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Factors related to the adoption of a two-way interactive distance education technology: instrument development, instrument validation, and causal model testing

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DEDICATION

This work is dedicated to my mother, father, bothers Khalil and Khaled, and sisters, Wafaa, Maha, Sahar, and Yasmeen. You supported me beautifully during this challenging journey. I love you all.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I. INTRODUCTION

Background for the study

Recent rapid development of telecommunication technologies has resulted in distance education systems that are powerful, flexible, and increasingly affordable (U. S. Congress, 1989). One form of advanced distance education technology that has been implemented recently in Iowa is the Iowa Communication Network (ICN).

The ICN is a state-wide two-way, full-motion interactive fiber-optic telecommunications network with at least one point of presence in each of Iowa's 99 counties. The ICN links public and private educational institutions throughout Iowa. This network makes it possible for widely separated schools and universities to share educational resources and will connect hundreds of schools, colleges, regional libraries, and governmental agencies. Iowa's vision for distance education is being built around the idea of enhancing the quality of education though the use of telecommunication. This state-of-the-art network is the only one of its kind in the United States (IDEA, 1992). In fact, it is the largest and the most comprehensive network of its kind in the United States (Corporation for Public Broadcasting, 1993). It permits the transmission of video, audio, and data between any or all the end points of the system. None of the other forms of distance education technologies has the same advantages as two-way interactive television.

Distance education in Iowa is based on the belief that live interactive instruction is fundamental to effective teaching. Teaching and learning in Iowa is going to be combined with other educational technologies to bring the best to the student faced with the challenge of being a citizen of the 21st century (TEA, 1994). The use of the ICN may affect the way teachers teach and the way students learn.

Teachers will have more opportunities to expose their students to a greater range of ideas, peers, teachers, visitors, and learning experiences. Teachers can use the ICN to upgrade their own skills and professional development through training and staff development in locations where experts and resources are difficult to obtain. In addition, teachers who work with other colleagues may find more opportunities to establish new relationships such as sharing parts of a course, team teaching, and learning from master teachers.

The use of interactive distance education technologies will offer more educational opportunities for students and teachers to engage in a productive interaction with each other and with the environment. In fact, this technological tool may give teachers the opportunity to use different pedagogical approaches for teaching and learning (Dede, 1991). Teachers will be able to engage students in mindful interaction in which students are encouraged to construct their own meaning (Garrison, 1993a). Interactive distance education technology is what Zuccermaglio (1993) describes as an "empty or open," not a "full," technology. Full technology is designed to transfer information from the machine to the learner, and the learning model is a "pouring model." Empty technology is designed by taking into account the constructivist view of learning, in which technology offers the opportunities for metacognition and reflection concerning the learning activity.

Teaching using interactive distance education technologies is very empowering if it is used to facilitate the learners' construction of their own meaning and to create new knowledge, not just to make the learning process faster or easier (Zuccermaglio, 1993). It may influence significantly the quality of student learning (Garrison, 1993a). Pittman (1991) cautions, however, that "the various media of instruction are only tools. Their successful and productive use depends upon the quality of teaching the content, not the newest miracles of communications" (p. 31). Meade (1991) pointed out that all educational technology software and hardware represent nothing more than a tool to enhance teaching and learning. Without ready and willing teachers, technology can accomplish nothing.

Theoretical framework

The research is based on two different, yet theoretically linked, bodies of research. These are the diffusion of innovations paradigm (Rogers, 1983) and the attitudes paradigm (Eagly & Chaiken, 1993). Diffusion theory has developed over the years as a basis for understanding and examining the introduction of innovations. Rogers' diffusion model posits that a new technology diffuses through a social system, where individuals learn about the technology through formal and informal communication channels. Access to these information channels provides potential adopters with data about the new technology and the various options available to them. Among the information sources that influence adoption behaviors are the mass media, commercial entities, formal organizations, educational institutions, and personal interaction. Individuals evaluate information about an innovation; if favorable attitudes toward the technologies emerge, Rogers' model assumes that adoption will follow (Rogers, 1983). People will not adopt innovations if they lack the skills or the accessory resources that may be needed (Rogers, 1983).

