ADULT LEARNERS' PERCEPTIONS OF THE EFFECTIVENESS OF COMPUTER-BASED INSTRUCTION RELATED TO SYSTEMS APPROACH DESIGN ELEMENTS

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PREFACE

My work for the past three years as an education specialist at the FAA Academy in Oklahoma City, Oklahoma, is what inspired me to select a combination of computer-based instruction and course development as the topic for my study. For several years now, various branches at the Academy have undertaken vast course development projects with emphasis, in many cases, being on computer-based instruction. Though many people have worked on these projects and large amounts of money are spent on them, there seems to be an overwhelming number of problems with courses once they are completed. Many revision efforts seem to be to correct errors in development. I wanted to find out why, and to devise a method whereby these unnecessary costs could be avoided. This study is my beginning in that direction.

Several key people have been instrumental in helping me work toward my goal. The most tolerant of these people have been my husband, J.W., and my two children, Chris and Shawna. They have been willing to give up many hours of my time to allow me the time to complete my study. Another very helpful individual has been my adviser,

Dr. Waynne James. Her encouragement, helpfulness, and interest in me gave me the "boost" I needed to complete my task. A special "Thanks" also goes to the other members of my committee, Dr. John Baird and Dr. Deke Johnson.

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INTRODUCTION

Adult education is a relatively new concept. It has really always been in existence, but it has "changed faces" in more recent years.

As pointed out by Naisbitt (1982), advanced technology has caused educators and other training personnel alike to take a good look at just how adults are educated or trained. Just when offices are demanding more highly-skilled workers - to operate a word-processing machine, for example - what they are getting is graduates who would have a hard time qualifying for the jobs that are already technically obsolete (Naisbitt, 1982). It is rather alarming to note that

> . . . the half-life of a graduating engineer's usable knowledge is estimated at five to seven years; that the career of a 20-year-old is destined for major redirection every ten years; that the 'Pepsi Generation,' now 35 years old, is continually relearning for jobs that did not exist ten years ago; and that the task of staging learning has shifted from the schools to the training rooms of business and industry (Neher and Hauser, 1982, p. 48).

It has become more and more apparent that many needs of adult learners are no longer being met via the heretofore accepted traditional methods of instruction. As

indicated by Neher and Hauser (1982), much of the responsibility for adult education or training has shifted from the classroom to the job. Many businesses, including government, have come to realize that training is now an integral part of any work environment. But the training need has grown at such an insurmountable rate that supply of individual instructors, classrooms, and money can no longer meet the demand. This is where advanced technology itself must meet the demands imposed by advanced technology (Naisbitt, 1982). This has given rise to the increased need for the computer.

Though computerized instruction is not new, it is still in the developmental stages (Grossnickle and Laird, 1981). The big "push" in recent years has been to "switch to automation," particularly in the field of training and education.

The problem is that many businesses and government agencies have not had in-house personnel who were adequately trained to develop quality courseware to be used on the computer. Contract development work was tried, in some instances, to satisfy this deficiency, but evidence still seemed to indicate that the target had been slightly missed; the users' needs were still not being fully met (Branson, 1978). Many of these user agencies went back to in-house development efforts. In their haste to satisfy an ever-growing need, very quick, often inadequate, training was provided in-house in an attempt to teach

people how to develop courseware for use on the computer. According to Fisher (1982), the result of this "quick training" was the production of many computer courses which were simplistic in design, did not utilize creative techniques, and did not exploit the medium as they should have. Untrained and unqualified developers were defeating the purposes for using advanced technology; they were blocking their own progress. The result was very costly in terms of time, money, and energy, both for the agencies and for the individuals being trained. Most importantly, as Fisher pointed out, the individuals who expected to receive quality training were, in essence, short-changed; they were "cheated" because of someone else's inadequate training and management's haste to respond to a need without first laying proper groundwork.

Statement of the Problem

There has been no investigation of adult learners' perceptions of computer-based instruction (CBI) course effectiveness as it relates to the systems approach to developing training materials at the Federal Aviation Administration (FAA) Academy, and there has been no development check-off sheet used to ensure that a systematic approach to development of training materials is used so that needs can better be met.

Purpose of the Study

The purpose of this study was to determine how adult students at the FAA Academy perceive the effectiveness of CBI courses as it relates to the systems approach to course development and to compile, from these data, a check-off sheet that can be used by course developers to ensure that a systematic approach to development is used. The study sought to answer the following questions:

1. Did students perceive that the systems approach to development of CBI training materials was utilized?
2. Were maximum computer capabilities utilized?
3. How did students perceive the effectiveness of the course?

Scope and Limitations

The scope and limitations of this study were as follows:

1. All surveying was conducted in the Oklahoma City area at the FAA Academy in the computer room.
2. The opinionnaire was given to adult students who had taken at least one FAA Academy CBI course during the time from February until April, 1983.
3. Courses reflected in the study were of varying degrees of difficulty and complexity.

Assumptions

For purposes of this study, the following assumptions were accepted by the author:

1. The computer-based courses taken by the surveyed students represented a cross-section of all computer-based courses.

2. All responses on the opinionnaires were honest expressions of students' opinions.

3. All students surveyed were qualified to assess the effectiveness of the courses.

4. Subject matter presented via computer was not considered in the outcome of the survey.

Definitions of Terms

The following definitions are furnished to provide a clear meaning of terms used in this study. The definitions as stated are compilations of definitions extracted from many sources.

Adult learner - Any individual who assumes responsibility for his own learning.

Branching - An option available on the computer which allows students to move at their own option from one area of instruction to another, depending upon their specific need.

