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The Development and evaluation of a computer assisted instruction module for university students in the field of adult education

by

Joan Bernice Lim 

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Education

in

Adult and Higher Education

Department of Educational Policy Studies

Edmonton, Alberta

Fall 1999

University of Alberta

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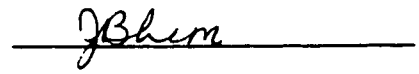
Degree: Master of Education

Year this Degree Granted: 1999



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Dr. Dave Collett, Supervisor

Dr. Don Richards

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Date: Sept. 23, 1999

Dedication

"And whatever you do, whether in word or deed, do it all in the name of the Lord Jesus, giving thanks to God the Father through him"(Colossians 3:17, New International Version).

I dedicate this work to my God, who has given me my purpose. I thank him for his guidance and direction, and his patience in showing me the path that I should go. I also thank him for his unfailing love, mercy, and faithfulness.

I also dedicate this work to my husband Mike, and my children Jonathan and Chrissy, who gave me their love, encouragement, and support throughout the time I spent in the Master's program.

Abstract

The purpose of this study was to develop and evaluate a computer-assisted instruction (CAI) module for the use of university students in the field of adult education. The content of the module dealt with selecting teaching technology for distance education. The study was guided by a research and development approach. It was implemented in five steps of the research and development cycle as follows: research and information collecting; planning; product development; preliminary field testing and product revision; and main field testing and final report. During the preliminary field test, formative evaluation was provided by three graduate students in the faculty of education. During the main field test, the product was accessed via the Internet and used by twenty-five off-campus students, eight of whom submitted summative evaluations electronically . The evaluations corroborated some previous research into the design of computer assisted instruction, and several aspects of adult learning theories.

Acknowledgment

I wish to acknowledge the support of all those who made it possible for me to conclude this thesis:

Dr. Dave Collett, my supervisor, for his counsel, encouragement, and patience as I worked on this thesis. I also thank him for providing me with the opportunity to learn first hand about distance education through my involvement with his outreach project.

Dr. Don Richards and Dr. Terry Anderson, for serving on my committee, for their valuable and insightful advice.

My husband Mike, my children Chrissy and Jonathan, for their unfailing love, support and encouragement.

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Chapter One: Introduction

Background to the Study

Distance Education has become a major delivery mechanism for educational programs around the world. This has been made possible by technological advances in the last several decades. Indeed, Garrison (1989, 1993) describes the technology of distance education as consisting of three generations, based on advances in communications technology: correspondence, teleconferencing, and computer-based instruction. These advances have made it possible for education to be accessible to those learners who are unable to attend conventional classes on campus because of the constraints imposed by time, location, and the responsibilities of work and family.

The separation of student and teacher is addressed in distance education through the use of technology. Moore (1973) notes that distance teaching is, "the family of instructional methods in which the teaching behaviors are executed apart from the learning behaviors, including those that in a contiguous situation would be performed in the learner's presence, so that communication between the teacher and the learner must be facilitated by print, electronic, mechanical or other devices" (p. 664). Garrison and Shale (1987) suggest three essential criteria for distance education: The majority of communication between (among) teacher and student(s) occurs noncontiguously; distance education must involve two-way communication between (among) teacher and student(s); distance education uses technology to mediate the two way communication.

Most of the students who take courses through distance education are adults between the ages of 25 and 50 (Moore and Kearsley, 1996). Moore (cited in Garrison, 1989) states that most of distance education is concerned with the education of adults, therefore its research plans should be informed by the theories and research about learning in adulthood, adult development, program planning, instruction and evaluation in adult

education. Theories of adult learning such as those of Knowles and Rogers are very helpful when one is designing and teaching distance education courses. Knowles' theory of andragogy makes the following presuppositions about adults: they are self-directed; they are mature and therefore experienced, with experience providing a rich resource for learning; their readiness to learn is linked to what they need to know; their orientation to learning is problem centered rather than subject centered; their motivation to learn is internal (Knowles, 1970). Rogers' significant learning theory focuses on learning which influences the learner's behavior, course of action in the future, attitudes, and personality (Rogers, 1961).

There is now a wide variety of courses available to adult learners through distance education. What is the quality of these courses? Do they address those learner needs which are derived from adult learning theories? What is the response of the learners? Are they satisfied or dissatisfied? What do they find rewarding, challenging and frustrating? These questions provided a basis for this study and led to the formulation of the purpose statement.

Purpose Statement

The purpose of this study was to develop and evaluate a computer assisted instruction module for university students in the field of adult education. This overall purpose was achieved through the following objectives, which were developed from the research and development model described by Borg and Gall (1989, pp. 781-802):

1. Research and information collecting. To undertake a needs assessment and a literature review. The purpose of the needs assessment was to determine if the proposed product would meet an important educational need. The purpose of the literature review was to determine the state of knowledge in the area of concern, and how this knowledge could be applied to the planned product.

2. Planning. To make a plan of the product, which included: the product's objectives; a description of its target audience; and a description of its components and how they would be used.

3. Develop preliminary form of the product. To prepare instructional materials, procedures, and evaluation instruments.

4. Preliminary field testing and product revision. To conduct a preliminary field test to obtain a small group evaluation of the product, and to make revisions in accordance with field test results.

5. Main field testing and final report. To conduct a main field test to obtain a summative evaluation of the product, and to produce a final report.

The module was designed for use in a course provided by the Faculty of Education, University of Alberta, in June, 1998, to twenty-five students in Northern Alberta and British Columbia. The course title was EDAE 404, Distance Education and the module's content dealt with selecting teaching technology for distance education.

The computer assisted instruction module was designed through the use of the Authorware Professional 4.0 authoring system, and accessed by the students through the Internet. Computer assisted instruction (CAI), also known as computer assisted learning (CAL), is an embracing concept for educational computer applications, which include drill and practice, tutoring, simulating, and problem solving (Garrison, 1989; Unwin and McAleese, 1988). According to Bates (1995), a CAI program allows the learner to work through pre-designed material, interacting by answering questions embedded within the material and receiving feedback to those answers, and choosing options or routes through the learning material. An authoring system is a program used in the production of software packages, and it uses special commands and editors for the creation of text, graphics and animated images, and for handling dialogue and analyzing user response (Glossary of educational technological terms, 1987). Gall, Borg and Gall (1996) describe the Internet as

a global network of computers that allows network members to communicate with each other and to access electronic information resources by computer.

Research Methodology

This study was guided by a research and development approach, and a modified version of the model outlined by Borg and Gall (1989). Educational research and development is "A type of research whose purpose is to develop and test new materials, products, procedures or programs" (Charles, 1988, p. 206). Borg and Gall (1989) refer to R and D as a strategy for developing educational products of proven effectiveness, whose purpose is to bridge the gap between educational research and practice. They describe this strategy as being made up of a cycle, in which a version of a product is developed, field-tested, and revised according to field-test data.

A variety of approaches and models were reviewed before the above mentioned approach and model were chosen. For a detailed discussion, see Chapter 3: Research Method.

Significance

This study, through the use of the R and D model, contributes to improved practice, and potentially bridges the gap between research and practice. It is of practical significance to learners, instructors, course designers, administrators, and others involved in the design and delivery of distance education courses since it develops a quality educational product. It is of additional significance to learners because it addresses learner needs and satisfaction through the use of a CAI module and the Internet.

Borg and Gall (1989) describe R and D as a potent strategy for improving practice. They view it as a process for developing and validating educational products. These products include textbooks, instructional films, computer software, instructional methods and programs. They contrast this with the goal of educational research, which is to find

out new information about foundational phenomena (through basic research) or about educational practice (through applied research). They add that R and D takes the conclusions produced by basic and applied research and uses them to produce tested products that are ready for operational use.

This study is learner-centered. It focuses on the needs and satisfaction of adult learners. The development of a CAI product and the use of the Internet are appropriate in this regard. CAI has several benefits for learners: by presenting information and using embedded questions and learner responses to these questions, it simulates dialogue with the learners; it allows learners to work at their own pace and to obtain feedback on their progress; it allows learners to select materials and pathways through subject matter; it is motivating because it uses innovative or amusing techniques for gaining and holding interest (Bates, 1995). The Internet makes education accessible to learners who are unable to attend conventional classes because of the restrictions of location, time and work/family responsibilities.

This study therefore contributes to improved practice through its use of the R and D model. It is of significance to adult distance learners, instructors, course designers, administrators, and others involved in the design and delivery of distance education courses, because it develops a quality product. Its learner-centeredness, as evidenced through its use of a CAI module and the Internet, is of additional significance to the learner.

Assumptions

Assumptions were made about the knowledge and abilities of those who participated in the study. It was assumed that the students who participated in the study would be able to critically reflect on their learning experiences and express their thoughts and feelings accurately and truthfully. It was also assumed that these students were sufficiently knowledgeable of their needs as learners in order to express what they desired from the instructor, administrators, and technical personnel. Finally, it was assumed that the development team, consisting of the course instructor, a doctoral student, the researcher, and a university professor, were sufficiently knowledgeable in the necessary content and technical areas to positively influence the development of the product.

Delimitations

This study was delimited to a group of twenty-five students taking a course about distance education in 1998, and to the time allotted by the development committee for the development of the product (May, 1998, to August, 1998). This course was also delivered through distance education. The results of this study may not apply to other courses taken through distance education.

Limitations

This study was limited by my lack of experience as a researcher, and the small number of subjects who responded to the on-line questionnaire during the main field test. While I had used the Authorware Professional authoring system in the past, and successfully designed and developed three computer assisted instruction modules, I had not conducted a research study that used the research and development or systems approaches. In addition, 8 students (32%) out of a class of 25 responded to the on-line questionnaire during the main field test. This low rate of return suggested that I may not have received all

the feedback that I needed, and some potentially important information may have been lost to the study.

Organization of Thesis

This thesis is organized into five chapters. Chapter 1, the Introduction, covers the background to the study; the problem statement; a short description of the methodology; the significance of the study; and the assumptions, delimitations, and limitations of the study. Chapter 2, the Literature Review, surveys the literature pertinent to the product being developed, that is, the literature on adult education, CAI, and the subject matter of the module. Chapter 3, the Methodology, describes the procedures used in the study. Chapter 4, Results and Discussion, presents the research findings and discusses the interpretation of the findings. Chapter 5, Summary and Recommendations, provides a brief summary of the research problem and method, and discusses the limitations of the study, the implications for education, and suggestions for future research.

Chapter Two: Research and Information Collecting

Introduction

The purpose of this study was to develop and evaluate a computer assisted instruction module for university students in the field of adult education. A literature review was undertaken in order to determine the state of knowledge in the area of concern, and how this knowledge could be applied to the planned product. Since the module was intended for the use of university students specializing in adult education, it was necessary to review the literature on adult education. This literature included learning theories dealing with the human potential for growth, and the individual's mental processes. As the product was a computer assisted instruction (CAI) module, it was necessary to review the literature on CAI, specifically the literature on the design of CAI systems. Finally, it was necessary to review the literature on the content of the module, which dealt with selecting teaching technology for distance education.

Theories Dealing with the Human Potential for Growth or the Humanist Orientation to Learning

Introduction

This section describes the theories of Maslow, Rogers, and Knowles, and considers their contribution to adult education. Prior to a discussion of these theories, it is appropriate to clarify what is meant by the term humanist orientation to learning. This orientation is characterized by the following views: humans, unlike animals, have the ability to choose, and they are therefore responsible for their own actions; the objective of adult education is to help learners make choices that maximize their human potential; since learners are responsible for their choices, they should control learning content, process, and evaluation, and the educator is a facilitator of learning rather than a transmitter of knowledge (Bader, 1989). These views have contributed to the emphasis in adult

education on the self-directedness of the learner and the value of experience in the learning process (Merriam and Caffarella, 1991).

Maslow

Maslow's theory of human motivation is based on levels of human needs, which are arranged according to a hierarchy of relative prepotency (Maslow, 1970). Maslow explains the concept of prepotency as meaning that the individual is under the control of needs at a lower level until these needs are met, then the individual comes under the control of the needs at the next higher level, and this process continues until the highest level, that of self-actualization, is reached. The different levels of Maslow's hierarchy are as follows (Maslow, 1970):

1. Physiological needs such as hunger, thirst, and sleep
2. Safety needs, such as security, stability, protection, and freedom from fear
3. Love and belongingness needs
4. Self-esteem needs
5. Self-actualization

The last level, self-actualization, is described by Maslow as the desire for self-fulfillment, the tendency to become self-actualized in what one is potentially, that is, the desire to become everything that one is capable of becoming (Maslow, 1970). Maslow uses the term "growth" needs interchangeably with "self-actualization" needs; however, he identifies self-actualization as the first of three growth needs, the other two being cognitive needs (the desire to know) and the aesthetic needs (Sahakian, 1984). For Maslow, the goal of learning is the realization of the growth needs: the self-actualization of the individual, the fulfillment of the cognitive impulse to learn and understand what life is about, and achievement of aesthetic satisfaction (Sahakian, 1984). Finally, Maslow describes the motivation to learn as intrinsic, that is, it comes from within the individual (Merriam and

Caffarella, 1991). He claims that intrinsic learning transforms people from within, enabling them to grow toward self-actualization, psychological health, and to become fully human; intrinsic learning is its own reward (Sahakian, 1984).

Maslow's contribution to education is his concern with the "self", and the "whole person". Tennant (1988, p. 13) describes Maslow's emphasis on the "self" as a reaction to the scientific methods of behaviorism, which minimize the person to the status of being an object of scientific inquiry. Tennant observes that Maslow's humanistic psychology reaffirms the human qualities of the person - such as personal freedom, choice, and the validity of subjective experience. Sahakian (1984, pp. 426-427) notes that, instead of using the scientific approach of isolating variables for experimental examination, Maslow prefers to deal with the "whole person" and Maslow refers to his orientation as the holistic approach. Sahakian adds that Maslow views the goal of education as one of personal growth, with the educational process continuing throughout life. To Maslow, learning is experiential for he states that "the basic coin in the realm of knowing is direct. intimate, experiential, knowing" (cited in Sahakian, 1984, p. 426).

Notwithstanding the above, how accurate is Maslow's theory, and does it really describe adult learning? Tennant (1988) has some difficulty with Maslow's concept of prepotency, which states that if, and only if, one has satisfied the lower level needs, may one proceed to the higher level needs. This, according to Tennant, means that those who have had all their physiological and safety needs met throughout life will become those who develop their highest potentialities. Therefore, Tennant deduces, those raised in luxury will become more creative, original and integrated personalities, and those raised in disadvantageous circumstances will end up as inferior individuals. Tennant contends that the facts do not bear this out. I observe that there are cases to which the concept of prepotency do not apply. For example, throughout history there have been painters and composers who have produced exceptionally creative works, while at the same time experiencing deprivation in other areas of their lives. Inspite of these exceptions there is a

general truth to the idea that if one has satisfied the lower level needs, one may proceed to the higher level needs..

There are also some shortcomings with regard to Maslow's description of self-actualization (Tennant, 1988). Maslow describes self-actualization as man's desire for self-fulfillment, the tendency for him to become actualized in what he is potentially, the desire to become everything that one is capable of becoming (Maslow, 1970). Tennant comments that the complete picture of the self-actualized person is elusive. Yet Maslow tells us that self-actualization is something towards which we are propelled (Tennant, 1988). What Maslow seems to be saying, according to Tennant, is that humans are set to self actualize because of their physiological make-up. In my opinion, it is not possible for one to become everything that one is capable of becoming, and the perfect person does not exist. Nevertheless, it is a worthwhile goal for one to strive to be the best that one can be.

Finally, Maslow's theory has not been substantiated by experimental research, and he has been referred to as an armchair psychologist (Sahakian, 1984). Inspite of this, I find Maslow's theory very useful. His hierarchy of needs does describe adult behavior and learning in general terms. While it is not possible for one to be fully self-actualized, it is worthwhile goal to pursue.

Rogers

Carl Rogers developed his significant learning theory from his client-centered therapy (Sahakian, 1984). Rogers (1961) describes significant learning as more than acquiring facts, as learning which influences the learner's behavior, future actions, attitudes, and personality. To Rogers, this learning is at one end of the continuum, while cognitive learning, or learning by association, or rote memory, is at the other end (Sahakian, 1984). Rogers views these two opposing types of learning as merging in a center position, and notes that it is possible for one form of learning to be transformed into the other. Significant learning has the following characteristics (Sahakian, 1984):

1. Personal involvement - the whole person is involved in the learning event.

2. Self-initiated - the sense of discovery must come from within.

3. Pervasive - it changes behavior, attitudes, and perhaps the personality of the learner.

4. Evaluated by the learner

5. Its essence is meaning- when this learning takes place, its meaning to the learner becomes incorporated into to the total experience.

Rogers (1961) identifies five conditions for learning in psychotherapy and education as:

1. Facing a problem - the learner confronts a serious and meaningful problem.

2. Congruence - the facilitator should be a unified, integrated, or congruent person.

3. Unconditional, positive regard - the facilitator should experience a warm caring for the learner, a caring which is not possessive, and which demands no personal gratification.

4. Emphatic understanding - the facilitator should have an accurate understanding of the learner's world as seen from the inside.