The individual's decision about an innovation is not an instantaneous act. It is a process that occurs over time and consists of a series of actions (Rogers, 1983). As shown in Figure 1, the individual passes from knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject the

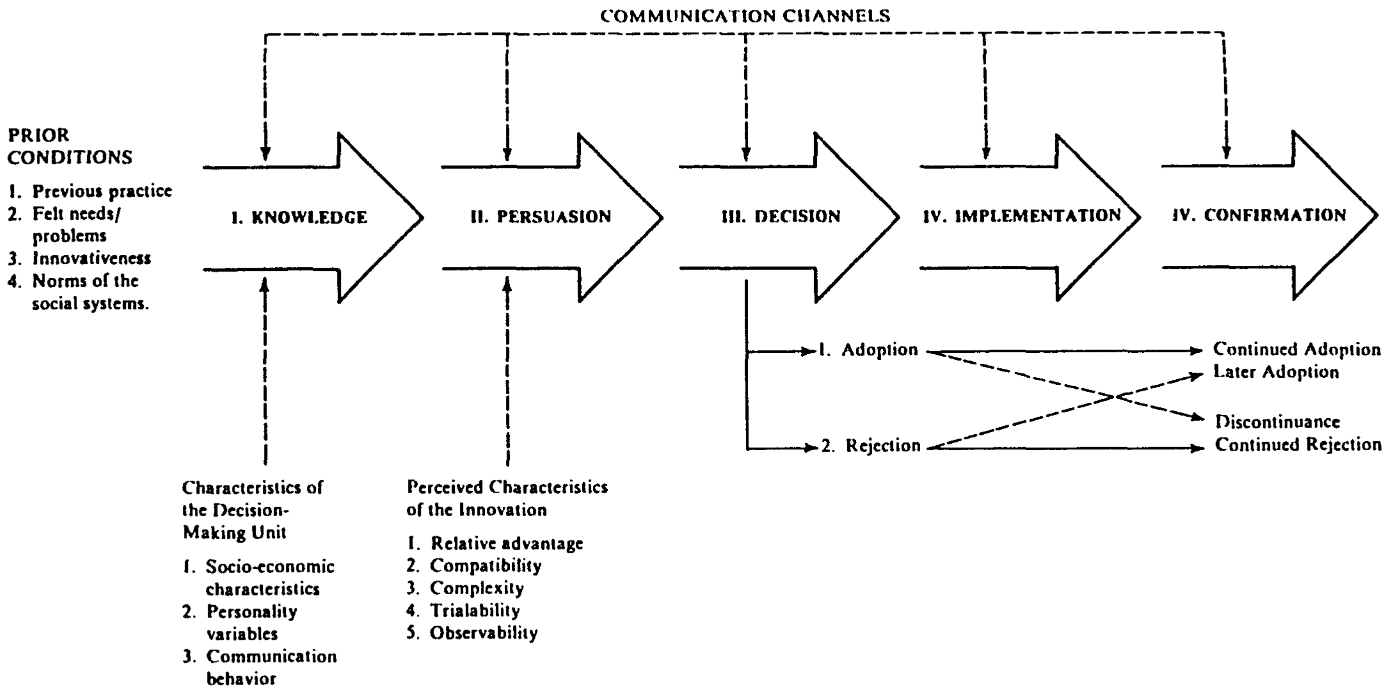


Figure 1. A model of stages in the innovation-decision process (Rogers, 1983).

innovation, to implementation of the new idea, to confirmation of this decision. The innovation-decision process can lead to a variety of decisions ranging from making full use of an innovation to a decision not to adopt an innovation.

Because the persuasion stage of the innovation-decision model involves the formation of attitudes towards the innovation, the attitude-behavior literature is relevant. For example, Eagly and Chaiken (1993) have developed a model, the composite model of the attitude-behavior relation, that delineates the conditions under which relatively good prediction of behavior can be achieved.

Eagly and Chaiken's (1993) model takes habit, attitudes toward targets, utilitarian outcomes, normative outcomes, self-identity outcomes, attitudes toward engaging in the behavior, and intention into account when predicting behavior (Figure 2). Eagly & Chaiken (1993) defined habit as the sequences of behavior that have become relatively automatic in the sense that they occur without self-instruction. Attitudes toward targets are the evaluations of targets of behavior formulated at any level of abstraction. Utilitarian outcomes are those rewards and punishments that are anticipated to follow from engaging in the behavior. Normative outcomes refer to the approval and disapproval that significant others are expected to express in relation to a behavior, as well as self-administered rewards and punishments that follow from internalized moral rules. Self-identity outcomes refer to affirmations of self-concept that are anticipated to follow from engaging in the behavior. Attitude toward engaging in the behavior is the evaluation of the respondent toward engaging in the behavior. Intention is the decision to act in a particular way.

In the composite model of the attitude-behavior relation, habit, attitudes toward engaging in the behavior, and intention influence behavior directly.

