guidelines for developing health education software. Health Education, 14(6), 85-86.

IDG's 3-D Visual Series. (1995). Computers simplified (2nd ed.). Foster City, CA: IDG Books Worldwide, Inc.

Infopoint (No date). Infopoint: Computer based training [Online]. Available HTTP: http://web20.mindlink.net/infopoint/cbt.html (1996, November 14).

Jaffe, C.C., & Lynch, P.J. (1995). Computer-aided instruction in radiology: Opportunities for more effective learning. American Journal of Radiology, 164(2) 463-467.

Jonassen, D.H. (1985). The real case for using authoring software. Educational Technology, XXV(2), 39-41.

Kearsley, G. (1984). Instructional design and authoring software. Journal of Instructional Development, 7(3), 11-16.

Komando, K. (1995). 1,1001 komputer answers. Foster City, CA: IDG Books Worldwide, Inc.

Kumar, N.B. (1992). An experimental comparison of three methods of instruction in health education for cancer prevention: Traditional paper prose text, passive non-interactive computer presentation and overt-interactive computer presentation. Unpublished doctoral dissertation, University of South Florida, Tampa.

McNeely, E.A. (1989). Computer-assisted instruction: A health education strategy for the older adult. Unpublished doctoral dissertation, Georgia State University, Atlanta.

Merrill, P. F., Hammons, K., Tolman, M N., Christenson, L., Vincent, B. R., & Reynolds, P. L. (1992). Computers in education. Boston: Allyn and Bacon.

Miller, L.A. (1995) Computer assisted instruction [Online]. Available HTTP: http://www.nova.edu/gtep/SCI/SCI1651/CRS124/leemill.html [1996, November 14].

Montelione, T.L. (1984). Computer assisted instruction in behavior management for the physical education setting. Unpublished doctoral dissertation, Texas Woman's University, Denton.

Napholz, L., & McCanse, R. (1994). Interactive video instruction increases efficiency in cognitive learning in a baccalaureate nursing education program. Computers in Nursing,12(3), 149-153.

Nardone, D.A., Schriner, C.L., Guyer-Kelley, P., & Kositch, L.P. (1987). Use of computer simulations to teach history taking to first-year medical students. Journal of Medical Education, 62, 191-193.

Paperny, D.M., & Starn, J.R. (1989). Adolescent pregnancy prevention by health education computer games: Computer-assisted instruction of knowledge and attitudes. Pediatrics, 83(5), 742-752.

Park, S. (1994). Cognitive psychology in education: Some implications of learning strategies for designing computer-assisted instruction. Unpublished doctoral dissertation, University of Oregon, Eugene.

Petosa, R., & Gillespie, T. (1984). Microcomputers in health education: Characteristics of quality instructional software. Journal of School Health, 54(10), 394-396.

Price B.J., March, G.E., & McFadden, A.C. (1987). Software development: The role of curriculum. T.H.E. Journal, 10, 84-87.

Raidl, M.A., Wood, O.B., Lehman, J.D., & Evers, W.D. (1995). Computer-assisted instruction improves clinical reasoning skills of dietetics students. Journal of the American Dietetic Association, 95(8), 868-873.

Reichle, G.A. (1992). The effect of a computer-assisted instruction program on the behavioral intent of adolescents to enhance mental well-being. Unpublished doctoral dissertation, Temple University, Philadelphia.

Sarvela, P.D., & Karaffa, M.J. (1990). Teaching about authoring systems: Instructional design tools for health education. Health Education, 21(3), 55-56.

Shute, V.J., & Gawlick-Grendell, L.A. (1994). What does the computer contribute to learning. Computers in Education, 23(3), 177-186.

Sponder, B., & Hilgenfeld, R. (1994). Cognitive guidelines for teachers developing computer-assisted instruction. The Computing Teacher, 22(3), 9-15.

Sternin, E. (No date). CCCP report on computer literacy 1993/94 [Online]. Available HTTP: http://www.physics.brocku.ca/doc/cccp/cccp.html (1996, November 14).

Tessler, F.N., Kimme-Smith, C., Marx, P.S., & Singh, H. (1995). Strategies for developing effective computer-assisted instruction: A computer-based teaching module on color Doppler US. RadioGraphics, 15(2), 469-473.

The Internet Public Library (1995). How to gain computer knowledge [Online]. Available HTTP: http://ipl.sils.edu/classroom/userdocs/compskills.html (1996, November 14).

Twigg, C. (1996). Academic productivity: The case for instructional software. Colorado Springs, CO: Broadmoor Roundtable.

Weil, M., & Rosen, L. (1990). The aetiology of computerphobia. Computers in Human Behavior, 6, 361-379.

Whiteside, M.F., & Whiteside, J.A. (1987/88). Microcomputer authoring systems: Valuable tools for health educators. Health Education, 18(6), 4-6.