5. Communication - the learner should experience or perceive something of the facilitator's congruence, acceptance and empathy.

The implication of significant learning is the elimination of conventional education (Rogers, 1961). Rogers believes we should do away with teaching, examinations, grades, credits, and degrees. His freedom to learn theory is based on allowing the learner the freedom to be involved in self-initiated, self-reliant learning that is motivated out of a desire for self-actualization (Sahakian, 1984).

According to Rogers, the goal of education is the facilitation of change and learning (Sahakian, 1984). Therefore, says Rogers, the teacher must cease to instruct and become a facilitator of learning, and the student must be free to learn, to choose goals that relate to self-actualization. Facilitators and students thus become a community of learners. Rogers

identifies the qualities of a good facilitator as: realness and genuineness; prizing the learner, acceptance and trust; and empathetic understanding of the learner (Rogers, 1961).

Like Maslow, Rogers believes that the motivation to learn comes from within the learner. He holds that is not necessary for teachers to motivate their students, for individuals are self-motivated (Sahakian, 1984). Rogers observes that "the motivation for learning and change springs from the self-actualizing tendency of life itself, the tendency for the organism to flow into all the differentiated channels of potential development, insofar as these are experienced as enhancing" (Rogers, 1961, p. 285). The teacher's function is to create an atmosphere conducive to the learning experience, that of allowing the self-actualizing tendency to develop freely (Sahakian, 1984).

Rogers has much in common with Maslow in terms of his contribution to adult education. Both emphasize self-actualization, with psychological growth and development as primary considerations; their orientation is person-centered, they both deal with ideas of self-regard, awareness, sanctity of human beings, and intrinsic or significant learning (Sahakian, 1984). Although Rogers' ideas are not supported by experimentation, they are based on clinical psychology, which is regarded in the psychological community as valid data from which reliable conclusions may be drawn (Sahakian, 1984).

Notwithstanding the above, I find that Rogers' comments regarding the elimination of examinations, grades, and credits to be impractical. The 1984 Statistics Canada Adult Education Survey shows that most adults take courses for job related reasons, that is, they desire skills applicable to their current or prospective jobs (Selman and Dampier, 1991). Therefore some form of evaluation is necessary to ensure that learners have acquired the necessary skills.

Knowles

Knowles' learning theory is known as andragogy, which he defines as the art and science of helping human beings learn (Knowles, 1970, p. 38). It is based on five assumptions about the characteristics of adult learners (Knowles, 1970, 1984):

1. Adult learners have a concept of themselves as being self-directed. They see themselves as being able to make their own decisions and face the consequences of these decisions, and to manage their own lives. Therefore adult learners want to be treated with respect and to be seen as unique human beings.

2. Adults have accumulated experiences, and these can be a rich resource for learning. When adults find themselves in situations where their experiences are not being used, or the worth of these experiences is minimized, they feel rejected.

3. In adults the readiness to learn is closely related to the developmental tasks of their social roles. That is, they become ready to learn those things they need to know and be able to do in order to cope effectively with their real-life situations.

4. Adults have a problem-centered orientation to learning. They engage in learning in response to pressures they feel from their current life-situation.

5. While adults are responsive to some external motivators, the most effective motivators are internal pressures such as the desire for increased job satisfaction, self-esteem, and the quality of life.

These assumptions have a variety of implications for the education of adults. One of these is self-directed learning, which Knowles refers to as a process in which learners diagnose their learning needs, with or without the help of others; formulate learning goals; identify human and material resources for learning; choose and implement learning strategies; and evaluate learning outcomes (Knowles, 1975). Knowles maintains that this learning does not take place in isolation, but there is collaboration between the learner and various helpers, including teachers, tutors, mentors, resource people, and peers. Moreover, learners should view other learners as collaborators rather than as competitors.

He recommends that instead of being a transmitter of content, the teacher should take on the new role of facilitator of learning. In discussing his own experience as a facilitator Knowles says, "I was performing the function of process designer and manager, which required relationship building, needs assessment, involvement of students in planning, linking students to learning resources, and encouraging student initiative" (Knowles, 1984, p. 191).

Knowles' theory of andragogy has given adult educators an identity which differentiates the field from other areas of education, especially childhood education (Brookfield, cited in Merriam and Caffarella, 1991). Bard (cited in Merriam and Caffarella, 1991) asserts that andrgogy, probably more than any other force, has changed the role of the learner in adult education.

However, andragogy has been a source of controversy. One criticism, raised by Merriam and Caffarella (1991), is that Knowles originally described andragogy as characterizing adult learning and pedagogy as characterizing childhood learning. They add that he later clarified his position by stating that andragogy-pedagogy represents a continuum and that the use of both systems is appropriate at different times and in different situations regardless of the learner's age. Merriam and Cafferella assert that since andragogy now seems to be situation-specific and not unique to adults, it does not qualify as a theory of adult learning. In addition, Hartree (cited in Merriam and Caffarella, 1991, p. 250) notes that it is unclear if Knowles has provided us with a theory of learning or a theory of teaching, whether adult learning is different from child learning, and whether there is a theory at all - perhaps these are just principles of good practice.
My view is that regardless of whether andragogy is a theory or represents principles of good practice, it gives adult educators some very good concepts, which are descriptive of adult behavior, and which are very useful when one is planning programs for adults.

Brookfield (1989) comments that Knowles' approach to facilitation is based on the felt needs rationale, which equates good practice with meeting learners' declared needs. He

warns that this can be overly consumerist, since it emphasizes giving learners what they say they want. Consequently, the facilitator's role can be reduced to that of an educational customer service manager. Brookfield concludes that facilitators would have to suppress their ideas, experiences, and insights, if these do not contribute to meeting learners' declared needs. My view is that education involves critical thinking by learners, which leads to a change in behavior. It is therefore important for instructors to stimulate critical thinking by contributing ideas and challenging learners' existing ideas.

Conclusion

This section has examined the humanistic theories of Maslow, Rogers, and Knowles, and considered their significance to adult education. Maslow contributed the theory of human motivation. Rogers contributed his significant learning and freedom to learn theories. Knowles contributed the theory of andragogy. Connected with these theories are the concepts of self-actualization, personal growth and development, experiential learning, self-directed learning, facilitation of learning, and intrinsic motivation.

Theories Dealing with the Individual's Mental Processes or the Cognitive Orientation to Learning

Introduction

This section examines Gestalt psychology, schema theory, and the theories of Piaget, Ausubel, and Brunner, and considers their contribution to education.

Prior to a discussion of the above mentioned theories it is appropriate to clarify what is meant by the term cognitive learning. Cognitive learning is "directed toward miniature models of specific facets of cognition, such as models of discourse analysis, models of comprehension, ways of aiding understanding and meaningful learning, the

nature of schemata, the memory system, the development of cognitive skills, and the like" (Di Vesta, 1987, cited in Merriam and Caffarella, 1991, p. 131).

Gestalt psychology.

Winn and Snyder (1996, p. 113) refer to Gestalt psychology as "the study of how people see and understand the relation of the whole to the parts that make up the whole." They elaborate that the whole is different from the sum of its parts; our perception and comprehension of objects and events in the world depend on the appearance and actions of whole objects.

Gestalt laws of perceptual organization, codified by Wertheimer, include the following principles: proximity, where elements close in time or space tend to be perceived together; similarity, where, other things being equal, like elements in the same structure tend to be seen together; direction, where elements tend to be seen together that compose a continuous smooth direction; objective set, where an organization perceived in one case tends to be seen in immediately following similar cases; common fate, where elements shifted in a similar manner from a larger group tend themselves to be grouped; and pragnanz, where figures are seen in as "good" a way as possible under stimulus conditions (Solso, 1988, pp. 55-56).

The above laws have formed the basis for design principles in CAI. For example, Fleming (1987, pp. 233-260) proposes forty-five principles in answer to the question, "What kinds of displays communicate?" One of these principles is that perception is organized. That is, learners try to construct meaningful wholes from their environment: objects, events, ideas. Unorganized stimulation, says Fleming, is difficult to understand and remember. Another principle is that displays and display elements that appear similar tend to be grouped in perception and associated in memory. Similarity, says Fleming, is a pervasive factor whose influence extends to concept formation (grouping and labeling similar things). He adds that similarity can be made apparent in many ways: perceptually (form, size, color) as well as procedurally and conceptually.

Notwithstanding the above, is there any evidence to support the Gestaltist laws of perceptual organization? Winn and Synder (1996, p. 114) cite Rock (1986) as one of the perceptual psychologists who have recently provided evidence from controlled experiments. According to Rock, the effects of such stimulus features as symmetry on perceptual organization has been explained in terms of "emergent properties". We see a triangle as a triangle, not as three lines and three angles. Winn and Snyder equate "emergent properties" with the Gestaltists' "whole" that has features of its own that are greater than the sum of its parts. In view of the evidence provided by Rock and others, I accept the Gestaltist position as credible.

Other key contributions from Gestalt learning theorists include the concepts of insight and meaning. Grippen and Peters (1984, cited in Merriam and Caffarella, 1996, pp. 128-129) describe the learning process as follows: "The human mind is not simply a passive exchange-terminal system where the stimuli arrive and the appropriate response leaves. Rather, the thinking person interprets sensations and gives meaning to the events that impinge upon his consciousness." The link between a stimulus and a response is not straightforward, and there are mechanisms that intervene to reduce the predictability of a response to a given stimulus (Winn and Snyder, 1996). Learning involves reorganizing experiences in order to give meaning to them, and sometimes this is accomplished through flashes of insight (Merriam and Caffarella, 1996). According to Hergenhahn (1988, p. 252), "Learning to the Gestaltist is a cognitive phenomenon. The organism 'comes to see' the solution after pondering a problem. When the solution comes, it comes suddenly, that is, the organism gains an insight into the solution of the problem."

How do we know that the above descriptions of meaning and insight are true? I know from my experience that this is true. I have had many insightful experiences after pondering on problems. Winn and Snyder (1996) note that we all experience mental images, feelings, insight, and a whole host of other unobservable and unmeasurable

phenomena. They cite Searle (1992) as stating that to deny the importance of these experiences is to deny much of what it means to be human.

However, according to Winn and Snyder (1996), one of the methodologies for studying the mind is introspection. They refer to Wundt's proposal that the best way to study the mind is for a person to examine his or her own thoughts. Winn and Snyder point out that the danger of introspection lies in the difficulty persons have thinking about their own thinking. They ask if the act of thinking about thinking interferes with and changes the thinking that one is interested in studying. I am of the opinion that thinking about thinking does interfere with the natural process of thinking. While I accept the Gestaltist views of meaning and insight, I believe that some caution is necessary.

Schema theory

The next cognitive theory examined in this section is schema theory, which deals with how we store information in memory, represent it in our mind's eye, or manipulate it through the processes of reasoning (Winn and Snyder, 1996). Piaget (cited in Solso, 1988) defines schema as a mental representation of some action (mental or physical) that can be performed on an object and that, as the organism develops, increases in integration and coordination.

Schema has the following characteristics (Winn and Snyder, 1996, p. 117):

1. It is an organized structure that exists in memory.

2. It exists at a higher level of generality, or abstraction, than our immediate experience with the world. According to Norman and Rumelhart (1975), cited in Winn and Snyder (1996, p. 118), it uses "place-holders", "slots", or "variables" to be "instantiated" through recall or recognition, to deal with our immediate and specific experiences.

3. It is a network of concepts connected by links.

4. It is dynamic. As we learn new information, either from instruction or from day-to-day interaction with the environment, our memory and understanding of the world will change.

5. It provides a context that affects how we interpret new experiences and directs our attention to particular sources of experience and information.

Schema theory is credible because it has been corroborated by research. Bartlett (1967), cited in Winn and Snyder (1996), concluded from experiments that human memory consists of cognitive structures that are built over time as a result of our interaction with the world, and that these structures color our encoding and recall of subsequently encountered ideas. Piaget's concepts of assimilation and accommodation confirm the idea that schema is dynamic. Evidence for schema as context comes from research in reading comprehension. The methodology used in these studies required the activation of a well-developed schema to establish a context, the use of a text that was deliberately ambiguous, and a comprehension posttest. For example, Anderson, Reynolds, Schallert, and Goetz (1977). cited in Winn and Snyder (1996), introduced a story that could have been about playing cards or playing music to a group of musicians. The subjects interpreted the story to be about playing music.

Schema theory has influenced educational technology in a number of ways. One of these is the belief that schemata can be more effectively built and activated if the learning material is "isomorphic", that is, corresponds, to the generally accepted structure of schema (Winn and Snyder, 1996, p. 119). This belief has led to the use of pictures and graphics in educational technology. Research cited by Winn and Snyder (1996) include those by Paivo (1983), Clark and Paivo (1992), Kulhavy, Lee and Caterino (1985), and Kulhavy, Stock and Caterino (1985), which provide evidence that pictures and graphics contain information that is not found in text; and that information shown in pictures and graphics is easier to recall because it is encoded in both memory systems, as propositions and images, rather than just as propositions.

Another way that schema theory has influenced educational technology is in the development of information mapping, that is, techniques for learners to use to impose structure on what they learn, therefore making it more memorable (Winn and Snyder, 1996). Some mapping techniques are radial, with the key concept in the center of the diagram and related concepts on arms reaching out from the center. Others are hierarchical, with concepts placed on branches of a tree.

Piaget

Another cognitive theory which this section examines is that proposed by Piaget (Merriam and Caffarella, 1991). According to Piaget, the learner's internal cognitive structure changes because of maturational changes in the nervous system, and changes due to the organism's interaction with the environment and exposure to more experiences. To Piaget, the key to learning lies in the interaction of two processes: the accommodation of concepts to experiences in the world, and the assimilation of events and experiences from the world into existing concepts (Kolb, 1984). He argues that learning results from a balanced tension between accommodation and assimilation. Piaget proposes four stages of cognitive development: sensory-motor, preoperational, concrete operational, and formal operational (Merriam and Caffarella, 1991). It is the final stage, formal operational, which Piaget views as occurring between the ages of fifteen and twenty, which characterizes the beginning of mature adult thought. Piaget contends that at this stage, the individual is able to reason hypothetically, logically, and systematically.

Tennant (1998) provides a summary of Piaget's most important contributions to our understanding of cognitive development in adults. Firstly, Piaget emphasizes qualitative rather than quantitative developmental stages in cognition. That is, he challenges the view that children are quantitatively diminished adults by claiming that children progress through different types of thinking as they develop towards mature adult thought. Secondly, he stresses the importance of the active role of the individual in constructing knowledge,

thereby suggesting that learning through activity is more meaningful than passive learning. Thirdly, he offers a conception of mature adult thought (formal operations).

Piaget's work focused entirely on childhood cognitive development. Does it really apply to adults? I feel that to a certain extent it does, and many studies have been done to prove its applicability. Merriam and Caffarella (1991) refer to the work by Bee (1987) which shows that in Western culture, nearly all adults think easily at the concrete operational stage, whereas half of adults think at the formal operational stage. However, I feel its applicability needs to be taken with caution. Tennant (1998) contends that formal operations does not describe all mature adult thought. He views it as limited by its abstractness and removal from everyday problem-posing and solving, which require the ability to tolerate contradiction and ambiguity. Tennant adds that it has application to a narrow range of problems and can only play a subordinate role in attempts to solve the concrete problems of adult life.

Ausubel

The theory proposed by Ausubel (Merriam and Caffarella, 1991) differentiates between rote learning and meaningful learning. Ausubel views learning as becoming meaningful when it is connected to ideas which exist within the learner's cognitive structure. Since rote learning is not connected to the learner's cognitive structure, it is forgotten. Ausubel proposes the concept of reception learning, in which new information is processed only as far as more inclusive and appropriately relevant concepts already exist in the cognitive structure to serve a subordinate role or to provide definitional anchorage. He suggests the use of advance organizers. These are sets of ideas used by teachers to introduce learners to new and meaningful ideas; and to help learners recognize relevant ideas, concepts, or facts (Dejnozka, 1991).

Ausubel developed a theory of instruction, based on the above theory of learning (Reigeluth and Curtis, 1987), which I feel is of particular relevance to instructional

technology. Here, with regard to lesson sequencing, he advocates progressive differentiation, or a general to detailed sequence that begins with more general and inclusive anchoring ideas, which in turn serve as organizers for the next level of detail and specificity. The ideas on that next level in turn serve as advance organizers for another level, until the desired level of specificity is reached. This process, according to Ausubel, results in cognitive structures that are stable and therefore resistant to forgetting. I find this general to detail sequencing very useful particularly when one is presenting information on the computer screen. However, in order to maintain the learners' interest and provide them with sufficient challenge it should be used with other methods of presenting information, such as those described in the section below on research into the design of CAI systems.

Bruner

The final cognitive theorist examined in this section is Bruner. His instructional theory includes the concepts of learning through discovery and the spiral curriculum.