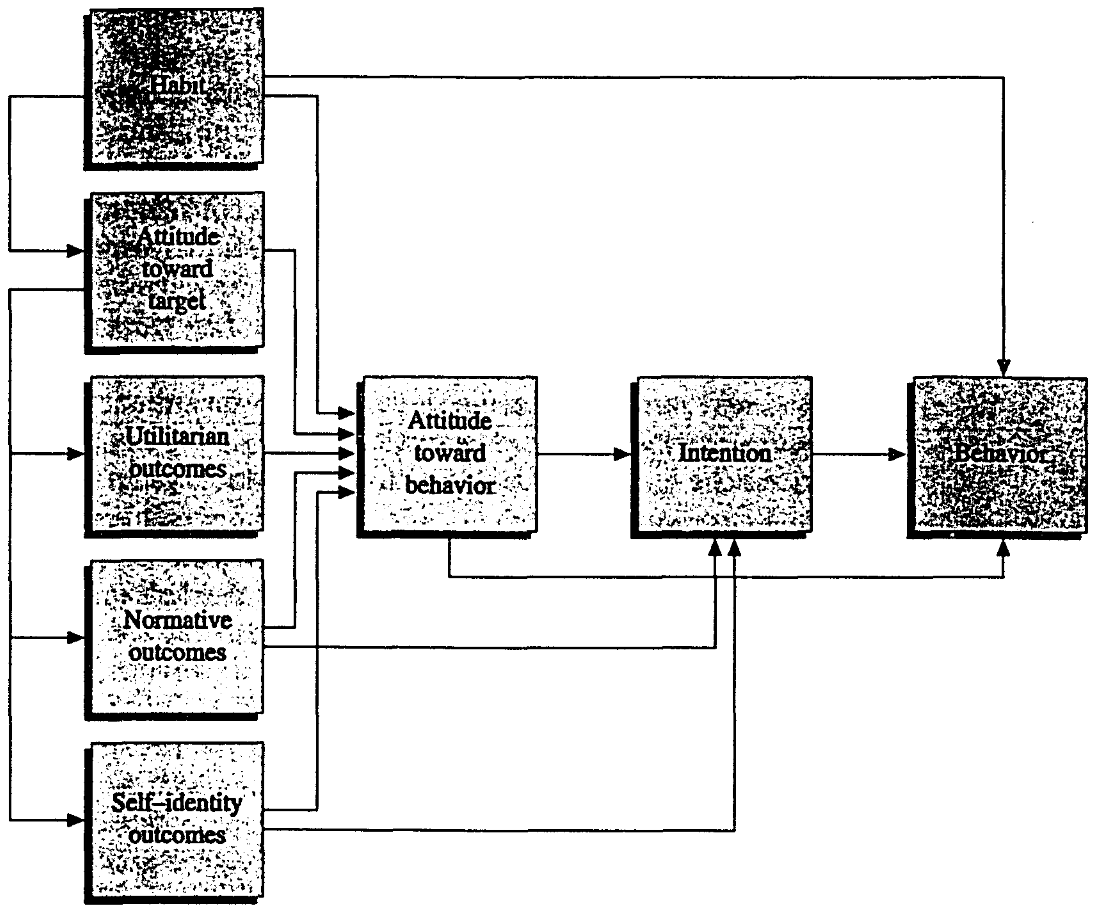


Figure 2. The composite model of the attitude-behavior relation (Eagly & Chaiken, 1993).

Attitudes toward engaging in the behavior and intentions are the mediating factors between habit, attitudes toward targets, utilitarian outcomes, normative outcomes, self-identity outcomes and the behavior. Intention is determined directly by the attitude toward engaging in the behavior and by normative and self-identity outcomes, and indirectly by the attitudes towards target, habit, and the anticipated utilitarian, normative, and self-identity outcomes (Eagly & Chaiken, 1993).

As shown in Figure 2, Eagly and Chaiken state that behavior originates in the activation of habit, attitudes toward targets, and the anticipated outcomes of behavior. People's habits, attitudes toward targets, utilitarian outcomes, normative outcomes, and self-identity outcomes directly affect their attitudes toward engaging in the behavior. Accordingly, the attitude toward engaging in the behavior affects the behavior itself directly or indirectly through intention. Habit can impinge directly on behavior without mediation by other processes. Normative outcomes, self-identity outcomes, and attitude toward engaging in the behavior affect people's intention to engage in a behavior (Eagly & Chaiken, 1993). Habit, attitude toward the target, utilitarian outcomes, normative outcomes, and self-identity outcomes also indirectly may affect people's intention to act in a particular way.