Computer-assisted adult learning (CAAL) - Any learning endeavor involving an adult who utilizes a computer to

master a portion of the curricula.

Computer-assisted education (CAE) - Often used synonymously with computer-assisted instruction.

Computer-assisted instruction (CAI) - Any instruction which utilizes a computer to present a portion of the course material.

Computer-based instruction (CBI) - Any instruction which utilizes a computer to present all or any portion of the course material. It includes CMI and CAI. NOTE: CAI and CBI are often used interchangeably in this study.

Computer-managed instruction (CMI) - Any administrative use of a computer, specifically record-keeping and student statistical data.

Courseware - Educational or training material developed specifically to be utilized for computerized teaching.

Organization of Study

Chapter I introduces the study, provides a statement of the problem, specifies the purpose of the study, sets forth the scope, limitations, and assumptions, and provides definitions of terms utilized in the study. Chapter II provides an overview of materials researched to provide background information and supportive data for the study that was conducted. This includes the transition from traditional to computerized instruction, evolution of computerized instruction, computerized instruction for adults, and design and development of CAI courses.

Chapter III explains exactly how the study was conducted, describes the data-gathering tool, and explains how the data-gathering tool was utilized. The results of the study are described in Chapter IV in both narrative and tabular format. Chapter V includes a summary of the entire study, the conclusions gleaned from the study, implications, and author recommendations, including a proposed CAI lesson development check-off sheet.

CHAPTER II

REVIEW OF LITERATURE

The literature related to this study was reviewed in the following four areas: (1) Transition from Traditional Instruction to Computerized Instruction, (2) Evolution of Computerized Instruction, (3) Computerized Instruction for Adults, and (4) Design and Development of CAI/CBI Courses.

> A decade ago, in Future Shock, Alvin Toffler predicted that the illiterate of tomorrow will not be people who can't read and write, but rather people who can't learn, unlearn, and relearn. That tomorrow is today (Neher and Hauser, 1982, p. 48).

In order to accurately capture the reality of the impact of computerized instruction on adult learners, the evolution of computerized instruction for that decade Toffler mentioned (Neher and Hauser, 1982) was traced. During that same time span, a gradual weaning from the traditional learning to computerized learning took place (Palko and Hata, 1982). That transition was also explored in this study.

Use of computerized instruction impacts on the design structure of the training material itself (McPherson-Turner, 1979). With this in mind, the idiosyncrasies of

computerized instruction as it pertains to adult learners was investigated. Since design structure of computerized courses was a primary focal point for this study, research then delved into the "how's" and "why's" for quality course development.

Transition from Traditional Instruction to Computerized Instruction

The straight lecturing environment for training adults is almost a thing of the past (Morgan, 1978). Instruction has undergone numerous metamorphic changes over the last several decades. The "new math" has come and gone. The pendulum has swung away from teaching phonics and then swung back again. Emphasis of curriculum has shifted from vocational to academic and then begun shifting back to vocational. Students are now allowed to interact in the classroom where once they were expected to simply listen.

Instruction has constantly been in a state of flux simply because society itself is in a continual state of change. Each time there has been a new invention or discovery, instruction has been influenced in some way or another (Toffler, 1980). The introduction of the computer age was certainly no exception. If anything, this one advance in technology may well prove to have had the most profound impact on instruction of any other single discovery in history (Grossnickle and Laird, 1981).

It is extremely difficult to give up or alter old ways of doing things, particularly if they work. Instructors are no different. If they were comfortable in a lecturing, instructor-centered atmosphere, they probably found it difficult to shift to a student-centered atmosphere. If instructors preferred to do it all themselves, they probably had a difficult time adjusting to the idea of using computers as instructional media (Steffin, 1982). Instructors have actually had to adjust to moving from the "print age" into the "electronic age," and many of them have had adjustment problems (White, 1981).

Research (Grossnickle and Laird, 1981) tends to indicate that, in order for the transition to take place and be accepted by instructors, the change must be planned, organized, slow, and methodical. In places where the change has already begun, the transition started with the indoctrination of those who had to use the system - - the instructors themselves.

The greatest proponents of computerized instruction at first were instructors of math and foreign languages, because their subjects lent themselves more readily to systematic, sequential presentation (Dence, 1980). In fact, math instructors were recognized as the agents of change from traditional methods of instruction to the use of the computer (Grossnickle and Laird, 1981).

According to Grossnickle and Laird (1981), many

educational institutions have tried, often with expensive and devastating results, to implement the use of computers in their curricula without the proper planning. One school district, however, planned and implemented properly by carrying out the initial phases of the transition in a methodical way, with very good results (Grossnickle and Laird, 1981). This was a suburban school district in Chicago. Their primary focal point was Palatine High School.

The district was viewed as a rather conservative one, slow to make changes. Because of this, however, they introduced electronic learning gradually, one school at a time. They began with an implementation plan which included strategies designed to enhance the project's success (Grossnickle and Laird, 1981).

The district's first purchase was in 1973. It was a computer with two terminals and was to be used in the math department for a computer programming course. In 1974, they supplemented their system with a timesharing system with several classroom telephone lines. Another purchase made in 1974 was from IBM. It was a computer used primarily for administrative purposes.

Since the math teachers were the first users, they served as recourse specialists in each of the schools in the district. They helped other teachers.

Laird (Grossnickle and Laird, 1981) was one of these

resource specialists who became interested enough in the program that he went to school at night and in the summers at the Illinois Institute of Technology. There he received his master's degree for teachers in computer science.

Many other resource specialists also attended training seminars, often on their own time, to learn more about the program. They did this because they recognized the fact that teacher training in computerized instruction was extremely inadequate (Grossnickle and Laird, 1981).