To Bruner, discovery is "in its essence a matter of rearranging or transforming evidence in such a way that one is enabled to go beyond the evidence so reassembled to additional new insights" (Merriam and Caffarella, 1991, p. 130). Bruner holds the constructivist view, that is, the belief that learning consists of individual constructions of knowledge (Hannafin and associates, 1996). Therefore he refers to learning as a personal event that results from sustained and meaningful engagement with one's environment (Hannafin and associates, 1996). According to Bruner (Adler, 1963, p. 37), there are four advantages associated with learning through discovery. Firstly, it increases intellectual potency by leading the learner to use a "cumulative constructionist" strategy. Thus, says Bruner, the learner is more likely to attain Piaget's formal operational stage "in the fullest sense". Secondly, discovery is self-rewarding, the reward being intellectual mastery. Thirdly, the learner "discovers how to discover". Bruner notes that the heuristics of inquiry, the intuitive sense of the rightness or wrongness of an approach, can be developed

in an atmosphere of discovery. Fourthly, to Bruner, the discovery of a mediating principle to connect unrelated items of information is the most effective method for ensuring that the material will be remembered.

My view of discovery learning is that it lends itself to the teaching of adults. Knowles, in his theory of andragogy, describes adults as being self-directed and problem-centered in their learning (1970), and possessing an intrinsic motivation to learn. (1984). Bruner's constructivist approach is relevant to the self-directedness and problem-centeredness of the adult leaner. Because discovery learning is self-rewarding, it appeals to the adult learner's intrinsic motivation.

However, care should be taken not to misinterpret or misuse discovery learning. It can be employed as a method for acquiring content, that is, the learner has to acquire what the teacher knows (Duffy and Cunningham, 1996). Here the goal is not inquiry or exploration of a domain, but discovering what the teacher wants the learner to discover.

Bruner is also an advocate of the spiral curriculum (Reigeluth and Curtis, 1987). He proposes that if an idea is deemed to be sufficiently important for a learner to know, it should be presented as early as possible on an intuitive, experiential basis. It is then developed and redeveloped as the learner matures intellectually. This continuous exposure results in the learner having a deeper and more meaningful understanding of the idea. Reigeluth and Curtis note that the spiral curriculum has only been used occasionally, and that Bruner does not offer specific guidelines on how to create a spiral curriculum. Therefore, they contend, it has not been easy for instructional designers to use this strategy. My opinion is that this strategy is more appropriate for teaching children since the idea is developed and redeveloped as the learner matures intellectually. Adult learners have already reached intellectual maturity.

Conclusion

This section has thus examined cognitive theories in order to consider their impact on education. The cognitive theories examined included Gestalt psychology, schema theory, and the theories of Piaget, Ausubel, and Bruner. The Gestaltists contributed the concepts of perception, insight, and meaning. Schema theory contributed the assumption that schemata can be more effectively built and activated if learning material corresponds to the generally accepted structure of schema. It also contributed to the development of techniques for learners to use to impose structure on what they learn (information mapping). Piaget's contributions were the emphasis on qualitative developmental stages, the significance given to the active role of the individual in constructing knowledge, and a conception of mature adult thought. Ausubel's contributions were his recommendations of advance organizers and progressive differentiation for lesson sequencing. Bruner's was in the concept of learning through discovery.

Research into the design of CAI systems

Introduction

Specific research into the design of CAI systems discussed in this section covers the following areas: orienting the learner, presenting the lesson, encoding support, detecting and correcting errors, lesson sequencing, motivation, applying knowledge and skills, and contextual factors.

Orienting the learner

Hannafin and Hughes (1986, pp. 239-240) define an orienting activity as "a mediator through which new information is presented", and add that the inclusion of appropriate activities before instruction prepares learners for the upcoming instruction. They state that orienting activities include advance organizers, embedded pre-questions,

behavioral objectives, as well as other strategies for preparing learners for instruction. They cite studies by Andre (1979) and Hamilton (1985), which indicate that the effects of orienting activities are tempered by the kind and specificity of the activities: content-explicit strategies are effective for specific learning, but more generalized, integrative strategies are effective for higher-order learning.

Presenting the lesson

Multi modal instruction. Hannafin and associates (1996) point out that it is a widely held belief that multimodal instruction enhances learning more than information introduced from a single source. For example, they say, it is believed that introducing information through sound, pictures, and text improves comprehension. They note, however, that research on cognitive resource allocation shows that more is not necessarily better when presenting stimuli: individuals possess limited ability to process information presented simultaneously in multiple channels. The study by Gavora and Hannafin (1995) shows that the cognitive processing resources of human subjects are limited. Gavora and Hannafin contend that computers can display and process data far more rapidly than humans, and this suggests that cognitive resources can become quickly overtaxed. They suggest that the effectiveness of interactions increases as competition for the same resources decreases, and vise versa. They use as an example the tasks of novice pilots, which are unduly complicated by the need to simultaneously control the aircraft, listen to a flight instructor, and receive traffic control directions from air traffic controllers.

Illustrations. Graphics can be used to display the hierarchical structure of text and illustrate relationships; they help make explicit the structure of content to be learned, and this reduces ambiguity and clarifies relationships among important lesson concepts (Hannafin and associates, 1996). According to Dunstan (1992), cited in Hannafin and associates (1996), they are readily recalled, and when associated with important content, enhance recall of that information. Kenny (1993), cited in Hannafin and associates (1996)

concluded, based on several studies of pictorial graphic organizers, that pictures help learners to integrate lesson content during CAI.

Screen design and display. The recent research has examined the effects of varying information placement and access. Aspillaga (1991) examined the effects of screen location of information on the retention of information. The results indicated that presenting information at a consistent location or relevant to graphical information is conducive to learning. Grabinger (1993) provided three rules of thumb. Firstly, divide the screen into consistently placed functional areas. Secondly, use organizing techniques to illustrate the structure of a screen. That is, use headings as organizers, and directive cues to point out important terms and phrases. The latter can be done by using increased spacing between paragraphs rather than traditional indentations, and by showing comparisons in side by side columnar arrangements. Thirdly, design screens that are interesting but not complex: excessive complexity results when too many elements and too much information is crammed on the screen. In this regard Fleming (1987) cites the work of Moray (1967) and advises that the amount of displayed information that can be processed at one time is limited. Fleming states that information provided by the designer should be rationed. This can be done by prechunking according to spatial grouping, temporal pacing and pauses, or by semantic grouping of related concepts. He suggests that a general limit of five familiar items can be perceived or reported on at one time. He adds that the size of the display and the complexity of the task need to be controlled to keep within processing capacity limits.

According to Rieber (1994), the effect of color on learning has not been shown to be especially significant. He states that the greatest role of color may be in supporting other instructional elements, such as a cosmetic-based amplification technique to help focus the learner's attention on important screen information. He advises that color use should not be avoided, nor should it be used indiscriminately, as poor color choices have a high potential for distraction.

Encoding support.

Encoding is the process whereby the organism modifies incoming stimuli into codes that the brain can understand and use (Gordon, 1989). According to Bliss (1994), cited in Hannafin and associates (1996), effective encoding support helps learners select, organize, and integrate learning experiences within mental models which have been formulated in memory.

Two approaches for supporting encoding are personalizing instruction and designing interaction strategies (Hannafin and associates, 1996). Personalizing instruction involves integrating personally relevant information to help learners connect unfamiliar lesson content to their background and interests. The research by Anand and Ross (1987) applies to elementary school students. However, I believe that it may be extended to adults. Anand and Ross examined the effects on students of modifying computer based mathematics learning materials. Students demonstrated higher achievement and better attitudes after receiving mathematics problems that included personal information.

Gavora and Hannafin (1995) provide a conceptual model for the design of human-computer interactions. To them cognitive restructuring is integral to the definition of interaction. They describe successful interactions as having cognitive as well as physical requirements, and being mediated by the quantity and quality of effort. That is, interactions cause differential allocation of cognitive resources according to the learner's familiarity with the domain of study. As a domain becomes familiar, the associated cognitive responses become automated, and require few or no cognitive resources. Complexity and lack of familiarity cause competition for limited resources, a problem that Gavora and Hannafin say can be managed through interaction. In unfamiliar domains, complexity is managed by instigating simple and discrete interactions. These responses eventually become automated. Once familiarity is achieved, the amount and complexity of interactions can be increased.

Detecting and correcting errors

This activity promotes effective learning. According to Hannafin and associates (1996), error identification allows learners to become aware of inadequacies in their mental models and activates deeper understanding. Bangert-Downs, Kulik, Kulik, and Morgan (1991) note, in their meta analysis of forty studies, that feedback must be used mindfully to be effective. Simply informing a learner as to the accuracy of a response is less effective than providing some degree of elaboration. A study of college undergraduates found that subjects who received elaborative feedback during instruction performed better on a posttest than students who received verification feedback (Pridemore and Klein, 1991). Under elaborative feedback, a student was told whether or not a response was correct, the correct answer, and an explanation. According to the researchers, performance improved because of the increased amount of information in elaborative feedback messages, and the increased time students spent studying these messages.

Lesson sequencing

There are two views on who should control lesson sequencing (Hannafin and associates, 1996). The first view is that the computer allows the creation of environments in which students complete optimal instructional sequences, according to external judgments, to achieve predetermined goals. The second view is that the computer provides the opportunity for student-centered learning. The computer encourages learners to build relationships among lesson concepts through exploration, experimentation, and manipulation. According to Kinzie (1990), learner control of lesson execution contributes to learner achievement and improved attitudes and motivation. However, the research by Hannafin (1984), cited in Hannafin and associates (1996) shows that learners are poor judges of their learning needs, and often look for information that is not required, or end lessons prematurely. Chung and Reigeluth (1992), cited in Hannafin and associates (1996) note that complete program control is effective for domain novices and for tasks with

clearly stated performance requirements. However, it is limiting for high-ability and high-prior knowledge students.

Motivation

Kinzie (1990) propose that two motivational constructs, intrinsic and continuing motivation, are important for maintaining participation in computer based environments. Intrinsic motivation refers to the learner's participation in an activity where the reward is generated by the activity itself. Continuing motivation refers to the learner's choice to return to a lesson without the presence of external motivators.

Keller and Suzuki (1988), cited in Hannafin and associates (1996) provide a motivational model for instructional design, which incorporates the four categories of attention, relevance, confidence, and satisfaction. Attention gaining deals with strategies to arouse and sustain performance. Relevance deals with how instruction is related to the learner's personal goals. Confidence relates to the extent that learners believe they will succeed at a task. Satisfaction refers to the learners' views of the outcomes of instruction. Keller and Suzuki also identify motivational objectives and learner characteristics as key factors. They point out the importance of motivational objectives to the design and evaluation of computer based instruction. They explain that it is assumed that learners are motivated if they respond positively to questionnaires or if they perform well on achievement tests. However, task persistence, indicators of continuing motivation, and increased confidence and relevance are better indicators of motivation. Keller and Suzuki also state that a careful consideration of learner characteristics can help designers determine the motivational objectives needed. For example, students who view content as important and relevant do not require as much additional motivation as students who lack confidence or perceive little relevance in the content.

Fleming (1987) makes some further comments on attention. He states that without attention there can be no learning, so designers usually seek to gain the learner's attention

and to keep it. He notes that attention is highly selective, that is the learner gives attention to only a small part of the environment at one time, and sees most sharply in the small central portion of the visual field. Fleming adds that attention is drawn to what is novel or different, but this need not be something that is entirely new to learners, it need only be different from what they have just recently experienced. For example, in speech change the volume or inflection, in print change the typeface. He also notes that changes in brightness and motion are strong attention gaining factors. In addition, Fleming states that attention is drawn to moderate complexity. If it is overdone, it leads to learner avoidance, if it is too simple it gets little attention.

Applying knowledge and skills

Hannafin and associates (1996) note that retrieving and using knowledge and skills are closely connected with encoding. This is because a learner cannot access what has not been learned. They add that retrieval depends on the quality and nature of the encoding, the existence of cues (internally produced or externally provided) that trigger relevant processes, and the application of strategies to identify and restructure information. Lambrecht (1993) recommends three approaches to teaching problem solving with computers: general (teaching self regulation or metacognitive skills), integrated (teaching within realistic learning contexts), and immersed (focusing on the nature of the learning experience).

Contextual factors

Context has become the focus of contemporary research in such areas as situated cognition, cognitive apprenticeships, authentic learning, and anchored instruction (Hannafin and associates, 1996). For example, Brown, Collins and Duguid (1989) note that knowledge is situated, and that it is in part a product of the activity, context, and culture in which it is developed and used. They comment that conventional schooling too

often ignores the influence of school culture on what is learned. As an alternative to conventional practice they propose cognitive apprenticeships, and provide examples from the teaching of mathematics. One example cited is Schoenfeld's teaching of problem-solving. Here Schoenfeld deliberately attempts to generate mathematical practice and to show college students how to think mathematically about the world, how to see the world through mathematicians' eyes, and thus, how to use the mathematician's tools.

Recent studies have investigated the effects of collaborative learning. The study by Hooper, Temiyakarn and Williams, (1993) compared the performance of learners who completed computer based tutorials alone with those who worked as a group. They found that following cooperative learning, the students demonstrated increased achievement and efficiency as well as better attitudes toward both the computer lesson and the grouping.

Conclusion

This section has examined the research into the design of CAI systems with respect to orienting the learner, presenting the lesson, encoding support, detecting and correcting errors, lesson sequencing, motivation, applying knowledge and skills, and contextual factors.

Orienting activities support the learner by providing expectancies for, and perspectives on, forthcoming lesson content. Presenting the lesson involves the following factors: multi versus single modal instruction, where it should be borne in mind that more is not necessarily better when presenting stimuli; the use of graphics for displaying the hierarchical structure of text, and illustrating relationships among concepts; the display of information at consistent locations, or relevant to graphical information, which is conducive to learning. Effective encoding support helps learners select, organize, and integrate mental models which have been formulated in memory. Error identification allows learners to become aware of inadequacies in their mental models and activates deeper understanding. Feedback has to be elaborative in order to be effective. Learner control of lesson execution

contributes to learner achievement, and improved attitudes and motivation, and should be encouraged for high-ability, high prior-knowledge learners. Intrinsic and continuing motivation are important for maintaining participation in computer-based environments. Retrieving and using knowledge and skills are closely connected with encoding since the learner cannot access what has not been learned. Cognitive processes and context are closely related as knowledge is situated in the context in which it is acquired.

Content of the Module: Selecting Teaching Technology for Distance Education

Introduction

This section examines a number of approaches, models, and criteria for selecting technology and media for distance education, and considers the research into media effectiveness. It concludes that the selection criteria and twelve rules recommended by Bates (1995) are effective for helping distance educators select technology and media.

In order to provide clarification, it is necessary to define the terms technology and media. Both terms may be defined in various ways. Moore and Kearsley (1996) describe technology as including the machines that distribute messages, and the structure and people that make them work. These authors state that media are the messages or symbol systems distributed through technologies. Bates (1995) regards a medium as a generic form of communication connected with specific ways of representing knowledge. A single medium, such as television, says Bates, may be delivered by several different technologies (satellite, cable, video cassette, etc.). According to Bates, the five most important media are direct human contact, text, audio, television, and computing. Romiszowski (1988) defines technology as "the systematic application of knowledge (usually scientific

knowledge) to achieve a particular practical purpose" (p. 15), and media as "the carriers of messages, from some transmitting source (which may be a human being or an inanimate object) to the receiver of the message (which in our case is the learner)" (p. 8). Rowntree (1982), writing from a narrower perspective, defines educational technology as being "concerned with the design and evaluation of curricula and learning experiences, and with the problems of implementing and renovating them" (p. 1). He regards media as an amalgam of five stimulus modes, which he identifies as human interaction, realia, pictorial representation, written symbols, and recorded sound.

Selection Models and Approaches

According to Criticos (1996), media selection models and approaches treat media selection as an important step in the instructional design process. He adds that the approaches differ in where they locate media selection within the instructional design process, and in the emphasis and priority given to factors (selection criteria) which influence selection decisions. Criticos identifies four major models in the field of instructional technology: those developed by Romiszowski; Gerlach and Ely; Rowntree; and Reiser and Gagne.

Romiszowski's (1988) model is summarized as follows:

1. Instructional methods have to be selected before media can be selected.

2. Instructional methods are directly influenced by type of learning task (objectives), target population (location, size, etc.), student characteristics (learning style, skills, etc.) and practical design constraints (money, time, what's available, etc.).

3. While media selection is directly influenced by instructional methods, it is also directly influenced by student characteristics; practical design constraints; teachers' attitudes and skills, etc.; and teaching space, lighting, facilities, etc.

Gerlach and Ely's (1980) approach is based on a media selection rule, which states that "A medium of instruction must be selected on the basis of its potential for

implementing a stated objective" (p. 250). They recommend a four step process for implementing this rule (p. 251):

1. Write an objective.
2. Determine the domain in which the objective can be classified: cognitive, affective, psychomotor.
3. Select an appropriate strategy within the domain determined in step 2.
4. Select appropriate media.

Rowntree's approach is described by Criticos (1996). This approach does not recommend a linear order of steps since, according to Criticos, Rowntree acknowledges that there are many situations in which media selection will not be the final stage of instructional design. In Rowntree's model the five factors that are derived from learning objectives - content, sequence, strategy, mode, and medium - will be chosen in an order consistent with the nature of the instructional task and its environment (Criticos, 1996).