Examining the innovation-decision model and the composite model of the attitude-behavior relation, it can be seen that links can be made between the two models. Behavior in the composite model could be thought of as the actual adoption or rejection of an innovation, and the behavioral intention corresponds to the actual decision either to adopt or reject the innovation. The formation of attitudes towards engaging in the behavior corresponds to the persuasion stage of Rogers' (1983) innovation-decision model. People's attitudes at the persuasion stage are formed as a result of their selective perceptions of the innovation. In the composite model of the attitude-behavior relation, people's attitude towards engaging in the behavior are determined by their habit, attitudes toward the target, and the anticipated utilitarian, normative, and self-identity outcomes.

It is evident that the composite model of the attitude-behavior relation describes more fully than Rogers' model (Figure 1) the factors that predict people's intention. The model incorporates several psychological factors that influence indirectly people's intention and behaviors. Habit, attitude toward the target, utilitarian outcomes, normative outcomes, and self identity outcomes impact people's attitude toward engaging in the behavior, and accordingly influence the adoption decisions. Thus, a research model (Figure 3) might be proposed to delineate the factors that influence people's likelihood of using an innovation. It might be proposed that teachers' habit of using innovative technologies, attitude toward ICN, utilitarian outcomes, normative outcomes, and self-identity outcomes may determine teachers' attitude at the persuasion stage, in which these factors indirectly influence teachers' likelihood of using the ICN for classroom instructional activities if it were available. Moreover, the research model proposes that normative outcomes and self-identity outcomes may influence directly teachers' likelihood of using the ICN if it were available.

Need for the study

To prepare and help teachers to use the new distance education technology in Iowa, the Teacher Education Alliance (TEA), which is a partnership of Iowa's three public universities (Iowa State University, the University of Iowa, and the University of Northern Iowa) has organized several distance education inservices to prepare