The entire implementation effort was aided and supported by the Board of Education. Even with this support, it took two years to develop the software to support their first initial program.

In the fall of 1979, two different schools in the district requested microcomputers. The demand for the instructor training became so great that Laird was released from his teaching duties to work full time on this endeavor. These instructor training sessions were conducted in small groups, with representatives from each school. The instructors who were selected (from volunteers) to attend the first training sessions were those whose use of the computer would be greatest. The in-service training sessions lasted 12 weeks and covered (1) operation of the equipment, (2) examination of software, and (3) identification of specific applications of the microcomputer for instructional use (Grossnickle and Laird, 1981).

In addition to this training provided during the day, three courses were offered in the district at night for graduate credit. These courses were an Apple II BASIC programming course and two microcomputer introductory courses.

The implementation of computerized instruction was so successful in this district that instructors were volunteering for the training at a rate far greater than demand could meet. The success of this program was specifically due to the fact that initial realistic, attainable goals were set, then a systematic plan of implementation was slowly and methodically carried out (Grossnickle and Laird, 1981). This is only one example of many which proves that transition from traditional instruction to computerized instruction can occur rather smoothly and successfully if there is (1) proper managerial support, (2) adequate instructor training, and (3) sufficient time allowed to implement the program properly (Grossnickle and Laird, 1981).

Evolution of Computerized Instruction

According to Atkinson and Wilson (1969), three factors which significantly contributed to the rapid growth of CAI were: (1) development of programmed instruction, (2) mushrooming of electronic data processing, and (3) increased federal aid to education. Computerized instruction as it

exists today, then, owes much of its succes to the "seeds" which were planted, as early as the 1950's by individuals such as Skinner, since his work was credited with having incited interest in programmed (individualized) instruction. It might even be said that programmed instruction was computerized instruction in an embryonic state (Atkinson and Wilson, 1969).

It was in the late 1950's that the concept of computers as tools in the educational process was actually introduced (Campbell, 1980). These ideas, however, seemed to be more favorably viewed by scientists than they were by educators. According to Campbell, scientists were looking at the usability, practicality, and far-reaching aspects of the equipment, while the educators were a bit skeptical about the prospects of possibly being replaced by machines. There was still, however, some interest from educators in the possibility that there might be "something" out there that could free them a little by assuming some of their instructor responsibilities (Campbell, 1980).

The tremendous cost was another initial negative aspect of CAI. Costs greatly limited extensive employment of this new innovative approach to instruction (Campbell, 1980).

As pointed out by Campbell (1980), the decade of the 1960's really brought about the birth of computerized instruction. This birth was assisted by a "mid-wife" in the form of federal support,

In 1963, Suppes at Stanford University received some of the first federal money. Suppes's initial work was in the development of CAI in arithmetic computation and was designed primarily to be used by elementary school children (Campbell, 1980).

By 1965, Suppes was field-testing his program. The students who participated in his study used a typewriter like terminal. They were given simple addition, subtraction, multiplication, and division problems. The students were required to type in their responses. If either one or both of their first two responses were incorrect, they were given another chance on that problem. If they missed three times in succession, they were given the correct response, and were then given a new problem. If they responded correctly at any time, they were also given a new problem.

As cited by Campbell (1980), Suppes's subsequent work branched into programs in reading and spelling. The type of instruction he used came to be known in the computer world as "drill and practice." This era marked the infancy of computerized instruction.

According to Campbell, by 1968 other universities, namely Harvard and Florida State, had gotten their fingers into the CAI pie. Harvard even had its own CAI laboratory and was using it to offer instruction in such advanced courses as physics and chemistry. By that time, interest in computerized instruction had also spread to such

companies as RCA and IBM.

Research and experimentation continued (Campbell, 1980), with more and more people becoming involved. The next advance in CAI utilized a method of feedback for students which provided remedial instruction. This approach was called "tutorial." In the tutorial approach, a student's incorrect responses were analyzed by the computer, and the student was given feedback to assist him in his comprehension of the subject. This feedback could be provided in a variety of ways, depending upon the program developer's ingenuity and, of course, the limitations of the equipment at that time. Computerized instruction had officially entered its childhood (Morgan, 1978).

The next significant advance in CAI was in simulation and gaming (Campbell, 1980). This, too, was experimental at first, but rapidly spread to various universities and companies. IBM even began developing CAI materials to use in training its own employees.

Instructors began to realize that CAI could be a great boon in the education of some special students. As an example, Rochester Institute of Technology used CAI to teach deaf students (Campbell, 1980). In-home computers were also introduced to assist home-bound students.

According to Morgan (1978), in the late 1960's and early 1970's, computerized instruction entered adolescence. Experimentation proved that computers could be used for

administering, scoring, and analyzing results of tests. Computer-managed instruction (CMI) also came into existence. But mixed with these sporadic growth spurts, CAI also experienced some tremendous growing pains (Morgan, 1978; Campbell, 1980). According to Campbell (1980), government funding came to a halt and, as a result, so did many CAI programs. Though more than a decade had passed since CAI's birth, development and equipment costs were still prohibitive for all but a few.

Campbell (1980) cited one CAI development effort which survived the financial crunch. It was a program conducted by the University of Illinois. Their program was known as PLATO (Programmed Logic for Automatic Teaching Operations). PLATO's survival was due, in part, to the funding received by the National Science Foundation (NSF) and Control Data Corporation (CDC). According to Campbell (1980), other than PLATO, the growth of computerized instruction seemed to have almost stopped.