Reiser and Gagne (1983) use a flowchart which contains six panels. Each panel begins with a list of possible media. Panels two to six show media which are left as possible choices, since they have not been removed by the flowchart procedure of previous panels. The instructional designer starts with the possible media in mind, and follows a procedure by answering questions until a smaller set of media are reached at the bottom of the chart. Further choices among these are made by applying the factors of cost, availability, and convenience.

Bates (1995) comments that there are problems with applying these models to distance education. The first problem is that these models are created for use in a classroom or face-to-face context. The second problem is that they are reductionist in their approach: since they focus on matching a specific medium to a specific instructional event, the teaching or learning process is broken down into basic elements of activity, against

which a particular medium is selected. The result, says Bates, is that many different media are required for a small amount of teaching.

Bates (1995) notes that these models are rarely used in distance education, where technology decisions are made intuitively by decision-makers, based on their personal experience. Rather than a completely intuitive approach, he proposes an alternative model which has the following characteristics (p. 34):

1. It will work in a wide variety of contexts.

2. It allows decisions to be taken at both a strategic, or institution-wide level, and at a tactical, or instructional level.

3. It give equal attention to instructional and operational issues.

4. It will identify critical differences between technologies, thus enabling an appropriate mix of technologies to be chosen for any given context.

5. It will accommodate new developments in technology.

Bates proposes the ACTIONS framework, which consists of criteria for selecting technology for distance education (p. 34). These criteria are discussed in the following section.

Selection Criteria

Bates' (1995) ACTIONS framework is based on an analysis of questions which are grouped under the following criteria (pp. 1-2):

1. **A** Access: How accessible is a particular technology for learners? How flexible is it for a particular target group?

2. **C** Costs: What is the cost structure of each technology? What is the unit cost per learner?

3. **T** Teaching and learning: What kinds of learning are needed? What instructional approaches will best meet these needs? What are the best technologies for supporting this teaching and learning?

4. **I** Interactivity and user-friendliness: What kind of interaction does this technology enable? How easy is it to use?

5. **O** Organizational issues: What are the organizational requirements, and barriers to be removed, before this technology can be used successfully? What changes in organization need to be made?

6. **N** Novelty: How new is this technology?

7. **S** Speed: How quickly can courses be mounted with this technology? How quickly can materials be changed.

Bates is not the only educator who uses selection criteria. Writers in the field of instructional technology apply a variety of criteria to their selection models. These criteria are reviewed by Reiser and Gagne (1983), who group them into three categories: physical attributes of media; learner, setting, and task characteristics; and practical factors. Reiser and Gagne describe media attributes as the physical capabilities of the media, which include the capability of depicting motion, sound, and visual displays. In the next category, learner characteristics include reading ability and age of the learner; instructional setting includes the location where the course is to be delivered, whether instruction is to be presented to individuals or a group, and, if a group is involved, the size of the group; task characteristics include objectives, which are classified according to types of learning outcomes. The final category, practical factors, includes costs, availability, and convenience.

While the selection criteria used in the field of instructional technology are useful in their field, I agree with Bates that they are reductionist in their approach. The distance educator needs to consider the overall framework of the course, and apply economy and simplicity to the types and number of media selected. Therefore, Bates' (1995) ACTIONS framework (pp. 1-2) is more useful to distance educators.

Research into Media Effectiveness

The research into media effectiveness does not provide educators with much help in selecting media. Romiszowski (1988) provides a summary of half a century's research in this area. He concludes that individual studies and the meta-analyses of Campeau, Kulik, and others, have found no significant difference in the quality of instruction when comparing one medium with another. Clark (1996), also provides a history of media research, and states that the claim of no learning benefits from media has been made and proven in the past, and that many researchers have maintained that media have different economic benefits, but no learning benefits. Referring to his own research, Clark argues that media are mere vehicles that transport instruction but do not influence student achievement anymore than a truck that delivers groceries causes changes in nutrition. He explains that instructional methods have been confused with media, and it is the former which influence learning. According to Clark, a delivery technology formats and packages instructional methods.

In view of the above, what resources, other than Bates' (1995) ACTIONS framework, do distance educators have for helping them select teaching technology and media? Bates (1995) offers twelve golden rules, which, I believe, when used in combination with his ACTIONS framework, provide a good basis for decision making. These rules are discussed below.

Bates' (1995) Twelve Golden Rules

Bates offers some very practical advice for choosing and using technologies in the field of distance education (pp. 12-14):

1. Good teaching matters. Good teaching may compensate for a bad choice of technology, but technology will never rescue bad teaching, it usually makes things worse.

2. Each medium has its own aesthetic. Good production and design are required to exploit the unique features of each medium.

3. Educational technologies are flexible. They may be used interchangeably to accomplish the same objectives. Differences within a technology or medium may be greater than between media. However, there are intrinsic differences between technologies, which have implications for teaching and learning.

4. There is no super-technology. Every technology has strengths and weaknesses, therefore technologies should be combined.

5. Make all four media available to teachers and learners. Learners vary in terms of educational background, age, experience and learning style. Therefore the four media of print, audio, television, and computers should be available.

6. Balance variety with economy. In order to avoid complexity in the design process, redundancy, and wasted expenditure, use a limited range of technologies.

7. Interaction is essential. Interaction with learning materials, between teachers and other learners is necessary for learning to be effective.

8. Student numbers are critical. Some technologies decrease in cost when there is a corresponding increase in student numbers. Other technologies increase in cost when there are more students.

9. New technologies are not necessarily better than old ones. Technologies should be selected according to educational and operational factors, not according to age.

10. Teachers need training to use technologies effectively. Teachers need training not only in the selection and use of technology, but more importantly, in the principles of learning, and instructional design.

11. Teamwork is essential. No one can be an expert on the educational use and design of every technology, and on subject matter.

12. Technology is not the issue. The issue is how and what students should learn, and where. Focus on designing the learning experience.

Conclusion

This section has reviewed a variety of approaches, models, and criteria for selecting technology and media for distance education. In addition, it has examined the research into media effectiveness to find out if this research provides information that may assist distance educators in their task. It concludes that the ACTIONS framework and twelve rules recommended by Bates (1995) are effective for selecting technology and media.

Conclusion

A literature review was undertaken to ascertain the state of knowledge in the area relevant to the purpose of this study, and how this knowledge could be applied to the planned computer assisted instruction module. A review of the humanistic learning theories of Maslow, Rogers, and Knowles yielded the concepts of self-actualization, personal growth and development, experiential learning, self- directed learning, facilitation of learning, and intrinsic motivation. An examination of cognitive learning theories yielded the Gestaltist concepts of perception, insight, and meaning; schema theory's assumption that schemata can be more effectively built if learning material corresponds to the generally accepted structure of schema; Piaget's concepts of qualitative developmental stages and mature adult thought; Ausubel's concept of advance organizers; and Bruner's concept of learning through discovery. A review of the research into the design of CAI systems yielded a variety of guidelines with regard to orienting the learner, presenting the lesson, encoding support, detecting and correcting errors, lesson sequencing, motivation, applying knowledge and skills, and contextual factors. A review of the approaches, models, and criteria for selecting technology and media for distance education concluded with the recommendation that the ACTIONS framework and twelve rules proposed by Bates (1995) are effective for selecting technology and media.

Chapter Three: Research Method

Introduction

The purpose and objectives of this study were achieved through its research method. The selection of an appropriate research method was guided by the following question: What is the best approach, and, within this approach, what is the best model for developing and evaluating a computer assisted instruction module for use in adult/distance education? This chapter discusses the approaches and models reviewed by the researcher, and explains the choice of the research and development approach, and the model recommended by Borg and Gall (1989). It also discusses approaches to evaluation, sampling and data collection methods, and ethical considerations as they relate to this study. Finally, it discusses how the model was implemented.

Research Design

Approaches and models

This section examines the remote classroom, systems, and research and development approaches to course design and development. The last two approaches are related and may use similar procedures.

Bates (1995) states that the two dominant instructional paradigms in distance education are the remote classroom and the front-end systems design. He explains that the remote classroom is a transposition of traditional, face-to-face teaching to the distance education environment. Examples given by Bates are the televised lecture and the audio conference. Bates adds that, while technology is used to enable delivery, the teaching strategy is the same as in the classroom context. He identifies several problems with this model when it is compared with the systems design model. Firstly, it is less formal, and less open to examination and criticism. This may have a negative impact on the quality and effectiveness of the instructional process. Secondly, this model is more dependent on the abilities and attitudes of individual teachers, making it more variable. Thirdly, while this

model allows students to be more self-directed in terms of determining important content, and structuring learning to their needs, students may have problems with assessment if they have not accurately identified the intellectual skills and content areas teachers expect of them. Lastly, since this model is a transfer of face-to-face teaching to the distance education context, teachers who use it may not exploit the unique teaching features of a technology.

The front end systems design is based on a systems approach (Bates, 1995). This approach draws from several theoretical perspectives, including general systems theory, information and communications theory, behavioral psychology, and cognitive learning theory (Knirk and Gustafson, 1986; Garrison, 1989). While many instructional design models exist, most of them follow the same process: design, development, evaluation, and revision (Willis, 1993). The process is systematic and cyclical, that is, each step leads to the next, and, after the last step (revision) the cycle is repeated, beginning at the design step (Willis, 1993). These models require a heavy investment at the beginning design step (Bates, 1995), which consists of problem identification, needs assessment, audience analysis, and formulation of goals (Willis, 1993).

Gustafson (1996) developed a taxonomy of instructional design models, based on the primary focus of the design effort: a classroom orientation, an instructional product orientation, and an instructional system orientation. According to Gustafson, classroom models are designed for classroom, teacher-based instruction. Classroom models will not be discussed here as this study is concerned with distance education, where the teacher and student(s) are at different locations.

Gustafson (1996) describes product models as being designed for producing specific instructional products, either for clients or for commercial marketing. An example of a product model is the one developed by Bergman and Moore (1990) for interactive video/multimedia projects. This model is made up of the following steps: analysis, design, development, production (of video sequences, audio, graphics, or text), authoring

(integration of individual media elements into a seamless, interactive presentation), and validation.

Gustafson observes that instructional systems models and product models have many assumptions in common, however one of the main differences is the size and scope of the undertaking. He explains that product models are concerned with producing one package at a time, while systems models are concerned with large scale projects, where multiple products are created as part of an integrated system. An example of an instructional systems model is the one developed by Dick and Carey (1990), which is made up of the following ten steps (pp. 2-3):

1. Identify instructional goals
2. Conduct instructional analysis
3. Identify entry behaviors and characteristics
4. Write performance objectives
5. Develop criterion-referenced test items
6. Develop instructional strategy
7. Develop and select instructional materials
8. Design and conduct formative evaluation
9. Revise instruction
10. Design and conduct summative evaluation

In the above model, formative evaluation (step 8), or in-process evaluation, is carried out throughout the developmental process, and its results are used to revise (step 9) any work carried out during the first seven steps. Summative evaluation, or evaluation to determine the effectiveness of the program/product, is carried out in step 10.

There are several benefits to the systems approach. Dick and Carey (1990) point out that the process is empirical and replicable, that is instruction is designed to be delivered as many times as possible, with as many learners as possible. They elaborate that, since it is reusable, it is worth the time and effort that is spent in evaluation and

revision: data are collected to find out what part of the instruction is not working, and it is revised until it does work. Garrison (1989) finds the systems approach particularly useful for distance and adult education since it emphasizes front-end analysis, and, since it is concerned with the entire instructional system, it is holistic. Therefore, says Garrison, if a program is being designed for adults, then all the particular needs of the adult would be analyzed and incorporated into the design. He adds that special problems associated with distance education, such as mediated communication, would be addressed. Garrison does not see this approach as precluding a humanistic or flexible framework from the educational transaction. Bates (1995) observes that course teams, consisting of individuals with specialist skills, are used with this approach. He notes that course teams have helped establish the credibility of autonomous distance teaching universities as they produce teaching material which is of a high academic standard, and which reflects advanced and effective instructional strategies.

In spite of the above favorable comments, Bates (1995) sees several problems with the systems approach. One problem he mentions is the lack of adaptation of teaching materials to individual learner needs, since all learners receive the same material. However, he acknowledges that tailoring to individual needs may be done by the remote tutor. Bates also cites the criticism by Harris(1987) that this approach is authoritarian since the nature and structure of content are determined in advance, and it is difficult for students to negotiate, re-configure, or transform the learning experience to their own needs. I believe that these problems may be resolved through the use of two-way technologies such as audio conferencing, live interactive television, video conferencing, and computer-mediated conferencing, where students have the opportunity of interacting with instructors, and among themselves, and expressing their views. Also, when a computer assisted instruction module is developed, as was done in this study, it is possible to build flexibility into the structure by allowing students to choose which material to cover, the sequence it is to be covered, and whether they wish to review the material.

The final approach to be examined in this section is educational research and development (R and D). Gall, Borg, and Gall (1996) describe R and D as "A research-based approach to developing new programs and materials to improve education" (p. 679). In an earlier edition of their work, Borg and Gall (1989) refer to the R and D process as the R and D cycle, and state that it is made up of the following steps: investigating research findings relevant to the product being developed; using these findings to develop the product; field testing the product in the environment where it will be eventually used; and revising the product according to field test results. Borg and Gall add that in some R and D programs, this cycle is repeated until the field test indicates that the product has met behavioral objectives. They point out that R and D bears a close relationship to the field of instructional technology, where the primary interest of instructional technologists in recent years has been in the design and validation of learning systems. They suggest that anyone considering an R and D project should study the methods and conceptual models of instructional technology to determine if any of these methods/models can be used in the project. Gall, Borg, and Gall (1996) refer to Dick and Carey's (1990) systems approach model as one of the most widely used models in educational R and D.

According to Borg and Gall (1989), educational R and D has two benefits. The first benefit is that it develops educational products that are effective and ready for use in schools. They contrast R and D with educational research, the goal of which is to find out new knowledge about fundamental phenomena (through basic research) or about educational practice (through applied research). While acknowledging that many applied research projects involve the development of educational products, Borg and Gall note that these products are developed only to the point of testing the researcher's hypothesis. They make the additional point that tests are carried out in settings that do not reflect actual school conditions. They conclude that applied research rarely yields products that are ready for operational use in schools. The second benefit noted by Borg and Gall is that R and D bridges the gap between research and practice by taking the findings obtained from basic

and applied research, and using them to build tested products that are ready for operational use in schools.

In view of the benefits of the R and D approach, and in view of its close relationship to the systems approach, which itself has benefits previously discussed, it is appropriate to use the R and D approach for this study. In considering which specific model to use, it was noted earlier that Gustafson (1996) viewed systems approach models, such as Dick and Carey's (1990) model, as being concerned with large scale projects, where multiple products were created as part of an integrated system. In fact, Gall, Borg and Gall (1996) caution that R and D projects require substantial resources, and they are of the opinion that it is highly unlikely that a graduate student would be able to find the financial resources and personnel support to complete a major R and D project. They recommend that the graduate student scale down the project by limiting development to just a few steps of the R and D cycle. In accordance with this recommendation, I consider the following steps of the R and D cycle, which are a modification of those outlined by Borg and Gall (p. 784), to be appropriate for this study:

1. Research and information collecting
2. Planning
3. Develop preliminary form of product
4. Preliminary field testing and product revision
5. Main field testing and final report

This section has examined the remote classroom, systems, and research and development approaches to course design and development. It has noted the relationship between the last two approaches, and the benefits to be derived from using them. It has explained the choice of the research and development approach, and a modified version of the model recommended by Borg and Gall (1989).

Evaluation

This section discusses formative and summative evaluation. Dick and Carey (1990) define formative evaluation as "the collection of data and information during the development of instruction which can be used to improve the effectiveness of the instruction" (p. 234). Willis (1993) states that, in distance education, formative evaluation can be conducted on two or more levels: the first level includes a review of sample instructional material by content experts; the second level includes the actual delivery of one or more instructional components to the intended target audience. Dick and Carey (1990) suggest the review of instruction by interested specialists, who are not directly involved in the project. These include content specialists, those who are familiar with the type of learning outcomes involved, and those familiar with the target population. This review, they say, should be followed by three levels of evaluation: one-to-one, where the designer works with individual students to obtain data to revise the materials; a small group evaluation; and a field trial.

Commenting on the use of experts, Bates (1995) notes that course teams are used by autonomous distance teaching universities to determine and monitor content and methods. Moore and Kearsley (1996) describe these teams as consisting of 20 or more content and technical specialists. The latter include editors, graphics designers, radio and television producers, instructional designers, and librarians. According to Moore and Kearsley, the use of many experts results in course materials which are effective and complete. These authors note, however, that the course team approach is very labor-intensive and therefore expensive, and involves a lengthy development period. They conclude that it is appropriate only for courses with large enrollments and long-term use. In view of the fact that this study dealt with the development of one module in a course delivered to twenty-five students, I considered the course team approach to be too unwieldy. However, recognizing the important contribution of content and technical specialists, I decided to form a development team of four specialists for this study. The

team was made up of the course instructor, a doctoral student, my thesis supervisor, and myself. Each team member was knowledgeable about the content as well as instructional technology.

With regard to additional levels of formative evaluation, it was noted in the previous section that this study used a scaled down version of the R and D model recommended by Borg and Gall (1989), because a graduate student, like myself, did not have the financial and personnel support to complete a major R and D project. Therefore one other level of formative evaluation was conducted, and this was the field test where three graduate students were asked to try out the module.