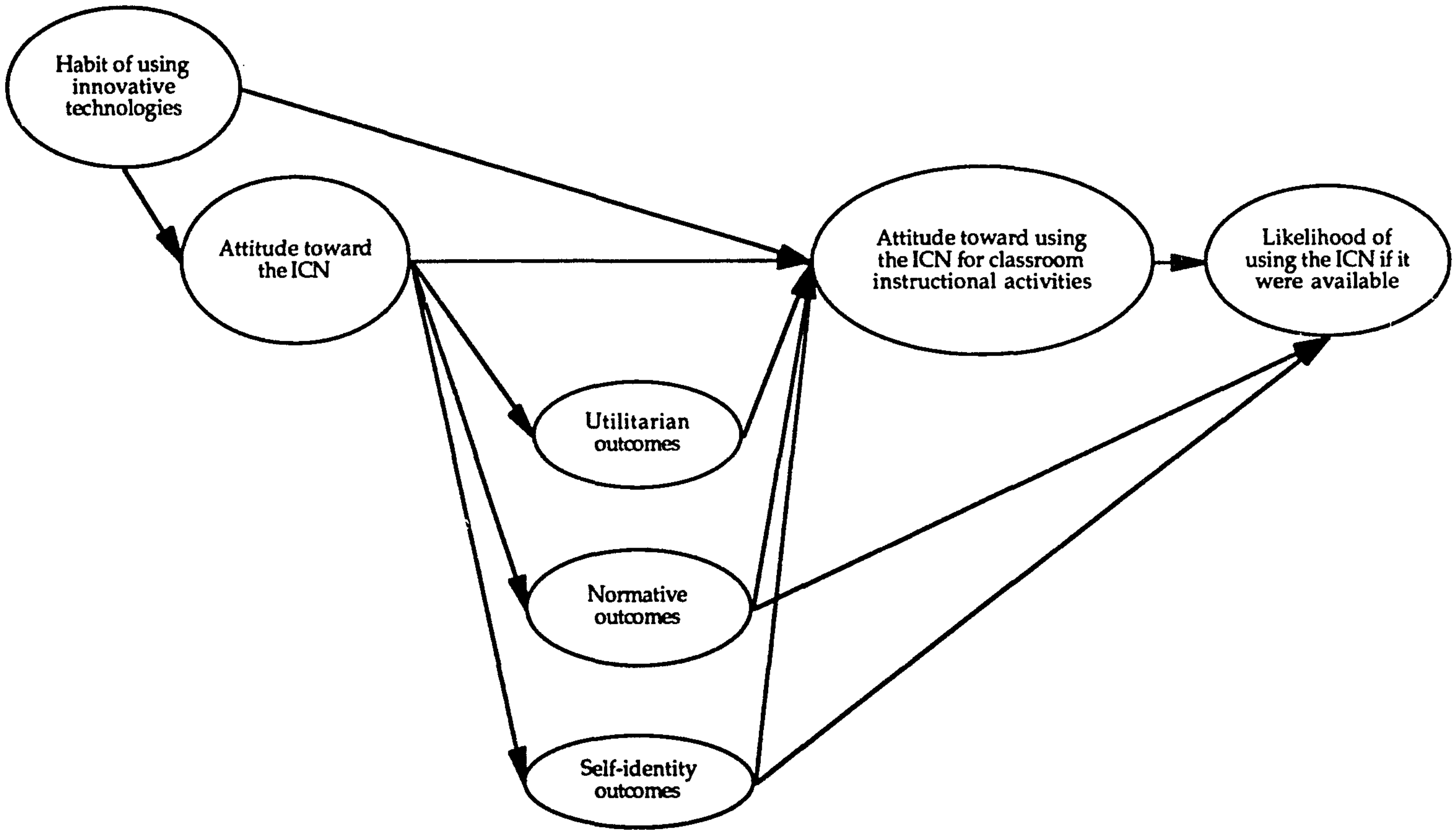


Figure 3. Research model

teachers to use the ICN. The inservices cover distance teaching methodology, special curriculum needs, the design of instructional materials used in distance teaching, the development of curriculum implementation strategies, and training and practice in operation of the telecommunications system used to deliver instruction over the ICN (Schlosser & Anderson, 1994).

Teachers who complete the inservices in distance education may know and learn about the ICN but not regard it as relevant to their situation, and consequently may not adopt it (Rogers, 1983). Different factors may influence teachers' decisions to adopt an innovation. Some factors are external, such as the availability and the accessibility of the innovation, administrative support, and the existence of environments that encourage innovations (Farquhar & Surry, 1992; Rogers, 1983). Other factors are personal, such as feeling incompetent, uncertain, and having anxiety (Wild & Hodgkinson, 1992). Teachers' judgments (either good or bad) about using the ICN for classroom instructional activities may intervene between their knowledge about the ICN and their future adoption decisions (Rogers, 1983).

While there is considerable research in the area of distance education, most of it is anecdotal (Beaudoin, 1990; Dillon & Walsh, 1992; Moore & Thompson, 1990; Schlosser & Anderson, 1994), focuses primarily upon adult learners' outcomes, characteristics, and attitudes (Dillon & Walsh, 1992; Schlosser & Anderson, 1994), and addresses print-based and earlier forms of telecommunication-based distance education (Threlkeld & Brzoska, 1994). Little research, if any, is evident relating to teachers' adoption of two-way interactive video-based instruction over fiber optic networks. Research is needed concerning the adoption of two-way interactive distance education technologies (Moore & Thompson, 1990). This study will contribute to the body of knowledge by testing the applicability for part of the composite model of the attitude-behavior relation in this behavioral domain.

Statement of the problem

The problem of this study was to determine (a) whether self-identity outcomes, normative outcomes, and attitude toward using the ICN have direct effects on teachers' likelihood of using the ICN for classroom instructional activities if it were available (Figure 3), and (b) whether habit, attitude toward the ICN, utilitarian outcomes, normative outcomes, and self-identity outcomes indirectly affect teachers' likelihood of using the ICN for classroom instructional activities if it were available (Figure 3).

Statement of the purpose

The purpose of the study was to test a model of the theoretical relations among habit, attitude toward the ICN, utilitarian outcomes, normative outcomes, and self-identity outcomes, attitude toward using the ICN, and teachers' likelihood of using the ICN, if it were available, after attending distance education inservices. The research model was tested using structural equation modeling. The objective of structural modeling is to provide a means of estimating the relationships among the underlying constructs of a hypothesized substantive model (Ecob & Cuttance, 1987).

Research hypotheses

The hypotheses underlying this study are the following:

1. Teachers' likelihood of using the ICN, if it were available, is affected directly by their attitude toward using the ICN, strength of beliefs about the influence

of important others [normative outcomes], and perceptions of self-affirmations that are anticipated to follow from using the ICN [self-identity outcomes].

2. Teachers' attitude toward using the ICN for classroom instructional activities is affected directly by their habit of using innovative technologies, general attitude toward the ICN, strength of beliefs about the consequences of using the ICN [utilitarian outcomes], strength of beliefs about the influence of important others [normative outcomes], and perceptions of self-affirmations that are anticipated to follow from using the ICN [self-identity outcomes].
3. Teachers' strength of beliefs about the influence of important others [normative outcomes] are affected directly by their general attitude toward the ICN.
4. Teachers' strength of beliefs about the consequences of using the ICN [utilitarian outcomes] are affected directly by their general attitude toward the ICN.
5. Teachers' perceptions of self-affirmations that are anticipated to follow from using the ICN [self-identity outcomes] are affected directly by their general attitude toward the ICN.
6. Teachers' general attitude toward the ICN is affected directly by their habit of using innovative technologies for classroom instructional activities.