About that same time, however, another growth spurt occurred in the form of miniaturization of computer components. This caused a considerable decline in the cost of computer hardware; consequently, schools could afford to actually buy the equipment they had only heard about before and home computers became a reality (Campbell, 1980). Teachers began to view computers as aids to instruction rather than as threats to their job security. Large

companies began once again to invest money to support the expansion of CAI. Interactive instruction came into being. Televisions, tape recorders, printers, telephones, and other media were merged with the computer to further expand the technological capabilities. As illustrated by Campbell (1980), computerized instruction had finally reached adulthood. Its history, however, is not over. It has come a long way in a few short years, and it appears it will have a long, productive life (Campbell, 1980).

Computerized Instruction for Adults

Though the computer equipment capabilities are very far-reaching, computers are no better than the programs that they deliver. This is where the developers come into play (Seiler, 1981).

One thing many developers of computerized instruction have failed to realize is that adult learners do not respond to exactly the same type stimuli as do children. Adults also do not learn for the same reasons children do. The andragogical approach to learning versus the pedagogical approach should exist in computerized instruction just as it should in the traditional classroom environment. The comparison of the assumptions and designs of both these approaches is best illustrated in Figure 1 shown on the following page (Knowles, 1978).

Adults who are responsible for their own livelihoods

Assumptions		
	Pedagogy	Andragogy
Self-concept	Dependency	Increasing self-directiveness
Experience	Of little worth	Learners are a rich resource for learning
Readiness	Biological development social pressure	Developmental tasks of social roles
Time perspective	Postponed application	Immediacy of application
Orientation to Learning	Subject-centered	Problem-centered

Figure 1. A Comparison of the Assumptions and Designs of Pedagogy and Andragogy

Design Elements

	Pedagogy	Andragogy
Climate	Authority-oriented; Formal; Competitive	Mutuality; Respectful; Informal
Planning	By teacher	Mechanism for mutual planning
Diagnosis of needs	By teacher	Mutual self-diagnosis
Formulation of objectives	By teacher	Mutual negotiation
Design	Logic of the subject matter; Content units	Sequenced in terms of readiness
Activities	Transmittal techniques	Inquiry techniques
Evaluation	By teacher	Mutual re-diagnosis of needs; Mutual measurement

Figure 1 (Continued)

and are experienced in taking responsibility and making decisions, want a role in deciding what is to be learned, that is, they want to be involved in planning their own learning experiences (Bedient and Rosenberg, 1981). Computerized instruction offers them this opportunity (Campbell, 1980).

Since most adults have a broad learning base, CAI lessons which offer branching and by-passing are generally of more benefit to them. This not only allows adults to learn what they want, but to learn when they want to (teachable moment) (Dence, 1980; Neher and Hauser, 1982).

Pre-testing is also available to allow learners the option of taking only those portions of a course in which deficiencies exist. Lessons can also be designed to allow for individual pacing, periodic self-checks, and individual self-evaluation. The one major plus in all this is that adults do not feel threatened, embarrassed, or intimidated by a computer, providing the lessons are well designed. Adults can interact as often as they so choose, make numerous errors, and no one knows except the individual himself (Neher and Hauser, 1982).

Design and Development of CAI Courses

The real crux of the effectiveness of computerized instruction lies in the design and development of the courseware (Seiler, 1981). When taking a CAI course,

particularly for the first time, most people expect to participate in a rather unique learning experience. When they do nothing except read one screen display after another (page turners), they quickly become bored and disappointed in this "new way" of learning (Anderson, 1976).

To be effective, it is of utmost importance that CAI lessons be developed following certain guidelines. Once instructional materials are on a computer, it takes more effort to make changes or corrections than it does if an instructor is presenting the material himself. If the design and development guidelines are properly followed, quality CAI lessons ought to be developed with greater effectiveness and more positive impact on learners (Seiler, 1981).

The primary aspects of any CAI development endeavor are (1) team effort, (2) formal training, (3) the systems approach, and (4) periodic reviews (Seiler, 1981). As Seiler (1981) points out, designing and developing CAI lessons requires expertise in several areas. There needs to be a subject-matter specialist, an experienced instructor, an education specialist with writing and instructional design experience, a programmer, a graphics artist, and an editor. Some of these people may, of course, have overlapping qualifications, so there may not necessarily be six separate people involved.

Research at the University of Delaware on CAI

development indicates that, for any quality development effort to transpire, there must first be adequate training provided for those involved (Seiler, 1981). This training must be accomplished before the development actually begins.

In designing CAI instructional materials, a systematic procedure should be followed. This procedure could be divided into four major components - - planning, development, evaluation, and implementation (Seiler, 1981).

The planning stage should begin with the establishment of a need for training. Once a need has been verified, the target audience is identified, and a task analysis should be conducted to determine exactly what needs to be taught.

The next planning step would be to develop some educational objectives. These objectives should tell the student what he should be able to do at the end of his training.

According to the systematic approach to lesson/course development, the next step in the procedure would be to develop the evaluation instrument that would be used to test mastery of the objectives. It should be criterion referenced.

The next step in planning would be to determine how training could best be conducted. Outlining the lesson itself would be the final planning step, incorporating notes on possible problem areas.

The development stage would involve sequencing and writing materials (including interactive items) and programming. In the initial implementation, it would be best if the development team could "try it out" first to see that everything worked as it should and to ensure that all objectives were taught.

The evaluation stage would actually not be last but, in fact, would be on-going throughout the entire development effort. Evaluation should be done both by those involved in the design and development and by the users (students).

Evaluation results should be used to revise, correct, and update instructional materials and methods of presentation. It should be continual even after development is considered complete.