The selection of the three graduate students was based on some suggestions made by Alessi and Trollip (1991) and Dick and Carey (1990). Alessi and Trollip advise the choice of students very much like those for whom the lesson is designed. They suggest using at least three students: one should be representative of the best of the potential students; one representative of an average student; and one representative of the slowest of the students (p. 397). This spread of capabilities, they say, will enable the researcher to test if the lesson meets the needs of the entire target population. Dick and Carey (1991) recommend that when the group of learners available to draw from is small, the researcher should include at least one representative of each type of subgroup that exists in the population. Subgroups would include learners who are familiar with a particular procedure, such as computerized instruction, and those who are not. In this study three graduate students were selected to try out the module. Two of them were in the field of adult education, and one in educational administration. The target population consisted of fourth year undergraduates. While there were differences between the two groups, I felt that there were enough similarities in that both groups were education students, and the fourth year students had almost the same number of years of university education as the graduate students. The population size was small (twenty-five), so I chose three students,

one who had little familiarity with the content and computer assisted instruction, one with average familiarity, and one with a lot of familiarity.

The other type of evaluation applicable to an R and D model is summative evaluation. This evaluation is conducted upon completion of a course and it is used to assess the overall effectiveness of the finished instructional product (Willis, 1993). In this study, summative evaluation was conducted at the main field test step. Here, the class of 25 undergraduate students were asked to use the module. Volunteers from this group later participated in a focus group interview which was conducted through computer conferencing.

Computer conferencing allows students and instructors to be in contact with each other while they are physically at a distance. Bates (1995) describes the benefits of computer conferencing as active and interactive participation; freedom from the constraints of time and location; and learner control. With regard to active and interactive participation, subjects can ask questions, participate in discussions, develop arguments, respond to conflicting ideas, and add new information. This, according to Bates, contributes to intense academic discourse. Also, since the participants can access the conference at a time which is convenient for them, communication is asynchronous, and the participants are freed from the constraints of time and location. They can join the conference over a period of time, read the development of comments by others, and add their own comments when they are ready. These characteristics of computer conferencing make it particularly suitable for the focus group interview, which, according to Krueger (Gall, Borg and Gall, 1996), is a carefully planned discussion, the purpose of which is to obtain the participants' views in a permissive and non threatening environment.

This section has discussed formative and summative evaluation. The former is conducted during the development of instruction, and is used to improve the effectiveness of instruction. The latter is conducted upon completion of a course and is used to assess its overall effectiveness.

Quantitative and qualitative approaches to data collection and analysis

Both quantitative and qualitative approaches may be used in formative and summative evaluation. Rowntree (1992) describes the quantitative approach as asking the question, "Have the goals been achieved?" (p. 214), and focusing on the formal assessment of learners and the statistical analysis of achievement tests and attitude questionnaires. In contrast, he describes the qualitative approach as asking the question, "What has been going on?" (p. 214), and emphasizing sensitive observation, discussion, and interviewing, with findings conveyed by analogies and anecdotes.

According to Willis (1993) quantitative evaluation methods are often forced choice scales in which students place themselves in certain categories. He cites as examples the Likert scales, where students are asked to respond to statements according to their level of agreement, which could range from "strongly agree" to "strongly disagree" (p. 63). He adds that these responses are tallied and statistically analyzed, and result in broad conclusions based on the level of agreement.

Willis (1993) lists the following benefits for quantitative methods: they are especially useful when there are large numbers of respondents for whom more in-depth, personalized responses are not practicable; their dependence on statistical analysis improves objectivity; they are quick and easy to administer and complete, making them less expensive to conduct than qualitative methods. However, Willis acknowledges that quantitative methods present several problems for distance education: many distance education courses have small class sizes with students from different backgrounds, making statistical analysis difficult; quantitative surveys usually have a low rate of return (under 50 percent), and revising courses on this basis means using false assumptions; statistical analysis frequently results in an illusion of precision that may not be true.

Willis (1993) notes that qualitative methods focus on the quality of the response, and the collection of information from fewer subjects. He describes the qualitative evaluator as observing behavior that might be open to different subjective interpretations,

and cautions against personal bias, which can be overcome by collecting data from multiple sources.

Willis prefers qualitative methods to quantitative ones. Rowntree (1992) expresses the view that both methods may be needed for different aspects of a particular program, and recommends that the researcher pragmatically take what is needed from both. I agree with Rowntree that both methods have their advantages. I am of the opinion that both may be used to complement eachother, therefore I have used both in this study.

I used quantitative and qualitative methods in the design of an attitude questionnaire (Appendix C), which was administered twice in the study, the first time to three graduate students during the preliminary field test, and the second time to twenty-five undergraduate students during the main field test. The questionnaire was designed to obtain the students' views on various components of instruction: language and grammar, surface features of the displays, questions and menus, other issues of pedagogy (e.g. student control, motivation, and interaction), subject matter, and the user guide (Alessi and Trollip, 1991). A quantitative method was used in which the students were asked to choose one of three response types (yes, no, don't know) to each question. A qualitative method was used in which ample space was provided at the end of each section for students to write their comments. I also included an open-ended question at the end of the questionnaire which asked for the students' overall impressions of the module. Other qualitative methods (Alessi and Trollip, 1991; Willis, 1993) used in this study were: interviews of individual students during the preliminary field test (Appendix D), during which the subjects were asked the same questions as they were asked in the questionnaire; a focus group interview (Appendix E) at the conclusion of the main field test, during which students were asked questions of a summative nature, which included their overall impressions of the module, the strengths and weaknesses of the module, and how its quality could be improved; non-participant observation during the preliminary field test, when I observed the subjects using

the module; and content analysis during the planning and product development steps, when the developmental team reviewed the teaching material.

This section has discussed quantitative and qualitative approaches to data collection and analysis. The quantitative approach asks the question, "Have the goals been achieved?", and the qualitative approach asks, "What has been going on?" (Rowntree, 1992, p. 214). Both approaches are of value and were used in this study.

Ethical Considerations

Ethical considerations include protecting the privacy of the participants, ensuring their informed consent, giving them the opportunity to opt out at any time, and making the written report available to all interested parties.

I ensured the privacy of the participants by coding materials used in the study and refraining from using any methods or descriptions which would identify the participants. The informed consent of each participant was obtained by me after an explanation was provided of the research procedure and intended use of the data. This was done both verbally and in written form during the preliminary field test. It was done in writing during the main field test and focus group interview (computer conference) as my communication with the subjects here was via computer. The participants were given the opportunity to opt out of the study at anytime. The participants, instructors, course designers, administrators, and others involved in the design and delivery of distance education courses have access to this written report.

Research Procedure

The purpose of this study was to develop and evaluate a computer assisted instruction module for university students in the field of adult education. This study was guided by a research and development approach, and a modified version of the model outlined by Borg and Gall (1989). The following section discusses the steps which were taken in this study.

1. Research and information collecting

This step involved a needs assessment and a literature review. Borg and Gall (1989) provide a list of criteria to be considered in the needs assessment phase. The criteria are as follows (p. 785):

1. Does the proposed product meet an important educational need?

2. Is the state of the art sufficiently advanced that there is a reasonable probability that a successful product can be built?

3. Are personnel available who have the skills, knowledge, and experience to build this product?

4. Can the product be developed within a reasonable time?

The first criterion is the identification of the instructional problem or need. Willis (1993) states that at this stage, there is an assumption that an instructional gap exists between what is and what should be, and it is the instruction that fills this gap. In many R and D projects, the identification of the problem or need is carried out by the teacher or instructor (Charles, 1988). This study focused on one unit (Selecting teaching technology) of a course on distance education. The course instructor felt that the students needed to be able to select teaching technology for distance education courses, which they themselves would teach. However, would the proposed product meet this need? The learning material was available from several sources: text on the course website, and selected readings from the books by Bates (1995), and Willis (1993). The instructor was concerned that if

students read from these sources and answered the accompanying reflective questions, their learning experience would be somewhat passive. She wanted the students to be actively involved in the learning event, to develop critical thinking, to interact directly with the content by answering questions and receiving feedback. Since the course content dealt with selecting technology, the instructor wanted the students to experience using a technology, and the media that were related to it. In view of these considerations, the instructor and I felt that computer assisted instruction, with its accompanying features of text, graphics, questions, and feedback, would meet the important educational need identified by the instructor.

The second criterion relates to the probability that a successful product can be built. All members of the development team were sufficiently familiar with CAI and authoring systems to conclude that the state of the art was sufficiently advanced for a successful product to be built. The third criterion relates to the availability of personnel with the requisite skills, knowledge, and experience to build the product. I had used the Authorware Professional authoring system in the past, and successfully designed and developed three CAI modules. Therefore I had the ability to build the product. Finally, the fourth criterion asks if the product can be developed within a reasonable time. It was concluded by the development team that the product could be produced within three months. The development phase was scheduled to begin in May, 1998, with the main field test scheduled for August, 1998.

The research and information collecting step also involved a literature review. The purpose of the literature review was to determine the state of knowledge in the area of interest and how this knowledge could be applied to the planned product (Borg and Gall, 1989). The literature review is described in Chapter 2 of this thesis. The information from the literature review was used in Step 2, the planning process.

2. Planning

The planning step involved making a plan of the product, which included: the product's objectives; a description of its target audience; and a description of the product's components, and how they would be used.

The product's general objective, which was determined by the course instructor, was that students would be able to select teaching technology for distance education. This was further refined by the instructor and broken down into sub-objectives. They are stated below.

After completing the module (unit), students would be able (or better able) to:

1. Discuss the factors that influence the selection of instructional technologies for distance education.

2. Identify the strengths and weaknesses of the various technologies.

3. Suggest appropriate technologies to support specific learning outcomes.

Instructional objectives include the design criteria for a CAI module. I developed a set of criteria, which were based on the research discussed in the literature review section of this study (Chapter 2). Specifically, an effective CAI module should:

1. Provide orienting activities, which establish expectancies for, and perspectives on, forthcoming lesson content.

2. Use text and illustrations. Avoid multi modal instruction as more is not necessarily better when presenting stimuli.

3. Divide the screen into consistently placed functional areas; use organizing techniques to illustrate the structure of a screen; design screens that are interesting, not complex.

4. Use color to support other instructional strategies, such as organization of information and providing contrasts between screen objects.

5. Integrate personally relevant information to help learners connect unfamiliar lesson content to their background and interests.

6. Use feedback mindfully and elaboratively.

7. Give learners control of the sequence of instruction. Within overall content of the module, allow learners to choose specific material they wish to cover.

8. Ensure motivation by incorporating the four categories of attention, relevance, confidence and satisfaction.

9. Facilitate problem solving by using the following approaches: general (teaching regulation or metacognitive skills), integrated (teaching within authentic and realistic contexts that mirror real life problem-solving situations), or immersion (focusing on the nature of the learning experience) approaches.

The product's target audience was made up of 25 university students, who were taking the distance education course as part of their Bachelor of Education Degree program (adult education route). The University of Alberta Calendar 1998/1999 describes this program as continuing education for adult educators and trainers instructing in various settings. In accordance with Knowles' theory of andragogy, which was discussed in Chapters 1 and 2 of this study, the following characteristics of adult learners were taken into account at the planning stage: adult learners are self-directed; they have accumulated experiences, which are a rich resource for learning; their readiness to learn is closely related to the developmental tasks of their social roles; they have a problem centered approach to learning; their motivation to learn is intrinsic. Other adult learning theories, such as Rogers' significant learning theory, with its characteristics of personal involvement, self-initiation, pervasiveness, evaluation by the learner, and the incorporation of the meaning of this learning into the learner's total experience, were taken into account.

The plan of the product included a description of the product's components and how they would be used. The content was presented in four sections as follows:

1. The technological explosion - a brief history of technology.

2. Media and technology - a description of the various types of media and technology, and their strengths and weaknesses.

3. Selection factors - based on Bates' (1995) ACTIONS framework, these factors were: access, costs, teaching and learning, interactivity and user friendliness, organizational issues, novelty, and speed.

4. Twelve golden rules (Bates, 1995) for choosing and using technologies for distance education.

Each section followed the same structure. Firstly an advance organizer, or orienting activity, was used. This took the form of an open-ended question the students were asked to think about as they worked their way through the section. Secondly, the content was presented through the use of text and illustrations. Thirdly, a question with appropriate feedback was asked at the end of the section to ensure the students had understood the content and thought about its implications. If the students did not answer the question correctly on the first try, the feedback would guide them in the right direction, and they were allowed as many tries as it took to arrive at the right answer. I planned on using one of several response types for the question at the end of each section. These were: choosing a letter of the alphabet (a, b, or c), choosing "yes" or "no", pointing and clicking the cursor at the right answer, dragging a word and putting it in the right box, keying in a word, and keying in several lines of text.

3. Develop preliminary form of product

This step involved the preparation of instructional materials, procedures, and evaluation instruments (Borg and Gall, 1989).

A preliminary form of the product was developed in accordance with the plan described above. At this stage, three out of four sections were completed, and Section 3 contained fewer questions than Sections 1 and 2. A user guide was also designed to accompany the product. It explained the purpose of the computer assisted instruction module, and provided a summary of the content and instructions for downloading the module onto the students' personal computers.

The product (module) and user guide were evaluated by the development team. As a result of this evaluation several changes were made to the module and user guide. The changes to the module included: using lighter colors for the background and some illustrations; reducing the number of illustrations; and inserting additional questions throughout each section. The changes to the user guide included deleting certain portions from the content summary, and the inclusion of explanatory information about Authorware Professional and computer assisted instruction.

A letter of introduction (Appendix A) and a participant agreement form (Appendix B) were drafted for use during the preliminary field test step. The cover letter explained the purpose and importance of the study, and provided assurance of confidentiality. A questionnaire (Appendix C) and interview guide (Appendix D) were drafted to gather feedback from three graduate students during the preliminary field test. The same questionnaire (Appendix C) was also administered through the Internet to twenty-five undergraduate students during the main field test. Focus group questions (Appendix E) were also developed for use with volunteers from the class of twenty-five students at a computer conference, which took place after the main field test.

4. Preliminary field test and product revision

The intent of this step was to conduct a small group evaluation of the product, and to revise the product in accordance with evaluation results.

Three graduate students in the Department of Educational Policy Studies were asked to individually use the module and complete the questionnaire (Appendix C). I met separately with each student in an on-campus computer lab, explained the purpose of the study, informed the student that the module was not a finished product, and provided a copy of the user guide and the questionnaire. The latter was to be completed after the module was used. I asked each student to read the user guide carefully as it contained the

instructions for downloading the module onto their computer. I also informed each student that I would stay in the lab and be available if they needed any assistance. Then I left each student to work on the module, while I observed unobtrusively from another part of the room. Two students worked fairly smoothly through the module and completed it in twenty minutes. One student appeared to have some difficulty with the downloading and answering one question, so I provided some assistance. The student completed the module in thirty-five minutes. I used the interview guide (Appendix D) to interview these students individually. The questions in the interview guide were the same as the ones in the questionnaire. These interviews were taped with the consent of the interviewees. The tape recordings were used by me as background material for the study.

The data obtained from the questionnaire and interview notes were compiled and analyzed. Answers to forced choice questions were summarized and categorized, while comments and open-ended answers were analyzed according to the subject's views on the phenomenon being studied (emic perspective), and categorized for patterns (Dick and Carey, 1990; Gall, Borg and Gall, 1996). As a result of the analysis several revisions were made to the module and user guide. The revisions to the module included: corrections of two typing errors; the addition of a "menu" button to each screen so that the student could exit a particular section and go the main menu; the addition of a "back" button so that the student could review previous information before answering a question. Section 4 was also completed, and more questions and exercises were added to the module. The revisions to the user guide included: bolding a particular instruction that was critical to the downloading process so that the student would not miss it; and providing clarification that different procedures were required for downloading onto a Macintosh and an IBM compatible computer.

4. Main field test and final report

The purpose of the main field test was to ascertain the success of the new product in meeting its objectives (Borg and Gall, 1989).

The user guide, module and questionnaire (Appendix C) were loaded onto the course website in July 1998. The twenty-five students were to use the module asynchronously, that is, at a time that was convenient for them, but prior to the completion date for the course. The user guide explained that their participation in the study was voluntary. It also gave instructions for completing the questionnaire and submitting their responses electronically to me. I received an e-mail from a student who was having some problems with the downloading, and provided her with guidance through e-mail until the problem was resolved. Eight students subsequently sent me their responses to the questionnaire.

After the main field test, I contacted the class by e-mail and requested for volunteers to participate in a focus group interview. This kind of interview is described by Krueger (Gall, Borg and Gall, 1996) as a carefully planned discussion, the purpose of which is to obtain the participants' views on a particular subject in a permissive and non-threatening environment. Krueger adds that the discussion is relaxed, comfortable, and often enjoyable for the participants. Four students volunteered, and the interview was facilitated by me through a computer conference.

During the computer conference, I worked from an interview guide(Appendix E) which contained questions of a summative nature. The questions were:

What is your overall impression of the module?

What are the strengths and weaknesses of the module?

How can the quality of the module be improved?

What advice would you give to other students who would be taking a similar module?