Dependent and independent variables

The composite model of the attitude-behavior contains one independent variable (habit) that is hypothesized to have a direct and an indirect effect on teachers' likelihood of using the ICN for classroom instructional activities if it were available.

Teachers' attitude towards the ICN, utilitarian outcomes, normative outcomes, self-identity outcomes, attitude towards using the ICN, and the likelihood of using the ICN, if it were available, are all dependent variables. Behavior, which is the actual use of the ICN for classroom instructional activities, is not going to be tested in this research.

Significance of the study

Assuming that all K-12 Iowa teachers have equal opportunities to use the ICN, it is important for Iowa educators to understand and explore the underlying forces that motivate teachers to adopt or reject this new technology after getting the required training. Figure 3 presents the research model that delineates the factors influencing teachers' likelihood of using the ICN for classroom instructional activities, if it were available, after attending distance education inservices. Testing the model will lead to an understanding of the factors that affect teachers' adoption of the ICN. Such an understanding will affect the planning of future distant education inservices for teachers and accordingly will allow the most efficient process of adoption to occur.

CHAPTER II. REVIEW OF RELATED LITERATURE

Introduction

The change in telecommunications technologies has been rapid in recent years (Keegan, 1993), creating an increasing interest in distance education in educational settings (K-12, colleges, universities), the professions, and businesses and industry (Dillon & Walsh, 1992). Although implementation of distance education technology is growing rapidly in many countries in the world, little is known about the factors leading to successful adoption in some places and rejection in others (Moore & Thompson, 1990).

The adoption of any innovation often is very difficult. Many technologists believe that the obvious advantages of a new idea will be realized widely by potential adopters, and that the innovation therefore will diffuse rapidly. But very seldom is this the case. Innovations require a lengthy period of time from the time when they are available to the time they are widely adopted (Rogers, 1983). Therefore, to understand and manage the diffusion and adoption of a technological innovation such as distance education, it is important for educators in the field to investigate the forces that influence the potential adopters' decisions to adopt or reject the use of the innovation (Moore & Thompson, 1990).

The purpose of the chapter is to construct a theoretical basis for the study of the factors that influence teachers' decisions to adopt a new interactive distance education technology. This will be accomplished through examining the field of distance education, and then investigating the diffusion of innovation paradigm and the attitude paradigm. A research model will be proposed as a result of the investigation. Since the research model will be tested using structural equation modeling, this statistical analysis will be discussed at the end of this chapter.

Distance education technologies

What is distance education?

Distance education is a broad term representing uses of a variety of technologies in a variety of teaching situations, mostly when there is a separation of time and/or space between the student and the teacher. In general, three characteristics can be used to describe this field. The main characteristic is distance, or the spatial separation which is at the heart of distance education. The second characteristic is the use of media or technology. The third characteristic is the communication between the student and the teacher, in which communication depends on a large extent on teaching modes that are related to the technology being used (Sauvé, 1993).

Several definitions of distance education have been proposed in the literature (Barker, Frisbie, & Patrick, 1989; Dede, 1990; 1991; Garrison, 1989; Holmberg, 1989; Keegan, 1988; Peters, 1988, Rumble, 1989; Shale, 1988). Some researchers have analyzed correspondence study, one-way multi-media courses, and two-way student support systems (Keegan, 1988; Holmberg, 1989; Rumble, 1989). They viewed distance education as "individualized teaching with limited teacher-student interaction; the student is separated from the teacher in time, space and therefore learns autonomously" (Sauvé, 1993, p 103). Others have analyzed two-way multi-media teaching and multi-media student support systems (Barker, Frisbie, & Patrick, 1989; Garrison, 1989; Shale, 1988). They viewed distance education as the digitized technologies that have "reduced the gap between face to face teaching and distance education by providing a wide range of communication possibilities to the institution willing to establish interaction with the distant learner" (Sauvé, 1993, p 103).

Peters (1988) emphasized the role of technology in society when he defined distance education as an industrialized form of teaching and learning. There are six components of his model: separation of teacher and student, influence of an educational organization, use of technical media, provision of two-way communication, possibility of occasional seminars, and participation in an industrial form of education.

As distance education moves to more reliance on technological innovations, so the definition of distance education shifts to reflect change. Dede (1990; 1991) provides a definition of technology-mediated interactive learning, which includes (a) a technological medium is interposed between direct person-to person interaction or provides a shared environment that shapes the process of interpersonal communication, (b) the technology provides the tools and experiences that enhance the collective learning of those involved, and (c) the human participant interaction is spontaneous.