Even after a lesson goes through this systematic development, it should be reviewed by all involved in the design and development. Reviews should focus on the structure and approach of the lesson, on the text, layout, graphics, interaction, feedback, help, and branching of every display (Seiler, 1981). According to Seiler (1981), the reviews should result in the production of more effective, quality instructional materials that would have a positive impact on students, which is the ultimate goal of computerized instruction.

Related Studies

The researcher found that there have been many related studies conducted regarding the systems approach to course development (Dick and Carey, 1978); however, studies concerning application of the systems approach to developing computerized instruction are somewhat limited. Three such specific studies were conducted, and are currently on-going, at the Universities of Ohio, Delaware, and Florida State (Dick and Carey, 1978; Seiler, 1981). All of these studies were utilized as resources for the development of this study.

There have been no previous studies conducted at the FAA Academy regarding the systems approach to course development and its application to CAI. This was the primary reason the researcher selected these subjects for research.

Summary

This study traced the transition of instruction from traditional to computerized. It documented the fact that, due to technological advances in automation, there was a gradual shifting from traditional methods of instruction to a computerized method. It traced the evolution of computerized instruction from its birth to the present. It specifically documented the peculiarities of computerized instruction as it relates to adult learners, and it documented the design and development of CAI courses.

CHAPTER III

METHODOLOGY

Introduction

The purpose of this study was to determine how adult students at the FAA Academy perceive the effectiveness of CBI courses as it relates to the systems approach to course development and to compile, from these data, a check-off sheet that can be used by course developers to ensure that a systematic approach to development is used. Spring semester, 1983, was the time utilized for compilation of the data. This chapter specifies the methodology used. It includes a description of the population and sample used, development of the data-gathering instrument, collection of the data, and the data analysis.

Population and Sample

The population of this study was adult students who enrolled in FAA Academy CBI courses. The total number of these students was not available to the researcher, since many of the students are physically located at some place other than the FAA Academy. They also are enrolled through four separate branches of the Academy, with each

branch maintaining its own confidential enrollment records. The sample was 25 randomly-selected students who took CBI courses in residence at the FAA Academy in the computer classroom during the spring semester, 1983. The sample contained only 25 students because there were only an average of four students enrolled per week who were available for this study.

For the sample students, CBI was only one medium utilized for their training. For many of the sample students, these courses gave them their first experience with a computer. Though this was not a considered factor in this study, it may have had some bearing on the outcome.

Development of the Data-Gathering Instrument

The data-gathering instrument (see Appendix A) was designed by the researcher. This "opinionnaire" was used to document students' opinions regarding the systems approach design elements specifically related to CBI courses.

The reaction questions contained in the opinionnaire were actually a compilation of ideas extracted from several other sources (Seiler, 1981; Dick and Carey, 1978). Also utilized was information extracted from course development research conducted at Ohio State University (McPherson-Turner, 1979) and information compiled at the University of Delaware (Seiler, 1981). Some of the questions were

developed by the researcher based on personal experience from having developed CBI courses and having taught and worked with adults who had been exposed to computerized instruction.

The format incorporated the first three of the four major components described by Seiler (1981)--planning, developing, and evaluating. The fourth component, implementation, was not incorporated because that extends beyond the scope of this study. The design structure of the opinionnaire was an original development project by the researcher.

The questions on the opinionnaire were divided into three major areas: (1) those regarding the systems approach, (2) those regarding utilization of computer capabilities, and (3) a single question to determine students' perceptions as to the effectiveness of the CBI portion of the courses. Also, additional comments were solicited to allow students to provide additional input so the resultant course development check-off sheet (see Appendix B) would be more complete and useful. The opinionnaire was field-tested with several technical and educational FAA Academy staff members, and no revisions were made prior to administration.

Collection of the Data

The opinionnaires were administered in the FAA Academy computer classroom. They were personally administered by

the researcher to each student and were collected as soon as they were completed. This ensured 100 percent response and also eliminated a time lag for mailing.

A brief description of the opinionnaire itself, including its purpose, was given to the students verbally by the researcher. After collection, all responses on the opinionnaires were tabulated and prepared for further analysis.

Analysis of the Data

The opinionnaires were all reviewed, and the various responses were tabulated. The responses were then summarized in narrative and tabular format to show the relationship between students' perceptions of the effectiveness of CBI and the systems approach design elements. The students' additional comments were then summarized and reported in narrative format.

CHAPTER IV

PRESENTATION AND DISCUSSION OF FINDINGS

Introduction

The findings of the study are presented in this chapter. These findings are organized as follows: (1) Respondents, (2) Utilization of the Systems Approach in Course Development, (3) Utilization of Computer Capabilities in Course Development, (4) Course Effectiveness, (5) Additional Student Comments, and (6) Development of CBI Course Development Check-Off List. The students' "No" responses and "Partially/Sometimes" responses on the opinionnaire were both considered as negative for this study.

Respondents

Persons responding to the opinionnaire were adults of varying ages and backgrounds. They were technical people, not educators. Both males and females responded. All 25 persons who were asked to complete the opinionnaire did so.

Utilization of the Systems Approach in Course Development

The first portion of the opinionnaire covered the

planning component of course development. The first item of that portion dealt with students' needs for the training they received via CBI. One of the primary aspects of the systems approach to course development is that a needs analysis must be conducted to determine that a need for the proposed training really exists. All students in this study indicated that they had a need for the training that was provided (see Table I).