Do you have anything else to add?

The conference took the following format: as the moderator, I asked a question; gave clarification by what I meant, if requested; gave the students time to respond to my question and build on each other's comments; answered any further questions asked of me; summarized the discussion when I was satisfied that the topic had been sufficiently explored; moved to the next question.

The data obtained from the questionnaire and focus group interview were compiled and analyzed. As in the preliminary field test, answers to forced choice questions were summarized and categorized, while comments and open-ended answers were analyzed according to the subject's views on the phenomenon being studied (emic perspective), and categorized for patterns (Dick and Carey, 1990; Gall, Borg and Gall, 1996).

Results from the main field test were used to produce this thesis, which is the final report of the study. Recommendations for future research and development are found in Chapter Five: Conclusions and Recommendations.

Conclusion

This chapter has discussed approaches and models relevant to the development and evaluation of a computer assisted instruction module for use in adult/distance education. It has explained the choice of the research and development approach, and the model recommended by Borg and Gall (1989). It has also discussed approaches to evaluation, sampling and data collection methods, and ethical considerations, as they relate to this study. Finally, is has discussed how the module was implemented.

Chapter Four: Results and Discussion

Introduction

A review of the evaluations obtained during the product development, preliminary field test, and main field test steps of the study indicated the value of using a combination of the research and development, and systems approaches for the study. Data were collected during the development and preliminary field test steps to find out what part of the instruction was not working, and revised until it worked. In addition, the evaluations corroborated previous research into the design of computer assisted instruction with regard to screen design and motivation. They also corroborated the adult learning theories of Knowles and Rogers with regard to the self-directedness of the adult learner, collaborative learning, and facilitation of learning. They indicated some technical limitations of using the Internet and Authorware Professional software for lesson delivery. Ratings of the product from the preliminary field test ranged from very good to fair. The overall impressions of the product obtained from the participants in the main field test ranged from positive to mixed.

Product Development

Formative evaluation of the product was provided by the development team, and used to revise the product while it was still in development. Comments were conveyed to me through informal discussions and e-mail messages which I received from members of the team. These comments were categorized according to the following components: surface features of the displays, other teaching/learning issues (e.g. student control, motivation, and interaction), subject matter, and other technical issues.

In the surface features of the displays category, the comments related primarily to screen design. Chapter 3 (Research Method) described how I had developed a set of design criteria for the CAI module, based on the research discussed in the literature review section of this study (Chapter 2). The criteria relevant to screen design were:

1. Use text and illustrations. Avoid multi modal instruction as more is not necessarily better when presenting stimuli.

2. Divide the screen into consistently placed functional areas; use organizing techniques to illustrate the structure of a screen; design screens that are interesting, not complex.

3. Use color to support other instructional strategies, such as organization of information.

In accordance with these criteria, I used both text and illustrations to present the lesson. I designed a screen which, in my opinion, was interesting but not complex. I divided the screen into consistently placed functional areas and used organizing techniques to illustrate the structure of the screen. That is, content displays were on the right half of the screen, illustrations on the left, the navigation (forward) button was on the bottom, and the control (quit) button was on the top. I used headings and increased spacing between paragraphs to indicate the hierarchy of the content and to break the content into manageable chunks. I used color to support other instructional strategies, such as organization of information. That is, I used black text to present content, and blue text to convey feedback messages. The background was a shade of green, which I did not feel would be too bright or distracting for the student.

With regard to the use of color, text, and font, the development team advised me to: change the background color of the screen to a neutral gray or white and to delete text from inside the graphics, so that it would be easier for the students to read what was on the screen; and to change the font from the default Times Roman to the sharper Arial. I had developed the module on an IBM Pentium computer, which had Authorware Professional software installed on it. Since I was working with state of the art equipment and software, the background green color did not appear to be too bright, and the text was clear and easy to read. However, I was advised that if the module were used on computers that the target population would be using (computers which did not have Authorware Professional

installed on them, and which had lower screen resolutions and fewer colors available), the green background would appear garish and distracting, and the text would lack clarity. I tested the module on one of these computers and confirmed the accuracy of the committee's comments, and subsequently made the changes recommended by the committee. The evaluative comments of the development committee corroborated the research into screen design, which is summarized in the three design criteria outlined above, and discussed further in the literature review section of this study (Chapter 2).

Also in the surface features of the displays category was the suggestion from the development committee to include a "back" navigational button so that students could review previous material if they wished. It had been my original intent to include this "back" button". However, owing to the length of time it took to design and develop the module, I had not included this button before the committee reviewed the product. The inclusion of this button related to the issue of who should control lesson sequencing. One view, which is behaviorist in orientation, holds that the computer allows the creation of environments in which students complete optimal instructional sequences, according to external judgments, to achieve predetermined goals (Hannafin and associates, 1996). The other view, which is humanistic in orientation, and represented by Maslow, Rogers, and Knowles, holds that learners are responsible for their own actions, and they should control, among other things, the process of learning. For example, Knowles' theory of andragogy holds that adults are self-directed, and see themselves as being able to make their own decisions and face the consequences of these decisions (Knowles, 1970, 1984). The suggestion from the development committee confirmed that they were in agreement with the humanist adult learning theories about the self-directedness of the adult learner.

Another evaluative comment in the surface features of the displays category was the suggestion to delete some of the graphics because too many graphics would slow down the use of the module by taking a long time to load. Again, working with an on-campus computer with Authorware Professional software in the hard drive, I was able to download

the module from the Internet onto the computer within five minutes. However, a test on an on-campus computer which did not have Authorware Professional on the hard drive proved that the downloading took at least thirty minutes. The development committee concluded that downloading on an off-campus computer would take longer because of the distance involved. Thus the committee suggested that I delete some of the graphics to cut down the downloading to under thirty minutes.

While the deletion of graphics was a screen design issue, the length of time it took to download the module was related to the issue of motivation. Kinzie (1990) proposed that two motivational constructs, intrinsic and continuing motivation, are important for maintaining participation in computer-based environments. Intrinsic motivation refers to the learner's participation in an activity where the reward is generated by the activity itself. Continuing motivation refers to the learner's choice to return to the lesson without the presence of external motivators. Keller and Suzuki (1988), cited in Hannafin and associates (1996), provide a motivational model for instructional design, which incorporates the four categories of attention, relevance, confidence, and satisfaction. Attention gaining deals with strategies to arouse and sustain performance. Relevance deals with how instruction is related to the learners' personal goals. Confidence relates to the extent that learners believe they will succeed at a task. Satisfaction refers to the learners' views of the outcomes of instruction. Excessive downloading time would contribute to learner frustration and have an adverse effect on the variables of attention and confidence.

In the other issues of teaching/learning category, I was advised to make the module more interactive by including more multiple choice or open-ended questions, some of which would not necessarily test the students on information previously presented, but require the students to respond in terms of their personal experiences or thoughts. The purpose of this technique was to personalize instruction and make it relevant to the students' experiences. As mentioned previously, relevance contributes to student motivation. Lessons that relate to prior or anticipated experiences are likely to increase

motivation (Keller and Suzuki, 1988). In addition, personalizing instruction supports encoding by integrating personally relevant information to help learners connect unfamiliar lesson content to their background and interests (Hannafin and associates, 1996). Adult learning theories also emphasize the personal experiences of learners. For example, according to Knowles' (1970, 1984) theory of andragogy, adults have accumulated experiences, which can be a rich resource for learning.

Also in the other learning/teaching issues category I was advised to reduce the amount of information on each screen, or to use two frames instead of one to display the same amount of information. This corroborated the work by Fleming (1987) who advised that the amount of displayed information that could be processed at one time was limited. Fleming stated that information provided by the designer should be rationed by prechunking. He suggested that a general limit of five familiar items could be perceived or reported on at one time.

In the other technical issues category, I was advised to create two versions of the module, one for use on a Mac computer, and one for an IBM-compatible computer. I had designed the original module on an IBM-compatible computer and made the assumption that, once the module had gone through a process known as "shocking", it could be used on both types of computer. However, the committee cautioned me to check this out. I ran the module on a Mac computer and noticed there was considerable distortion as to the size and clarity of text, and in some instances the graphics could not be downloaded. I subsequently created a Mac version of the module. This experience showed me that creating the wrong version of a module would give rise to student frustration and result in reduced motivation.

The module was eventually revised according to the above recommendations. However, because of the time involved in making the changes, not all of them were completed prior to the preliminary field test. Therefore, some of the comments made at this step of the study were repeated during the preliminary field test.

Preliminary field test

Formative evaluation was provided by three graduate students who used the module in an on-campus computer lab. Data were obtained from a questionnaire (Appendix C) completed by the students, interviews with them, and unobtrusive observation conducted by the researcher. Since the questionnaire was designed to obtain the students' views on various components of instruction, the results were categorized according to these components: language and grammar, surface features of the displays, other teaching/learning issues, subject matter, and the user guide (Alessi and Trollip, 1991). A Likert scale was used in the questionnaire in which the students were asked to choose one of three response types (yes, no, or don't know) to each question. Space was provided at the end of each section (category) for the students to write their comments. There was also an open-ended question at the end of the questionnaire which asked for the students' overall impressions of the module.

The students were generally satisfied with the language and grammar category. All three responded that the reading level was suitable for their needs. Two students reported that there was no cultural bias, and one student responded with "don't know". Two students reported that there were two typing errors in the module. The use of the research and development, and systems approaches allowed me to retain what worked in the module, and to improve what did not work.

The students were also generally satisfied with the surface features of the displays category. All three students reported that the text and graphics maintained their attention, and were suitable for learner needs; the text was easy to read; the menus were clear on how to make a choice; the questions were relevant to the content; the questions emphasized the content; it was clear how to respond to a question; and feedback messages were clear. It appeared that revisions I had made to the product, which were based on the suggestions of the development committee, had resulted in a more refined and better product. This confirmed the value of using a combination of the research and development, and systems

approaches for the study. Since the research process was cyclical in nature, it was empirical and replicable (Dick and Carey, 1990). That is, instruction was reusable, and the time and effort spent in evaluating and revising the module were of value.

In the written comments section, one student noted that the module had a very simple "clean" look which was appealing for a graduate student. When interviewed, this student said:

Well, my first reaction was, oh! is this ever a clean-looking sight. Because I had just finished EdPsy 597 and we had spent so much time looking at colors and graphics, and you spend so much time on the Net, you just get inundated with, almost as though I'm saturated with graphics, visual stimulation. But this I found very appealing. It was very clear, clean, you know, the white screen was a clear relief to, you know, everybody is trying to be very innovative.

However, this student wondered if a novice Internet or multimedia user would find it too simple. One possible explanation for this was that, based on the development committee's advice, I had deleted a considerable number of graphics from the module and replaced them with blank spaces in order to cut down on the downloading time. The blank spaces led another student to write (in the overall impressions of the module section) "Where there is text without graphics space is left for the graphics. The user doesn't know if the graphics failed to load". Perhaps this problem could have been rectified with a modification of the original screen design, where the left hand side of the screen was reserved for text (content) and the right hand side for graphics (or no graphics, if they were deleted). Perhaps some text could have been placed on the left hand side. The intent of removing the graphics was to reduce the frustration level of the students concerning the downloading time, and hence to improve their motivation. However, this was achieved at the expense of creating a screen which was perceived as too clean or having something missing from it. Another explanation for the perception of surface features being too clean was that, according to the criterion of avoiding multi modal instruction, I had used only text

and graphics in the module. Perhaps a novice student, who had heard about the wonders of the Internet and interactive computer programs, would have expected the module to use text, graphics, sound, and animation. If this were the case then an explanation should have been included in the course outline and module's user guide so that students would know what to expect.

The need for a "menu" button on each screen so that the student could exit a particular section and go to the main menu, and the need for a "back" button so that the student could review previous information before answering a question, became recurring themes. One student wrote, "You should be able to go back in the module to review the material". Another student commented that "I had problems with Section 2 'Audio Conferences', and without help I would have been unable to exit or view the answer". While in the lab, I had observed that the student was having some trouble with the question and I went over to provide some assistance. It appeared that the student could not get the right answer, and was unable to exit the section. This was due to the fact that I had designed the questions/feedback so that students were allowed as many tries as it took to arrive at the right answer. The foregoing comments were related to the issue of who should control lesson sequencing, which was discussed in the previous section. Since these comments indicated to me that the students desired to have more control, I facilitated this by adding a "menu" button and a "back" button to the module. In addition, I reviewed the question in Section 2 that the student was having trouble with. The right answer to the question was "audioconferencing" (one word). I changed the program so that other combinations of the word would be accepted i.e. "Audio Conferencing" and "audio conferencing".

In the other teaching/learning issues category, all three students found the lesson interesting, and that the information on each page was not excessive. However, two out of three students did not find the lesson challenging. One student wrote, "Questions that require thought (were) left to the user to answer or not. If possible provision should be

made for submitting answers to open-ended questions to an appropriate conference area where they could be shared and discussed". This was in reference to my use of an advance organizer for each section, which took the form of an open-ended question that the students were asked to think about as they worked their way through the section, but no answer was provided for this question. This was because, in accordance with Knowles' theory of andragogy, I was of the opinion that adult learners were self-directed and able to form their own conclusions. This student, who was in the graduate program in educational administration, and not familiar with adult learning theories, had a different perspective on teaching/learning. He felt that students should be tested on information presented earlier on in the lesson. This problem might have been avoided if I had selected three graduate students from the adult education program. The two other graduate students who used the module were in this program and did not have a problem with my use of this technique. In addition, the limitations of the Authorware Professional software were such that computer conferencing was not possible. However, at the conclusion of this study, I conducted a focus group interview through computer conferencing by using another software (First Class Conference).

The other student who did not find the lesson challenging commented that, "Some questions I had some background in. Others could be figured out without using text". Again, this might have been related with how I chose the participants for this step of the study. Being a graduate student in adult education, and having taken some technology/distance education courses, this student was familiar with some of the content. Perhaps the target population of fourth year undergraduate students would not respond in this manner. With regard to questions that could be figured out without using the text, these were questions which asked students to respond in terms of their personal experiences or thoughts. This was done on the advise of the development committee, in order to make the lesson personally relevant.

In the subject matter category, all three students found the objectives useful; that the information presented was relevant to the objectives; that the information was accurate (as far as they knew), well organized, and sequenced effectively. Two students found the information sufficiently detailed. One student did not and commented "I felt somehow there could have been more information and exercises, but I am used to graduate level work and this may be appropriate for undergraduate students". When interviewed, this student said "It kind of gave a view of some of the concepts that people are going to have to grapple with, but at some point they are going to have to put it into some sort of practical application, which may be handled within the course". The student suggested some exercises of a practical nature. I subsequently revised the module by adding more questions and exercises. The above comments corroborated aspects of Knowles' (1970, 1984) theory of andragogy. One of these was that in adults the readiness to learn is closely related to the developmental tasks of their social roles. That is, they become ready to learn those things they need to know and be able to do in order to cope effectively with their real-life situations. Another aspect was that adults have a problem-centered orientation to learning. They engage in learning in response to pressures they feel from their current life-situation.

In the user guide category, all three students responded that the guide made it clear on what equipment was needed to run the module. Two out of three students reported that the user guide did not give adequate instructions for starting the module. One student wrote, "The IBM Mac combined instructions are confusing". I subsequently provided separate instructions for IBM and Mac users. When interviewed, another student noted that "The problem (with the user guide) was the very first sentence: 'Please read this before you begin downloading'. I thought that could have been bolded and maybe large capped for people such as myself...I tend to be very impulsive and kind of charge through with those types of instructions". This comment corroborated the work by Fleming (1987) on attention gaining strategies in the design of computer-assisted instruction. Fleming

stated that without attention there could be no learning. He noted that attention was drawn to what was novel or different, but this did not have to be something that was entirely new to learners, it had to be different from what they had just recently experienced. He suggested changing the typeface for print and adding brightness. Based on the foregoing, bolded the first sentence in the user guide.

In the overall impressions of the module category, one student rated the module as "very good". Another wrote, "It is well organized and easy to navigate, except it needs a back button. It could use more interaction with questions and exercises. I particularly liked the exercise at the end of Section 4. The content may be appropriate for undergrads". Still another student rated the module as "fair" and made the following written comment: "Neat appearance, reasonably easy to use, information presented effectively." With regard to areas for improvement, this student asked "Why are there three different ways to select an answer?" Actually, when I designed the module, I had used six different ways to select the answer (choosing the letter a, b, or c; choosing "yes" or "no"; pointing and clicking the cursor at the right answer; dragging a word and putting it in the right box; keying in a word; keying in several lines of text). My purpose in doing this was to gain and maintain the students' attention, by having them use different methods for answering questions.

This student was also concerned that there was no provision in the module for student/student and instructor/student interaction. As mentioned previously, this was a limitation of the Authorware Professional software. The student's comment confirmed Knowles' (1975) and Roger's (Sahakian, 1984)) ideas about collaborative learning and facilitation of learning. Knowles (1975) maintained that adult learners were self-directed, and self-directed learning could flourish only when learners and teachers saw one another as mutually helpful human beings with resources to share. Knowles suggested that learners view other learners as collaborators instead of competitors. Knowles also recommended that the teacher should be a facilitator of learning rather than a transmitter of content. Rogers (Sahakian, 1984), thinking in the same vein, advocated that the teacher

cease to instruct and become a facilitator of learning, and viewed facilitators and students as a community of learners.