Difficulties in defining distance education are complicated by the ever-changing nature of the field. Researchers in the field of distance education have not been able to agree upon one common definition (Keegan, 1993; Sauvé, 1993; Schlosser & Anderson, 1994). Their definitions were influenced by their experiences and philosophies of education in which "each definition reflects a precise image of distance education or what the author would like it to be" (Sauvé, 1993, p. 105). Schlosser and Anderson (1994) concluded that no one theory or definition can fit the wide array of distance education practices, from correspondence, to television, to interactive video-instruction.

Forms of distance education technologies

Distance education is not a new field of inquiry; it is 150 years old. According to UNESCO, 10 million students from nearly every country of the world study at a distance, and most are adults (Keegan, 1993). The two characteristics that have marked the development of distance education are the adoption of increasingly sophisticated telecommunication technologies as they become available and the development of distance education according to the local resources of the organization providing instruction (Schlosser & Anderson, 1994).

Garrison (1993b) described the technology of distance education as consisting of three generations of advances in communication technologies. Garrison's taxonomy reflected technological features as well as significant shifts in the conceptualization and practice of distance education. The first generation or level relied upon correspondence and the mail system. Correspondence remains today the primary technology of distance education. It is a cost-effective and efficient method of providing access and meeting the demand for educational services. The downside of this technology is the questionable reliability of the mail system.

The second generation or level relied on teleconferencing where students gave up some control of when and where to study. Students had more opportunity to interact with their teacher and each other. This form of study resulted in more interaction and ultimately greater control for both teacher and student over the educational transaction at a distance (Garrison, 1993b). This was considered an advancement because teachers and students had the opportunity to interact.

The computer is at the core of Garrison's third generation. Its dominant application is computer-mediated communication (CMC). CMC combines the technologies of the second generation with computer capabilities to provide distinct methods of interacting at a distance. Schrum (1991) defined CMC as "communication across distances using personal computers, modems, phone lines, and computer networks. CMC provides immediate communication, access to previously unavailable communities, multiple participation in activities, and a window to the richness of the world" (p. 17). Garrison (1993b) stated that CMC represents a qualitative advance in facilitating interaction at a distance, and represents an important communication technology in the emerging paradigm. Garrison added that CMC should not be seen as a replacement of other forms of communication or as an optional add-on. He believed that "its distinctiveness must be recognized and considered in its application" (p. 19).

The demand for distance education

Telecommunications involving cable, fiber optics, microwave, slow scan, satellite, and microcomputers have expanded educational opportunities (Barker, Frisbie, & Patrick, 1989; U. S. Congress, 1989). Educational efforts involving these media will continue to increase for variety of reasons. Dede (1990; 1991) states some of these reasons. First, technological advances in fiber optics and other areas are driving the emergence of new technologies. Second, technologies are becoming more affordable. Third, demographic forces and the growing diversity of learners are creating a need for pooling instructional capabilities in response to the growing pluralism of learners' background and characteristics. Fourth, economic forces are driving American companies to use more advanced information technologies, and, as a result, the role of workers will change. Fifth, political forces are demanding higher performance outcomes and more advanced courses for students. Sixth, education is seeing changes in pedagogical practices. Distance education classrooms can be designed to "have a wider, deeper range of student skills than a local site could offer; a higher quality teacher than a single district could afford; and greater opportunities for students to interact than traditional single - classroom settings" (p. 262).

Further factors are identified in the literature. The new recognition of distance education technology as an empowering technology increases the possibility of using distance education in K-12 educational settings. Teachers in interactive distance education environments can create learning environments for meeting students' needs in the 21st century. Teachers can "design the learning process not just to learn information faster or easier but that will encourage and challenge learners to construct their own meaning and create new knowledge" (Garrison, 1993a, p. 207). According to Zuccermaglio (1993), distance education technologies are described as "empty or open," not a "full" technology. Full technology is designed to transfer information from the machine to the learner, and the learning model is a "pouring model." Empty technology is designed by taking into account the constructivist view of learning where technology offers the opportunities for metacognition and reflection concerning the learning activity. Teachers can add educational value to this powerful technology by collaborating with the technology to overcome the restrictions of time and space, enabling students to learn more (Kinnaman, 1995).

Another force driving the expansion of distance education, particularly at the K-12 level, is the federal government. In 1987, Congress authorized an initiative to promote use of telecommunications in K-12 education called the Star Schools Program Assistance Act. It was implemented by the government to encourage the following:

> ... improved instruction in mathematics, science, and foreign languages as well as other subjects such as vocational education through a Star Schools program under which demonstration grants are made to eligible telecommunications partnerships to enable such eligible telecommunications partnerships to develop, construct and to acquire telecommunications audio and visual facilities and equipment, to develop and acquire assistance for the use of such facilities and instructional programming (Public Law 100-418, 1988).