Another requirement of the systems approach is that objectives must be provided. This gives the developer the basis for all course development. These objectives are based on tasks required to perform a given job, and the tasks are extracted from a job task analysis. Further, these objectives should be provided to the student so he knows exactly what he must learn. The data in Table I indicate that 22 students in this study said objectives were provided; three students said objectives were sometimes provided. Of the 25 students who indicated that objectives were provided or were sometimes provided, 19 of them indicated that the objectives were understandable, 20 indicated they were sufficient in number, and 16 indicated that the text supported them. Of the same 25 students on the subject of objectives, six indicated they were sometimes understandable, one indicated there were not sufficient numbers of them, four indicated there were sometimes sufficient numbers, four indicated that the text

TABLE I

STUDENTS' RESPONSES CONCERNING
PLANNING COMPONENTS OF
COURSE DEVELOPMENT

Planning Components	Yes N	No N	Partially/ Sometimes N
Need	25	0	0
Objectives	22	0	3
Understandable	19	0	6
Sufficient	20	1	4
Supporting Text	16	4	5
Objectives Tested	20	0	5
Computer as Medium	10	15	0

did not support the objectives, and five indicated that the text sometimes supported the objectives.

The next step in the systems approach to course development specifies that mastery of objectives must be tested (measured). In response to the question regarding measurement of objectives, 20 students indicated that they were, and five indicated they were not.

The next step in the systems approach to course development is to determine the best medium/media through which the subject matter can be presented. Regarding the question on the opinionnaire pertaining to whether or not the computer was a good medium for teaching the material, 10 students indicated that it was, and 16 indicated that it was not (see Table I).

Students' responses to questions concerning the planning component of the systems approach to course development indicated that all students had a need for the training presented, but some felt that the computer was not the best medium for presenting the material. They also indicated that, though objectives were most often presented, they were not always written as they should have been, and the text was not always written to support them. Some students also indicated that there was not adequate testing over the objectives. These are all key points for quality courses that will, in fact, meet the needs of the students.

The second portion of the opinionnaire covered the

developing component of course development. Responses to this portion are presented in Table II. The first item of that portion dealt with whether students understood the directions. Of the 25 students, 16 of them indicated that the directions were understandable, two indicated they were not, and seven indicated they sometimes were.

As far as the course material being logically sequenced, 18 students indicated that it was, two indicated that it was not, and five indicated that it sometimes was. Of course, it does not matter whether subject matter is logically sequenced if the students do not understand it. In response to the question pertaining to the subject matter being written in an understandable manner, 12 students indicated that it was, four indicated that it was not, and nine indicated that it sometimes was.

Another primary factor in the systems approach to course development is that the students must have an opportunity to practice what they have been taught. Regarding practice, 17 students indicated that it was provided, four indicated that it was not, and four indicated that it sometimes was. Of the 21 students indicating that practice was or sometimes was provided, 12 indicated that it was sufficient, three indicated that it was not, and six indicated that it sometimes was; 18 indicated that the practice was relevant, two indicated that it was not, and one indicated that it sometimes was.

TABLE II

STUDENTS' RESPONSES CONCERNING
DEVELOPING COMPONENTS OF
COURSE DEVELOPMENT

Developing Components	Yes N	No N	Partially/ Sometimes N
Understandable Directions	16	2	7
Logical Sequence	18	2	5
Understandable Subject Matter	12	4	9
Practice Provided	17	4	4
Sufficient	12	3	6 *
Relevant	18	2	1 *
Feedback Provided	19	2	4
Helpful	18	2	3 **
Appropriate Time	19	3	1 **
Material Accurate	16	2	7
Course Length Adequate	16	5	4

*Numbers do not equal 25 because four students indicated no practice was provided.

**Numbers do not equal 25 because two students indicated no feedback was provided.

For students to be apprised periodically of their progress as they proceed through a course, the systems approach specifies that there should be feedback provided to the student, particularly regarding test items and practice items. In response to the question regarding feedback, 19 students indicated that it was provided, two indicated that it was not, and four indicated that it sometimes was. Of the 23 students who indicated that feedback was provided or was sometimes provided, 18 indicated that it was helpful, two indicated that it was not helpful, and three indicated that it was sometimes helpful; 19 indicated that it was provided at the appropriate time, three indicated that it was not, and one indicated that it sometimes was.

In response to the item dealing with technical accuracy of subject matter, 16 students indicated that it was, two indicated that it was not, and seven indicated that it sometimes was. Another primary aspect of the systems approach to course development is that only material which one needs to master given objectives should be included. Superfluous information should be avoided. This would influence course length. In response to the question regarding adequacy of course length, 16 indicated that it was adequate, five indicated that it was not, and four indicated that parts of the course were adequate in length.

Utilization of Computer Capabilities in Course Development

Maximum utilization of computer capabilities is also a major aspect of the developing component of course development. Results of computer utilization are in Table III. The first item concerning computer utilization was "Were graphics utilized?" To this question, 17 students indicated that graphics were utilized, five indicated that they were not, and three indicated that they were sometimes used. Of the 20 students who indicated that graphics were utilized or were sometimes utilized, 18 indicated that they were helpful, and two indicated that they were sometimes helpful; 17 indicated that they were relevant, and three indicated that they were sometimes relevant.

By-pass capabilities allow students to advance to materials they need without having to go through that which they already know or that for which they have no need. This is a very important aspect of computer utilization, particularly as far as training for adults is concerned. In response to the question regarding by-pass capabilities, 12 students indicated that it did have by-pass capabilities, and 13 indicated that it did not.