The information gathered from the preliminary field test was weighed against the comments made by the development team, as in some cases they contradicted the comments made by the team. Comments which contradicted those of the development team were: the need for more graphics, the screen being too "clean" and simple, the need for one method of responding to questions. Since the development team had extensive experience interacting with and instructing adults, I gave more weight to their comments. Revisions to the module included: the addition of a "menu" button and a "back" button; the refinement of the feedback in the section on Audio Conferencing to help students arrive at the correct answer; the addition of more questions and exercises to the module to make it personally relevant; the addition of sample answers to some open-ended questions (but not questions used as advanced organizers); the completion of the last section of the module. Corrections to the user guide included: bolding the first sentence in the guide, and providing separate instructions for downloading onto the IBM and Mac machines.

Main Field Test

Summative evaluation was provided by eight students out of the class of twenty-five who used the module. Further evaluation was provided by four students from the same class who participated in a focus group interview conducted through computer conferencing. Responses to the on-line questionnaire are shown in Table 1 and Table 2 on the following pages. They were categorized according to the same components as discussed in the previous sections.

In Table 1, in the surface features category, the majority of respondents (75% to 100%) reported that the text and graphics maintained their attention; the text was easy to read; color was used effectively; the menus were clear on how to make a choice; the

Table 1

Student Evaluations of Language and Grammar, and Surface Features

Categories/Questions	Yes	No	Don't Know	Didn't Answer
		N = 8		
Language and Grammar				
Is the reading level suitable for your needs?	100%			
Is there any cultural bias in the language and content?		100%		
Are there any errors in spelling, grammar and punctuation?	50%	25%	25%	
Surface Features				
Are the text and graphics attractive?	38%	38%	25%	
Do the text and graphics maintain attention?	75%	25%		
Is the text easy to read?	100%			
Is color used effectively?	75%		25%	
Are the menus clear on how to make a choice?	100%			
Are the questions relevant to the content?	88%		13%	
Do the questions emphasize content?	75%	13%	13%	
Is it clear on how to respond to a question?	75%	13%		13%
Are the feedback messages clear?	88%		13%	
When questions are incorrectly answered, do feedback messages provide enough help in reaching the right answers?	88%		13%	

Table 2
Student Evaluations of Other Learning/Teaching Issues, Subject Matter and User Guide

N = 8

Categories/Questions	Yes	No	Don't Know	Didn't Answer
Other Teaching/Learning Issues				
Is there too much information on each page?		100%		
Is the lesson interesting?	75%	13%	13%	
Is the lesson challenging?	50%	38%		13%
Are you able to apply what you have learned from the lesson to other situations?	100%			
Subject Matter				
Are the objectives useful?	100%			
Is the information presented relevant to the objectives?	100%			
Is the information accurate (as far as you know)?	75%		25%	
Is the information sufficiently detailed?	88%		13%	
Is the information well organized?	100%			
Is the information sequenced effectively?	88%		13%	
User Guide				
Does the guide make it clear on what equipment is needed to run the module?	75%	25%		
Does the guide provide adequate directions for starting the module?	88%	13%		
Is the content summary adequate for your needs?	63%		25%	13%

questions were relevant to content; the questions emphasized content; it was clear on how to respond to a question; feedback messages were clear; and when questions were incorrectly answered the feedback messages provided enough help in reaching the right answers. In the comments area, a representative response for this category was, "I really thought the explanations were comprehensive". Again, these responses confirmed the value of using the combination research and development, and systems approaches for the study. Data were collected during the development and preliminary field test steps to find out what part of instruction was not working, and revised until it worked.

However, only 38% of the students found the text and graphics attractive. Another 38% did not find them attractive, and 25% didn't know. One student commented, "Some of the screens would not come up for me, i.e. the 'school house' and other graphics did not download". Another student wrote "I was expecting graphics on every page. Don't we get spoiled quickly? The text was a little small, might be difficult to read". Yet another student commented "I found the font not very pleasing to my eyes. I felt it could have been formatted to make it more interesting - color, change of font size, etc.". The reason for these comments was that the students were downloading the version of the module which was incompatible with their computers, i.e. downloading a Mac version onto an IBM computer. I had tested this and confirmed it myself after receiving comments from the development team. This was also tested and confirmed later by one of the students who took part in the focus group interview. Downloading the wrong version of the module contributed to student frustration and resulted in reduced motivation. While the user guide provided separate instructions for downloading onto the Mac and IBM computers, some attention-getting strategies such as bolding and enlarging the fonts for the headings could have been used to alert students to how critical it was that they downloaded the correct version.

In Table 2, in the other teaching/learning issues category, the majority of students (75% to 100%) reported that the information on each page was not excessive; the lesson was interesting; that they were able to apply what they learned to other situations. One student wrote "I enjoyed this activity. Some minor technical problems but otherwise enjoyable". The technical problems were related to downloading the graphics. However, only 50% of the respondents found the lesson challenging. One student commented "I found the section on media/technology/application the most challenging, because these terms mean something different in my field, especially applications. The rest of it was interesting, but not challenging". The student found the section challenging because it had personal relevance. This confirmed Knowles' (1970) description of the adult learner as having a problem-centered orientation to learning. It also confirmed Knowles' assumption that the adult learner's readiness to learn was closely related to the developmental tasks of social roles. That is, they were ready to learn those things they needed to know and be able to do in order to cope effectively with real-life situations.

In the subject matter category, most of the students (75% to 100%) found the objectives useful; the information relevant to the objectives, accurate (as far as they knew), sufficiently detailed, well organized, and sequenced effectively. In the user guide category, 75% to 88% of the students reported that the guide made it clear on what equipment was needed to run the module, and that there were adequate directions for starting the module. When asked if the content summary was adequate for their needs, 63% said "yes" and 25% said they "didn't know" No elaboration was provided by the subjects in the comment area for this question. These responses indicated that the students were generally satisfied with the subject matter and user guide categories. The use of the research and development and systems approaches for the study allowed the product to be revised until it was satisfactory.

The questionnaire ended with an open-ended question which asked for the students' overall impressions of the module. The responses were classified as either positive or mixed. Positive comments included:

1. It was entertaining. The different methods of answering kept you paying attention. I like the way you are told why the answers are right or wrong.

2. My impression is that it is an interesting alternative to reading the module (book), with some good questions asked...I was having a problem getting the book from the library, so it was an excellent opportunity for me to see the condensed version of the Bates book.

3. Great learning experience. Thanks for your work.

In summary, the positive comments were that the students found the module interesting and entertaining, the different methods of answering questions gained and maintained their attention, they liked the feedback messages. This indicated that the research discussed in the Literature Review chapter of this study, particularly the research into adult learning theories, and the research into the design of computer assisted instruction, contributed positively to the development of a module which was well received by its users.

Mixed comments included:

1. Overall very good, although I am obviously not a fan of CBI. This type of DE seems plodding and slow. I think it is very easy for a learner to 'turn off'.

2. It was fine, but I think a little primitive given the software available to produce more animated material.

3. I would like to use this technology. Some minor problems. Lines overlapped. Good for visual learners.

In summary, the students had some pre-conceived notions in that either they did not like computer assisted instruction, or preferred other software to Authorware Professional. However, the content of the lesson was selecting teaching technology for distance

education, and the course instructor felt that some exposure to a module created through the use of Authorware Professional was a good learning experience.

Data were also obtained from a focus group interview conducted with four students by computer conferencing. The students' comments generally corroborated those made in the questionnaire and discussed above. When asked for their overall impressions of the module, positive comments were: they liked the look and the design of the module, and its use of objectives; good graphics related the subject matter to pictures, and therefore accommodated various types of learners; the module was organized, very user friendly and useful; each section was short enough to revisit for review and clarification.

Areas for improvement suggested were: each section was not stand-alone (modular) as one section built on another, therefore self-directed learning was not encouraged; compared to CD ROMS, it lacked appeal and interactivity; it took a long time for the module to download onto their computers, and for the graphics to appear on their screens. With regard to the comment that each section was not stand-alone, it is questionable as to whether a modular structure would be more effective. I had designed the sequencing of the lesson according to Ausubel's (Reigeluth and Curtis, 1987) concept of progressive differentiation. Here, a general to detailed sequence was used, which began with more general and inclusive anchoring ideas, which in turn served as organizers for the next level of detail and specificity. The ideas on the next level in turn served as advance organizers for another level, until the desired level of specificity was reached. This process, according to Ausubel, resulted in cognitive structures that were stable and resistant to forgetting.

The comment that the module lacked appeal and interactivity when compared to CD ROMS was indicative of the individual preferences of the students. As mentioned above, some exposure to Authorware Professional was a good learning experience on how computer assisted instruction worked in spite of the software's drawbacks. The module was one unit of a course which was offered through the Internet. Learning material was

drawn from several sources: text on the course website, selected readings from the books by Bates (1995) and Willis (1993), and the module.

The comment that it took a long time for the module to download onto students' computers and for graphics to appear on the screens was indicative of the technical problems encountered in using the Internet (and telephone lines) to access information. Hopefully, future improvements in technology and communications would resolve this problem.

Student suggestions for improving the quality of the module included: the lesson was solid, but it was too slow and rather simple, compared to other choices; perhaps this software was better suited on CD ROM, unless the audience was school children, in which case the bright colors and plain text would be appealing to them. Again, these comments indicated a personal preference for CD ROM and its use of multi-modal instruction. Perhaps additional research could be done in the future, in which Authorware Professional with multi modal instruction, or other software with multi modal instruction, could be put on CD ROM and field tested. This field test could be done to see if it corroborated the conclusions of existing research that multi-modal instruction should be avoided.

Advice the participants would give to others intending on taking a similar module included: they should look at the module as a break from other methods of learning; they should not try to complete all the sections at once; they should review the material before answering the questions; they should review it at least twice (students should do this with all lessons); the software lends itself to reviews; students should bookmark the module for future reference rather than printing; it should be used as supplementary to a book or other reference. These comments indicated that the students desired to use a variety of media in order to maintain their interest in the lesson. The comments on completing sections and reviews indicated that they approached the module in the same way as they approached traditional learning material (books).

In the additional comments category, the students said: they appreciated the work that went into the development of the module, and the different media being used throughout the course; the condensation of content was an excellent alternative to not being able to get the textbook. These comments agreed with the above comments on the students' desire to use a variety of media. However, one student felt there should have been a keyboard alternative to the requirement for using both the mouse and keyboard for answering questions, because the latter method was slower than the former. This comment indicated a personal preference for one method of answering questions. This learner characteristic was not known to me when I designed the module, and should be taken into account when computer assisted instruction is planned in the future. However, it should be weighed against time constraints, since developing computer assisted instruction is labor intensive and time consuming. Other comments were: dragging "False" or "No" into the answer box reinforced the negative; a graphical roadmap, or optional ways to progress would have been useful. These comments indicated the importance of emphasizing the positive in learning, and the self-directedness of the adult learner in desiring optional ways of moving through a lesson.

Conclusion

The evaluations discussed above indicated the value of using a combination of the research and development, and systems approaches for the study. They corroborated previous research into the design of computer assisted instruction with regard to screen design and motivation. They also corroborated the adult learning theories of Knowles and Rogers with regard to the self-directedness of the adult learner, collaborative learning, and facilitation of learning. They indicated some technical limitations of using the Internet and Authorware Professional software for lesson delivery. The overall impressions of the product obtained from the subjects in the main field test ranged from positive to mixed.

Chapter Five: Summary and Recommendations

Summary

This study examined the development and evaluation of instruction for adult learners at a distance. Technological advances in the last several decades have made instruction available to learners outside of the traditional classroom context. These learners are usually adults between the ages of 20 and 50 (Moore and Kearsley, 1996), who, because of family and work responsibilities, and their location at a distance from educational institutions, are unable to attend conventional classes. Since the majority of students taking courses through distance education are adults, these courses should be informed by adult learning theories such as those of Maslow, Knowles and Rogers, which emphasize the concepts of self-actualization, personal growth and development, experiential learning, self-directed learning, facilitation of learning, and intrinsic motivation.

The proliferation of courses available to adults through distance education created some questions in my mind about the quality of these courses. Do they address learner needs derived from adult learning theories? What is the response of the learners? Are the learners satisfied or dissatisfied? What do they find rewarding, challenging and frustrating? These questions provided the impetus for this study and led to the formulation of the purpose statement expressed in the following paragraph.

The purpose of this study was to develop and evaluate a computer assisted instruction module for university students in the field of adult education. This overall purpose was achieved through the attainment of the following objectives, which corresponded to steps in the Research and Development cycle:

1. Research and information collecting: To undertake a needs assessment and a literature review.

2. Planning: To make a plan of the product, which included the product's objectives; a description of its target audience; and a description of its components and how they would be used.

3. Develop preliminary form of the product. To prepare instructional materials, procedures, and evaluation instruments.

4. Preliminary field testing and product revision. To conduct a preliminary field test to obtain a small group evaluation of the product, and to make revisions according to field test results.

5. Main field testing and final report. To conduct a main field test to obtain a summative evaluation of the product, and to produce a final report.

The purposes and objectives of this study were achieved through its research method. I examined a variety of approaches and models before selecting a research and development approach and the model recommended by Borg and Gall (1989). Educational research and development is defined by Gall, Borg, and Gall (1996) as "A research-based approach to developing new programs and materials to improve education" (p. 679). The research and development process is cyclical in nature, and is made up of the following steps: investigating research findings relevant to the product being developed; using these findings to develop the product; field testing the product in an environment where it will be eventually used; and revising the product according to field test results (Borg and Gall, 1989). Educational research and development borrows the methods and conceptual models of instructional technology, which are based on a systems approach. For example, most instructional design models follow the same process: design, development, evaluation, and revision (Willis, 1993). This process is systematic and cyclical, that is, each step leads to the next, and, after the last step (revision) the cycle is repeated, beginning at the design step (Willis, 1993).

The benefits of adopting the above process, according to Dick and Carey (1990) are that it is empirical and replicable. By this they mean that instruction is reusable, and

worthwhile time and effort are spent in evaluation and revision: data are collected to find out what part of the instruction is not working, and it is revised until it works. Bates (1995) observes that course teams are used with the systems approach, and these teams produce teaching material which is of a high academic standard, and which reflects advanced and effective instructional strategies. Borg and Gall (1989) note that one of the benefits of the research and development approach is that it develops educational products that are effective and ready for use in schools.

This study involved evaluations of the product at various steps of the research and development cycle. Both formative and summative evaluation were used. Formative evaluation is "The collection of data and information during the development of instruction which can be used to improve the effectiveness of the instruction" (Dick and Carey, 1990, p. 234). I used a development team of four specialists to determine and monitor content and instructional methods during the development step of the study. Three graduate students used the product during the preliminary field test and provided formative evaluation. The selection of the three students was based on suggestions made by Alessi and Trollip (1991) to choose students very much like those for whom the lesson was designed, and to use at least three students, representative of the best, average, and slowest of the target group.

Summative evaluation is conducted upon completion of a course and it is used to assess the overall effectiveness of the finished instructional product (Willis, 1993). In this study summative evaluation was provided by eight students out of the class of twenty-five during the main field test step. Volunteers from this group later participated in a focus group interview which was conducted through computer conferencing.

Both quantitative and qualitative approaches to data collection and analysis were used in this study. A quantitative approach asks the question "Have the goals been achieved?", and focuses on the formal assessment of learners and the statistical analysis of achievement tests and attitude questionnaires (Rowntree, 1992, p. 214). A qualitative

approach asks the question "What has been going on?" and emphasizes sensitive observation, discussion, and interviewing, with findings conveyed by analogies and anecdotes (Rowntree, 1992, p. 214). I used both quantitative and qualitative methods in the design of an attitude questionnaire (Appendix C), which was administered twice in the study, the first time to three graduate students during the preliminary field test, and the second time to twenty-five undergraduate students during the main field test. Here, the quantitative method used was the Likert scale in which the students were asked to choose one of three response types (yes, no, don't know) to each question. The qualitative method used in the design of this questionnaire was the provision of ample space at the end of each section for students to write their comments. Other qualitative methods used in this study included: interviews of the individual students during the preliminary field test (Appendix D); a focus group interview (Appendix E) at the conclusion of the main field test; non participant observation during the preliminary field test; and content analysis during the planning and product development steps, when the development team reviewed the teaching material.

This study was implemented in five steps of the research and development cycle. Step 1, research and information collecting, involved a needs assessment and a literature review. During the needs assessment it was determined that the students needed to be able to select teaching technology for distance education courses, and computer assisted instruction was the vehicle that would help meet this need. It was also determined that the state of the art was sufficiently advanced for a successful product to be built; that I had the requisite skills, knowledge, and experience to build the product; and that the product could be developed within a reasonable time.