Zannis, M. (1992). Health educators' use of microcomputer technology in graduate programs. Unpublished Doctoral Dissertation. University of Maryland.

APPENDIXES

Appendix A

Human Subjects Review Committee
Consent to Conduct Research

TEXAS WOMAN'S
UNIVERSITY
DENTON/DALLAS/HOUSTON

HUMAN SUBJECTS
REVIEW COMMITTEE
P.O. Box 425619
Denton, TX 76204-3619
Phone: 817/898-3377
Fax: 817/898-3416

March 27, 1997

Ms. Lynn Miller
1020 Meadowbrooke Dr.
Cedar Hill, TX 75104

Dear Ms. Miller:

Your study entitled "Formative Evaluation of Computer Assisted Instruction on Computer Literacy" has been reviewed by a committee of the Human Subjects Review Committee and appears to meet our requirements in regard to protection of individuals' rights.

Be reminded that both the University and the Department of Health and Human Services (HHS) regulations typically require that agency approval letters and signatures indicating informed consent be obtained from all human subjects in your study. These consent forms and an annual/final report (attached) are to be filed with the Human Subjects Review Committee at the completion of the study.

This approval is valid one year from the date of this letter. Furthermore, according to HHS regulations, another review by the Committee is required if your project changes. If you have any questions, please feel free to call the Human Subjects Review Committee at the phone number listed above.

Sincerely,

Chair
Human Subjects Review Committee

cc. Graduate School
Dr. Judith Baker, Department of Health Studies
Dr. William Cissell, Department of Health Studies

Appendix B

Subject Consent to Participate in Research

TEXAS WOMAN'S UNIVERSITY
SUBJECT CONSENT TO PARTICIPATE IN RESEARCH

Title of Study: Formative Evaluation of Computer Assisted Instruction on Computer Literacy

Name of Investigator: Lynn Louise Miller Faculty Advisor: Dr. Judith Baker

Phone Number: Ms. Miller (817) 898-2862 Dr. Baker: (817) 898-2842

I understand that I am agreeing to participate in a research study and that the purpose of this study is to conduct a formative evaluation of a computer assisted instruction (CAI) module on computer literacy among undergraduate community health majors. First, I will be asked to self-report my age, gender, and prior computer training. In addition, I will complete a brief checklist to evaluate the CAI module during the viewing. I will be observed during the process of using the CAI and interviewed immediately afterwards in order to determine my perceptions about the CAI. I will be asked to spend no more than one hour to view the CAI, complete the checklist, and to be interviewed. The interview questions will address instructional design as well as computer literacy. Responses will be recorded on audiotape and notes will be taken during the interview by the investigator.

I realize that participation in this study may cause embarrassment or discomfort should information be inadvertently revealed. To protect my confidentiality, only the investigator will have access to information I provide. Individual subjects' data will be coded by an identification number rather than by name. Only the investigator will have access to the information linking identification numbers with names. Audiotapes recorded during the interview will also be stored in the locked file box until they have been transcribed, at which time they will be erased (no later than December, 1997). Information that I provide will be stored in a locked file box in the investigator's office for three years, at the end of which time it will be shredded and disposed of through recycling. The issue of confidentiality will be discussed with me at the beginning of the research. Every effort will be made on the part of the researcher to ensure that no personal information is revealed to anyone else. I will be observed and be interviewed individually. Every care will be taken to ensure that the environment is comfortable and safe. I will be given clear and concise written directions for completing the checklist and will have the opportunity to have any questions about the CAI and the checklist answered. I will be asked to openly express my feelings and opinions about the CAI.

I will benefit from this study through the use of the CAI on computer literacy. Computer literacy and computer skills are becoming increasingly important for the effective practice of health education in our technology-based society. While many of the technological skill requirements will change over time, basic computer literacy will remain essential. Many employers are anxious for their workers to have computer skills, because offices are less competitive without employees who are well versed in basic computer skills. Through participation, I will have the personal satisfaction of contributing to a body of research which will help instructors improve CAIs for future health educators. I will receive an abstract of the study's findings and a reference list on the use of CAIs in health education.

I understand that my participation in this study is voluntary and that I may withdraw from the study at any time. My refusal to participate will involve no penalty or loss of benefits to which I am otherwise entitled and will in no way affect my grade in any of my Health Studies courses. The instructor will not be aware of any student's participation or non-participation in this study.

An offer has been made to answer all of my questions and concerns about this study. I will be given a copy of the dated and signed consent form to keep.

- -

We will try to prevent any problem that could happen because of this research. Please let us know at once if there is a problem and we will help you. You should understand, however, that TWU does not provide medical services or financial assistance for injuries that might happen because you are taking part in this research. If you have any questions about the research or about your rights as a subject, we want you to ask us. Our phone number is at the top of this form. If you have questions later, or if you wish to report a problem, please call us or the Office of Research and Grants Administration at 817-898-3375.