Branching capabilities are another very important aspect of computer utilization that is vital to training adults (Fraser, 1982). This allows individuals to

TABLE III

STUDENTS' RESPONSES CONCERNING COMPUTER UTILIZATION AS PART OF THE DEVELOPING COMPONENT IN COURSE DEVELOPMENT

Computer Utilization	Yes N	No N	Partially/ Sometimes N
Graphics Utilized	17	5	3
Helpful	18	0	2
Relevant	17	0	3
By-Pass Provided	12	13	0
Branching Provided	10	12	2 *
Help Available	21	1	3
Via Instructor	21	2	1
Via Computer	12	7	5

*One student did not comment.

"branch" into subject areas for greater concentration on problem areas or areas of particular interest. In response to the question pertaining to branching capabilites, 10 students indicated that these capabilities were provided, 12 indicated that they were not, two indicated that they sometimes were, and one student did not comment.

It is also important that students feel that they are provided with help along the way as they progress through a course. Of the 25 students completing the opinionnaire, 21 indicated that help was available, one indicated that it was not, and three indicated that it sometimes was. Of the 24 students indicating that help was available or was sometimes available, 21 indicated that help was available via the instructor, two indicated that it was not, and one indicated that it sometimes was; 12 indicated that help was available via computer, seven indicated that it was not, and five indicated that it sometimes was.

Course Effectiveness

The third course development component utilized in this study was evaluation. The results of this portion of the opinionnaire are shown in Table IV. Since program evaluation is, in itself, a major study, the question used on the opinionnaire asked the students whether the impact of the course on them was positive or negative. There were 13 students who indicated that the impact was

TABLE IV

STUDENTS' RESPONSES CONCERNING
EVALUATION COMPONENT OF
COURSE DEVELOPMENT

Evaluation Component	Positive N	Negative N
Kind of Impact on Student	13	12

positive, and 12 who indicated that it was negative.

Additional Student Comments

In order to ascertain if the students perceived that there were other aspects of course development that should be incorporated, additional comments were solicited on the opinionnaire. Data in Table V indicate the following comments were made. Two students indicated that there was no capability for reviewing/changing items on exams. Also in regard to exams, one student indicated that ungraded exams should be utilized as learning tools. Three students would have preferred lecture/lab, one student indicated that the computer was not a good medium for initial training in a subject, and four students indicated that there were too many computer-specific problems. Regarding feedback, one student indicated that it was not immediate, three indicated that it was not personal, and one indicated that it was not specific, i.e., provide text pages to read, films to see, slides to view, etc. As far as computer utilization was concerned, one student indicated that by-pass capabilities were too limited for adults.

Development of CBI Course Development Check-Off List

The primary reason for conducting this study was to document adult students' perceptions of the effectiveness

TABLE V

STUDENTS' ADDITIONAL COMMENTS CONCERNING CBI COURSE DEVELOPMENT

Comments	N
No Capability for Reviewing/Changing Items on Exam	2
Ungraded Exams Should Be Learning Tools	1
Prefer Lecture/Lab Media	3
Computer Not Good Medium for Initial Training	1
Too Many Computer-Specific Problems	4
Feedback Not Immediate	1
Feedback Not Personal	3
Feedback Not Specific (i.e., pages to study, films, slides)	1
By-Pass Capabilities Too Limited for Adults	1

of CBI as it relates to the systems approach design elements and to compile, from the data, a check-off list to be used by CBI course developers. The opinionnaire was actually re-designed by the researcher so that it could be used by course developers as a check-off list. The resultant check-off list (see Appendix B) also took into consideration additional students' comments and those points deemed essential by the researcher.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

This is the concluding chapter of the study on adult learners, computerized instruction, and systems approach design elements. The chapter presents an overall summary of the study, conclusions regarding the study, and recommendations for further practice and research.

Summary

This study was conducted because there has been no prior investigation of adult learners' perceptions of CBI course effectiveness as it relates to the systems approach to developing training materials at the FAA Academy. There also has been no check-off list available for course developers at the Academy to use in order to ensure that a systematic approach to development of training materials is used, so that needs of students can better be met. The study sought to answer the following questions:

1. Did students perceive that the systems approach to development of CBI training materials was utilized?

2. Were maximum computer capabilities utilized?

3. How did students perceive the effectiveness of the course?

An extensive review of literature relating to adult learners, the systems approach to course development, and CBI was conducted by the researcher. The review specifically focused on the transition from traditional instruction to computerized instruction, evolution of computerized instruction, computerized instruction for adults, and design and development of CAI courses.

An opinionnaire was then developed by the researcher, was field-tested by fellow staff members, and was administered to 25 adult students who were enrolled in FAA Academy CBI courses. The opinionnaire was designed to document students' perceptions concerning systems approach design elements and CBI. The students' responses to the questions on the opinionnaire were tabulated and summarized in narrative form. Their additional comments were also reported in narrative form. Most of the students' responses indicated that they perceived that the systems approach to course development was used in part, but not entirely. The majority of them also perceived that computer capabilities were not utilized fully, particularly to the benefit of adult learners. This resulted in an almost equal split between positive and negative responses insofar as course effectiveness was concerned. All of the students' addition-

al comments could be directly related to some systems approach design element that had apparently been omitted in the development of their courses.

Conclusions

Based on the students' perceptions, the following conclusions regarding FAA Academy courses were drawn from this study:

1. The systems approach to CBI course development is not always being utilized.

2. Maximum computer capabilities are not being utilized to the benefit of adult learners.

3. As a result of (1) and (2) above, CBI courses are not always effective in meeting the needs of the students.

4. All current courses should undergo a summative evaluation to ensure that all systems approach design elements are present.