The literature review was conducted to ascertain the state of knowledge in the area relevant to the purpose statement, and how this knowledge could be applied to the planned computer assisted instruction module. A review of the adult learning theories of Maslow, Rogers, and Knowles yielded the concepts described at the beginning of this section. An

examination of cognitive learning theories yielded the Gestaltist concepts of perception, insight, and meaning; schema theory's assumption that schemata can be more effectively built if learning material corresponds to the generally accepted structure of schema; Piaget's concepts of qualitative developmental stages and mature adult thought; Ausubel's concept of advance organizers; and Bruner's concept of learning through discovery. A review of the approaches, models, and criteria for selecting technology and media for distance education concluded with the recommendation that the ACTIONS framework and twelve rules proposed by Bates (1995) are effective for selecting technology and media.

Step 2, planning, involved making a plan of the product, which included the product's objectives; a description of its target audience; and a description of the product's components, and how they would be used. The product's general objective was that students would be able to select teaching technology for distance education. This was broken down into the following sub-objectives:

After completing this module (unit), students would be able (or better able) to:

1. Discuss the factors that influence the selection of instructional technologies for distance education.

2. Identify the strengths and weaknesses of the various technologies.

3. Select appropriate technologies to support specific learning outcomes.

Instructional objectives included the design criteria for a CAI module. I developed a set of criteria, which were based on the research discussed in the literature review chapter of this thesis, and which dealt with orienting the learner, presenting the lesson, encoding support, detecting and correcting errors, lesson sequencing, motivation, applying knowledge and skills, and contextual factors.

The product's target audience was made up of twenty-five fourth year university students, who were taking the distance education course as part of their Bachelor of Education Degree program (adult education route). The University of Alberta Calendar

1998/1999 describes this program as continuing education for adult educators and trainers instructing in various settings.

The product was divided into four components or sections. The content was presented in each section as follows:

1. The technological explosion - a brief history of technology.

2. Media and technology - a description of the various types of media and technology, and their strengths and weaknesses.

3. Selection factors - based on Bates' (1995) ACTIONS framework, these factors were: access, costs, teaching and learning, interactivity and user friendliness.

4. Twelve golden rules (Bates, 1995) for choosing and using technologies for distance education.

Each section followed the same structure: an advance organizer, or orienting activity, followed by presentation of content through the use of text and illustrations, followed by questions and feedback.

Step three, develop preliminary form of product involved preparation of instructional materials, procedures, and evaluation instruments. The module was developed in accordance with the plan described in step two. A user guide was also prepared. It explained the purpose of the module, and provided a summary of the content and instructions for downloading the module onto students' personal computers. The module and user guide were reviewed by the development team, and revisions were made according to the team's suggestions.

A letter of introduction (Appendix A) and a participant agreement form (Appendix B) were drafted for use during the preliminary field test step. A questionnaire (Appendix C) and interview guide (Appendix D) were drafted to gather feedback from students during the preliminary field test. The same questionnaire (Appendix C) was also administered during the main field test. Focus group questions (Appendix E) were also developed for use at a computer conference at the conclusion of the main field test.

Step four, preliminary field test and product revision, involved a small group evaluation of the product, and revision of the product in accordance with field test results. Three graduate students in the Department of Educational Policy Studies were asked to individually use the module in the computer lab and complete the questionnaire (Appendix C). I observed the students unobtrusively, and provided assistance where necessary. I also used the interview guide (Appendix D) to interview the students individually. Information from the field test was analyzed and several revisions were made to the module and user guide.

Step five, main field test and final report, involved a summative evaluation of the product to ascertain its success in meeting its objectives. The user guide, module and questionnaire (Appendix C) were loaded onto the course website for use by twenty-five off-campus students. Eight students subsequently sent me their responses to the questionnaire. Four students out of the class of twenty-five volunteered for a focus group discussion which was conducted through computer conferencing.

A review of the evaluations obtained during the product development, preliminary field test, and main field test steps of the study indicated the value of using a combination of the research and development, and systems approaches for the study. Data were collected during the development and preliminary field test steps to find out what part of the instruction was not working, and revised until it worked. In addition, the evaluations corroborated previous research into the design of computer assisted instruction with regard to screen design and motivation. They also corroborated the adult learning theories of Knowles and Rogers with regard to the self-directedness of the adult learner, collaborative learning, and facilitation of learning. They indicated some technical limitations of using the Internet and Authorware Professional software for lesson delivery. Ratings of the product from the preliminary field test ranged from very good to fair. The overall impressions of the product obtained from the participants in the main field test ranged from positive to mixed.

The foregoing section has provided a summary of this study. It has outlined the purpose and sub-objectives of this study. It has explained the study's research design, and evaluation, data collection and analysis procedures. It has explained how the study was implemented, and provided information on the findings.

Limitations

This study was limited by my lack of experience as a researcher, and the small number of subjects who responded to the on-line questionnaire during the main field test. While I had used the Authorware Professional authoring system in the past, and successfully designed and developed three computer assisted instruction modules, I had not conducted a research study that used the research and development or systems approaches. In addition, 8 students (32%) out of a class of 25 responded to the on-line questionnaire during the main field test. This low rate of return suggested that I may not have received all the feedback that I needed, and some potentially important information may have been lost to the study.

Implications for Practice

This study began with my observation about the proliferation of courses that were available to adult learners through distance education. The existence and availability of these courses led me to consider the quality of these courses. Did they address learner needs derived from adult learning theories? What was the response of the learners? Were the learners satisfied or dissatisfied? What did they find rewarding, challenging, and frustrating about these courses? These questions provided the basis for this study, the purpose of which was to develop and evaluate a computer assisted instruction module for university students in the field of adult education. The findings of this study have implications for practice as they relate to adult learners and the institution.

From the perspective of adult learners, this study showed that they were listened to and their views (including those of experts who had extensive experience interacting with and instructing adult learners) contributed significantly to the design and delivery of instruction. This study confirmed the adult learning theories of Knowles and Rogers with regard to the self-directedness of the adult learner, collaborative learning, and facilitation of learning. That is, the students who participated in this study perceived themselves as being self-directed, and therefore wished to have control of the learning process and content. They also desired to learn collaboratively, and desired the instructor to be a facilitator of learning rather than a transmitter of content. This study also confirmed that adult learners agreed with the findings of previous research into computer assisted instruction with respect to motivation and several aspects of screen design.

From the institution's perspective, this study provided criteria for the design and development of computer assisted instruction specifically for adult learners. These criteria are useful for instructors, course designers, administrators, and others involved in the design and delivery of distance education courses.

A problem emerged during the study, which should be taken into account when institutions are considering whether or not to offer computer assisted instruction through distance delivery. This problem was the availability of time, money, and human resources. My experience showed me that the design and revision of one module alone was an extremely time consuming process. If a course were to be offered through this technology, it would require a considerable investment of time, money, and resources. Indeed, Bates (1995) states that developing original, high-quality computer-based learning material is expensive and requires highly skilled designers, if more than drill and practice techniques, or simple memorization of facts or principles, are required. Bates cites figures provided by Stahmer and Green (1993) which show that at the medium level (i.e. not high-end or low-end), the cost of computer-based instruction, per student hour, ranges from US$99 for up to 50 students, to US$6.75 for 1,250 students and over. Therefore computer based

instruction is more cost effective for large numbers of students, and for courses that are offered many times.

In conclusion, this study showed that adult learners' views contributed significantly to the design and delivery of instruction. From the institution's perspective, it provided criteria for the design and delivery of computer assisted instruction geared towards adult learners. It also raised the problem of the availability of time, money, and human resources, which should be taken into account when institutions are considering whether or not to offer computer assisted instruction through distance delivery.

Recommendations for Future Research

Further research could be done into the design of computer assisted instruction for adult learners, according to some theories and concepts which were not confirmed by this study. The research and development cycle used in this study could be extended, and the product (module) expanded and refined, in order to increase its utility, cost effectiveness, and reusability. Also, the sampling method used during the preliminary field test could be modified so that the students chosen at this phase of the study would have more similarities with the target population. Research could also be done, in which Authorware Professional with multi modal instruction, or other software with multi modal instruction, could be put on CD ROM and field tested to see if it confirmed existing research which cautioned against the use of multi modal instruction.

This study was concerned with the development of a quality product, which was designed according to adult learning theories, cognitive learning theories, and instructional design theories. It also considered the adult learners' views as to what constituted a quality product. This study confirmed that adult learners perceived themselves as being self-directed, and desirous of collaborative learning and learning which was facilitated by the instructor. That is, the study supported the adult learning theories of Knowles and Rogers in these areas. However, other aspects of adult learning theory were not confirmed. These

included the concepts of self-actualization, and personal growth and development, and future research could look into these areas. This study also confirmed previous research into the design of computer assisted instruction, particularly with regard to screen design and motivation. Questions about the desirability of multi modal instruction remained to be answered, and provided an opportunity for future research. In addition, the work by Piaget, Bruner, some aspects of Gestalt psychology (such as insight and meaning), and Schema theory (with regard to information mapping), were not touched on in this study and afforded further opportunity for research.

The research and development cycle used in this study could be extended, and the product (module) expanded and refined, in order to increase its utility, cost effectiveness and reusability. Chapter Three: Research method, discussed Gall, Borg, and Gall's (1996) claim that Research and Development projects required substantial resources, and it was unlikely that a graduate student would be able to find the financial resources and personnel to complete a major R and D project. They recommended that the graduate student scale down the project by limiting development to just a few steps of the R and D cycle. In accordance with this advice I confined my study to five out of the ten steps outlined by Borg and Gall (1989). It is recommend that my study be extended through the incorporation of steps six to ten. This would result in a product that is more refined and of more value to the institution and learners. In addition, time constraints prevented me from including additional questions and practical exercises in the module, and this could be done if the original study were extended. The utility, reusability, and cost effectiveness of the module could be improved by expanding the content, so that it covered an entire course on distance education.

If this study is to be repeated, I recommend that the selection of participants in the preliminary field test adhere more closely to the suggestion of Alessi and Trollip (1991), that the researcher choose students very much like those for whom the lesson is designed. In this study three graduate students in education were asked to try out the product during

the preliminary field test. However, the target population during the main field test consisted of fourth year students in education. Therefore, if this study is repeated, the participants in the preliminary field test should be fourth year education students. This will enable the researcher to test more satisfactorily if the lesson meets the needs of the entire target population.

In addition, the focus group discussion used in this study was facilitated by computer conferencing. This was one of the first times that computer conferencing was used for this purpose. There was evidence that it contributed to intense academic discourse, i.e. subjects asked questions, participated in discussions, developed arguments, responded to conflicting ideas, and added new information. This use of computer conferencing can be explored further in future research.

Finally, comments provided by participants in the study indicated personal preferences for CD ROM and multi modal instruction. Additional research could be done, in which Authorware Professional with multi modal instruction, or other software with multi modal instruction, could be put on CD ROM and field tested. The field test could be done to see if it corroborated the conclusions of existing research that multi modal instruction should be avoided.

In conclusion, further research could be done into the design of computer assisted instruction for adult learners, according to some theories and concepts which were not confirmed by this study. The research and development cycle used in this study could be extended, and the product (module) expanded and refined. Authorware Professional with multi modal instruction, or other software with multi modal instruction, could be put on CD ROM and field tested to see if it confirmed existing research which stated that multi modal instruction should be avoided.

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Appendix

A. Letter of Introduction

Date:

Dear Student:

Part of the course EDAE 404, Distance Education, includes accessing the module, "Selecting teaching technology for distance education", on the course website. This module was designed by me (Joan B. Lim) as part of a study to fulfill the requirements of my Master of Education program at the University of Alberta. The purpose of this study is to develop and evaluate a computer assisted instruction module for the use of students in the field of adult education.

By participating in this study you will help me: develop an educational product of proven effectiveness, and bridge the gap between educational research and practice. I would appreciate your involvement in this study.

You can become involved by completing the attached "Participant Agreement Form" and questionnaire. I plan to interview some of you either individually, or as a focus group, and this is indicated in the "Participant Agreement Form".

All the information that you give me will be anonymous and confidential. Your participation is voluntary and you can opt out at any time.

I look forward to your involvement in this study. Please fill in the "Participant Agreement Form" and questionnaire, and return them to me. If you have any concerns or questions please feel free to call me at the telephone numbers shown below.

Thank you in advance for your assistance.

Sincerely,

Joan B. Lim
Graduate Student
Department of Educational Policy Studies
7-167F Education Building North
University of Alberta.

Phone: 492-4913 (Bus.)
487-8797 (Res.)

B. Participant Agreement Form

This study is being done by me (Joan B. Lim) to fulfill the requirements of my Master of Education program at the University of Alberta. The purpose of this study is to develop and evaluate a computer assisted instruction module for the use of students in the field of adult education. The information will be obtained through a questionnaire, and a personal interview of approximately one hour, or a focus group interview.

Names of participants will not be reported and the information obtained in the interviews will be anonymous. The names of individuals obtained in the interviews will not be mentioned in the written report. Your participation is voluntary and you may opt out at any time. If you have any questions or concerns please call me (Joan B. Lim) at 492-4913 (business) or 487-8797 (residence). If you are willing to participate in this study, please sign this form and return it to me.

Thank you for your assistance.

Name: _____
Please print

Signed: _____

Dated: _____

C. Questionnaire

Study: To develop and evaluate a computer assisted instruction module for the use of students in the field of adult education.

All information will be kept confidential. Participation is voluntary and you may opt out at any time.

Evaluation of Module

Categories	For each item, circle the option which best describes your response		
Language and Grammar			
Is the reading level suitable for your needs?	Yes	No	Don't Know
Is there any cultural bias in the language and content?	Yes	No	Don't Know
Are there any errors in spelling, grammar and punctuation?	Yes	No	Don't Know
Comments:			
Surface Features			
Are the text and graphics attractive?	Yes	No	Don't Know
Do the text and graphics maintain attention?	Yes	No	Don't Know
Are the text and graphics suitable for your needs?	Yes	No	Don't Know
Is the text easy to read?	Yes	No	Don't Know
Is color used effectively	Yes	No	Don't Know
Are the menus clear on how to make a choice?	Yes	No	Don't Know
Are the questions relevant to the content?	Yes	No	Don't Know

Categories	For each item, circle the option which best describes your response		
Do the questions emphasize content?	Yes	No	Don't Know
Is it clear how to respond to a question?	Yes	No	Don't Know
Are feedback messages clear?	Yes	No	Don't Know
When questions are incorrectly answered, do feedback messages provide enough help in reaching the right answers?	Yes	No	Don't Know
Comments:			
Other Teaching/Learning Issues			
Is there too much information on each page?	Yes	No	Don't Know
Is the lesson interesting?	Yes	No	Don't Know
Is the lesson challenging?	Yes	No	Don't Know
Are you able to apply what you have learned from the lesson to other situations?	Yes	No	Don't Know
Comments:			
Subject Matter			
Are the objectives useful?	Yes	No	Don't Know
Is the information presented relevant to the objectives?	Yes	No	Don't Know
Is the information accurate (as far as you know)?	Yes	No	Don't Know

Categories	For each item, circle the option which best describes your response
Is the information sufficiently detailed?	Yes No Don't Know
Is the information well organized?	Yes No Don't Know
Is the information sequenced effectively?	Yes No Don't Know
Comments:	
User Guide	
Does the guide make it clear on what equipment is needed to run the module?	Yes No Don't Know
Does the guide provide adequate directions for starting the module?	Yes No Don't Know
Is the content summary adequate for your needs?	Yes No Don't Know
Comments:	
Other	
What is your overall impression of this module?	

D. Individual Interview

Study: To develop and evaluate a computer assisted instruction module for the use of students in the field of adult education.

Introduction

The purpose of this interview is to give me a better understanding of your thoughts about the quality of the module, "Selecting teaching technology for distance education".

Your responses will be included with other students' responses and used to compile a written report. You will not be identified individually in the report by anything you say. Please feel free to jump in at anytime if you have any questions about what I am doing. I would like to tape the interview. May I have your permission to do so? As we proceed with the interview you may have some questions as to what I am asking or my reason for doing so. You can stop the tape at anytime during the interview. The recording will be transcribed and a copy of the transcript will be sent to you for review. I need you to tell me if the transcript is accurate and if any corrections should be made.

Please be as open and as frank as possible. Your thoughts, opinions, and perceptions are important to this study.

Interview

I. Have you taken any distance education or computer courses before? What are your general impressions?

II. I'm interested in your thoughts and feelings about this module.

1. What do you think of the language and grammar used in the module? Probe for: reading level; cultural bias; spelling, grammar, and punctuation.

2. How do you find the surface features? Probe for: displays, presentation modes, text quality, menus, questions, feedback.

3. Pedagogical issues. How well were the following addressed in the module: student control, motivation, interaction, and graphics?

4. How do you think the subject matter was dealt with? Probe for: objectives, information, organization.

5. What is your opinion about the user guide? Probe for adequacy and appropriateness.

6. What is your overall impression of the module?

7. What do you like most about the module?

8. What do you like least about the module?

9. How can the quality of the module be improved?

10. Do you have anything else to add?

E. Focus Group Interview

Introduction

Explain the purpose of focus group interview: to obtain the participants' views on a particular subject in a relaxed, comfortable and enjoyable environment.

Explain process: informal.

Assurance of confidentiality. Right to opt out at any time.

Questions

What is your overall impression of the module?

What are the strengths and weaknesses of the module?

How can the quality of the module be improved?

What advise would you give to other students who would be taking a similar module?

Do you have anything else to add?