____________________________ __________________

Signature of Participant Date

____________________________ __________________

Signature of Investigator Date

Appendix C

Department of Health Studies
Consent to Conduct Research

TEXAS WOMAN'S
UNIVERSITY

DENTON / DALLAS / HOUSTON

DEPARTMENT OF HEALTH STUDIES
College of Health Sciences
P.O. Box 425499
Denton, TX 76204-5499
Phone: 817/898-2860

March 3, 1997

Lynn Miller has permission to conduct her research entitled "Formative Evaluation of Computer Assisted Instruction on Computer Literacy" within the Department of Health Studies during the Spring semester, 1997. Volunteering undergraduate Community Health majors will be the participants in this study.

Sincerely,

William B. Cissell

Dr. Bill Cissell
Chair, Department of Health Studies

Appendix D

CAI Checklist

CAI Checklist

_____ 1. Were the tasks you were asked to do about the right level for you?

_____ 2. When you weren't making choices, was it still interesting?

_____ 3. Did you feel that you could alter things sometimes to suit you personally?

_____ 4. Did you feel that the various features (text, sound, graphics, etc.) worked well together, or did one crowd out the others?

_____ 5. Did the use of the mouse seem natural when using the product or did it restrict you in anyway?

_____ 6. Were you always certain how to proceed?

_____ 7. How did you feel about the way in which information was presented to you?

_____ 8. What do you think this product was trying to be?
--a book?
--a tutor?
--a reference book?
--a tool?

_____ 9. Did this product help you assess how you were getting on?

_____ 10. Did you get any extra help from the product because it seemed to remember what you did in the past?

Your age?
Your gender?
Previous computer experience?
Previous computer training?

Appendix E

CAI Interview Questions

Engagement
Was there enough variety?

Did the product seem relevant to real life?

Was it always clear where you were in this product?

Was it always clear where you were going?

Was it enjoyable?

Was it interesting?

Was it challenging?

Did you feel that you had achieved or could achieve something with this product?

Would you want to use the product again?

Interactivity
Did the product give you enough opportunity to choose and enter things?

Did you ever feel that you were making choices just for the sake of it?

Did you feel that you could decide what you wanted to do?

Could you choose which route you wanted to take that was most relevant to you?

When you were using the product, did you feel that you were basically in control?

Did you get good feedback when needed?

Was it easy to make choices with the equipment provided?

Tailorability
Did you feel that you could alter things sometimes to suit you personally?
turn down the volume?

change the colors?

set up new ways of doing things?

save your own work?
work at the right level?

get just the right level of help?

Appropriateness of the multimedia mix
Video and graphics, did the size seem OK?

Audio, was the sound quality good enough?

In this case, do you think that having extra features would help you learn?

Do you think that having extra features made the product more enjoyable and interesting?

Mode and style of interaction
Did the use of the mouse make using the product more enjoyable or interesting?

Did you like the way that you made choices?

Did the way choices were made alter how you felt about the software?

Quality of interaction
How do you feel about the screen displays?

Was everything always clearly laid out?

Did you find enough help built into the product?

Could you always find out what you wanted from the help system?

Did you get the sense of where this product might fit into your own personal educational scheme?

Did the software ever bother you or confuse you or just mystify you, perhaps because of the language or examples used?

Was it racist or sexist?

Quality of end-user interfaces
Did you always know how to make important choices, like,
moving from one part to another?
calling up the help system?

Did you feel that there was a regular way of moving about the package?

If icons were used,
How did you feel about using the icons?

Was if fairly obvious how to use each one?

Learning styles
Were you able to bring to this product other skills you had already acquired in the outside world or from other computer packages?

Monitoring and assessment techniques
Do you think this product would help you to set goals for yourself?

Appendix F

Author's Permission to Use the Evaluation Checklist

For the purposes of my dissertation committee, your signature on this letter constitutes approval of the use of the "Evaluation Checklist" for my research. Please return one original and keep one for your files (or whatever you want to do with it!) Let me know if there is anything further you need from me.

Thank you for your support of my dissertation research. I will be sure to keep you apprised of the findings of my study. When I begin to get things in written form, you will be on my mailing list. I will also provide you with a copy of my reference list in case there is anything in it which might serve as a useful resource for you sometime.

Sincerely,

Lynn Miller

Lynn Miller, Doctoral Candidate
Department of Health Studies
Texas Woman's University

Permission is hereby granted to Lynn Miller by Philip Barker to use the "Evaluation Checklist" in her dissertation research.

P.G. Barker
Philip Barker

Date 6th August, 1997

Professor Philip Barker,
Interactive Systems Research Group,
Human-Computer Interaction Lab.,
School of Computing and Mathematics,
University of Teesside, Borough Rd,
Middlesbrough, Cleveland,
TS1 3BA, UNITED KINGDOM.