Recommendations

For Practice

The study indicated that a systematic approach to FAA Academy CBI course development should be utilized. It is recommended that the opinionnaire used to conduct the study be used to elicit students' responses to courses in the future as a formative evaluation for possible course

revision. It is further recommended that the resultant check-off list developed as a result of the study be utilized by CBI course developers in the future to ensure quality courses that meet the needs of the students.

For Research/Further Study

The study indicated that current FAA Academy courses should undergo an extensive summative evaluation. In order to do that, research would have to be conducted in evaluative techniques, an evaluation framework would have to be identified, and evaluation instruments would have to be developed for the various training materials and documents. It would also be necessary to develop some formative evaluation tools to be utilized in future development efforts.

In order to accomplish these tasks and future development efforts in an effective, efficient, cost-effective manner, the FAA Academy should first ensure that their personnel who have course development responsibilities are qualified and adequately trained to accomplish the tasks they are assigned. This is an essential requirement before a systems approach can be utilized effectively (Campbell, 1980).

To produce the best courses possible, it is further recommended that the team effort mentioned by Seiler (1981) be employed for all course development and course revision

efforts at the FAA Academy. This team should include (1) a subject matter specialist to provide the technical expertise, (2) an experienced instructor, (3) an education specialist with writing and instructional design experience, (4) a programmer, (5) a graphics artist, and (6) an editor.

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APPENDICES

APPENDIX A

STUDENT OPINIONNAIRE CONCERNING

COMPUTER-ASSISTED

INSTRUCTION (CAI)

DIRECTIONS: Please respond to the following questions regarding the most recent CAI/CBI course you have taken. Check the appropriate box. If you have additional comments, space is provided on the last page.

	Yes	No	Partially/ Sometimes
I. PLANNING			
1. Did you have a need for the training provided?			
2. Were objectives provided?			
3. If objectives were provided,			
a. Did you understand what they required you to learn?			
b. Were there sufficient numbers of them?			
c. Did the text content support them?			

	Yes	No	Partially/ Sometimes
4. Were the objectives tested (measured)?			
5. Was the computer a good medium for teaching the material?			
II. DEVELOPING			
1. Were directions understandable?			
2. Was the subject matter presented in a logical sequence?			
3. Was the subject matter written in an understandable manner?			
4. Was practice (reinforcement) provided?			
5. If practice was provided,			
a. Was it sufficient?			
b. Was it relevant?			
6. Was feedback provided?			
7. If feedback was provided,			
a. Was it helpful?			
b. Was it provided at the appropriate time?			
8. Was the course material technically accurate?			
9. Was the course length adequate?			

	Yes	No	Partially/ Sometimes
10. Computer utilization - -			
a. Were graphics utilized?			
b. If graphics were utilized,			
(1) Were they helpful?			
(2) Were they relevant?			
c. Did the course have by-pass capabilities?			
d. Did the course have branching capabilities?			
e. Was help available during the course?			
f. If help was available,			
(1) Was it via instructor?			
(2) Was it via computer?			

III. EVALUATION

	Positive	Negative
1. Overall, what kind of impact did the course have on you?		

ADDITIONAL COMMENTS: If you wish to expand on any of the questions above or to make comments regarding the course in addition to those, please use the space below and on the back.

APPENDIX B

CBI COURSE DEVELOPMENT

CHECK-OFF LIST

PURPOSE: The purpose of this check-off list is to provide the CBI course development team with a formative evaluation guide to be utilized throughout any CBI course development effort.

DIRECTIONS: Check the appropriate "Yes/No" spaces for each question presented. Explanatory notes for all "No" responses must be provided, and Branch Chiefs must initial approval prior to the course being administered. If all responses are "Yes," it is assumed the course is ready for administration.

	Yes	No
I. PLANNING		
1. Is a JTA available for the course?		
2. If not, has a training development plan conference been held?		
3. Do you have a list of job tasks?		
4. Do you have objectives?		
5. Does each objective support a job task?		
6. Is each objective understandable?		
7. Is each objective written in three parts?		
8. Do you have sufficient numbers of objectives?		

		Yes	No
9.	Does your text support each objective?		
10.	Is each objective tested (measured)?		
11.	Do exams provide for review and correction?		
12.	Is the computer the best medium for material presentation?		
II.	DEVELOPING		
1.	Are directions provided for each new segment?		
2.	Are the directions explicit and understandable? (Do not ASSUME anything.)		
3.	Is the subject matter logically sequenced?		
4.	Is the subject matter understandable?		
5.	Is subject matter format good?		
6.	Is practice provided at appropriate intervals throughout?		
7.	Is practice sufficient?		
8.	Is practice relevant to subject matter?		
9.	Does practice reinforce objectives?		
10.	Did you utilize a variety of questioning formats?		
11.	If feedback provided?		
12.	Is feedback immediate?		
13.	Is feedback personal?		
14.	Is feedback specific? (Does it provide pages to read, films or slides to view, etc.?)		

		Yes	No
15.	Is the course material technically accurate?		
16.	Is the course length adequate?		
17.	Did you provide re-cap information at appropriate intervals?		
18.	Did you use computer graphics?		
19.	Were graphics appropriate?		
20.	Were graphics relevant to subject matter?		
21.	Did you utilize computer by-pass capabilities?		
22.	Did you utilize computer branching capabilities?		
23.	Did you provide help to the student via computer?		
24.	Is the material on the computer of a different format than text book material?		

III. EVALUATION

1. Overall, what impact do you feel this course will have on students?

Positive _____ Negative _____

Signatures of Development Team:

_____	_____
Subject Matter Specialist	Programmer
_____	_____
Education Specialist	Graphics Artist
_____	_____
Instructor	Editor

v

VITA

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