Senator Edward Kennedy, presiding over the Hearings on Examining the Development of a Regional Educational Telecommunications System before the Senate Committee on Labor and Human Resources (1987), pointed out a variety of needs for applying telecommunications technologies in educational settings:

> By 1995, the National Science Board reports that we will need twice as many teachers in math and science as we have today. But for every qualified math and science teacher 13 are leaving... I am proud to be able to say that again Massachusetts is creating a better future. I call the concept 'Star Schools', and the idea is to harness satellite technology to reduce the shortage of qualified teachers and close the gaps that plague so many of our schools, especially in science and math. By making satellite time available to teachers and students on a regular basis, we can make quality education and instruction far more widely and equally available than it is today. With a satellite dish outside the door, even a one room school house can tap a whole world of knowledge (p. 6).

Many projects have been submitted to the Star Schools Program for funding. A number of projects were funded, mostly ones that were satellite-based. In 1992, a proposal was submitted to the federal government's Star Schools office by a partnership of Iowa educational organizations (IDEA, 1992). In October of that year, the Iowa Distance Education Alliance (IDEA) was awarded $8 million for a statewide telecommunication network (Simonson, Sweeny, & Kemis, 1993). Iowa's project was to demonstrate a distance education system that uses a statewide two-way full-motion interactive fiber-optics network. It also was planned to demonstrate that an effective educational environment can be combined with technology to offer the students the best possible education. The project emphasized

> local control of the curriculum, active involvement by educators from local schools' districts, interactive instruction, statewide alliances and regional partnerships, preservice, inservice and staff development activities, implementation using existing organizations and expertise and research-based instructional decision making (Simonson, Sweeny, & Kemis, p. 25).

The "Iowa Model," which is the predominant approach to distance education in Iowa, features intact classrooms and live two-way interaction between students and their instructors. Distance education in Iowa has been defined as "formal, institutionally-based educational activities where the teacher and the learner are normally separated from each other in location but not normally separated in time, and where two-way, full motion interactive telecommunications systems are used to connect them for the sharing of video, data, and voice instruction" (Simonson, 1994, p. 3). Simonson (1995) added that Iowa's theoretical approach to the study and practice of distance education is based on the belief that "the more similar the learning experiences of the distant student is to that of the local student, the more similar will be the outcomes of the learning experience" (p. 2).

Central to the successful completion of the Iowa Distance Education Alliance is the Iowa Communication Network (ICN). The ICN is a state-wide two-way full-motion interactive fiber-optic telecommunications network with at least one point of presence in each of Iowa's 99 counties. The ICN links colleges, universities, and secondary schools throughout the state and is being constructed entirely with state and local funds. This network makes it possible for widely separated schools and universities to share educational resources and will connect hundreds of schools, colleges, regional libraries, and governmental agencies. It permits the transmission of video, audio, and data between any or all of the end points of the system.

The new technologies in distance education are widening the communication channels between student and instructor, channels that were limited in earlier forms of distance education. Nowadays, teachers in distance education environments have more responsibility of helping students learn actively and interactively. Their collaboration with the technology will help them to overcome the restrictions of time and space and help students to learn. Therefore teachers' adoption of distance education technology is a key factor to the success of this technology.

Helping teachers to use distance education technologies

The successful use of distance education technologies in educational settings is highly dependent on the preparation of teachers to use the resources appropriately (Beaudoin, 1990; Corporation for Public Broadcasting, 1993; LeBaron & Bragg, 1994; Moore & Thompson, 1989; Schlosser & Anderson, 1994; U. S. Congress, 1989). Most teachers today have had little or no previous experience with telecommunication equipments. Though instruction via satellite or microwave represents close approximation of the regular classroom (face to-face), it still is a significant departure from the traditional delivery modes. Teachers need training on how to utilize these unconventional methods of teaching. They need to be trained in both the technical aspects of the technology and in its educational applications "in distance learning, teachers find that they are required to change their method of teaching and give more attention to advanced preparation, student interaction, visual materials, activities for independent study" (U. S. Congress, 1989, p 12).

Darling-Hammond (1993) posits that to create training programs that change the way teachers do things, a strong foundation must be built for professional development. Teachers have to be educated about the relationship between learning and technology, how to facilitate interactivity, and how to operate the technology (Corporation for Public Broadcasting, 1993; Dede, 1990; Strudler, 1993). Successful training programs in distance education are conceived to include any activity or process intended to improve skills, attitudes, understandings, or performance in present or future roles (Moore & Thompson, 1989; U. S. Congress, 1989).

Distance education technology, like any other educational technology, is a tool to enhance learning. Distance education technology cannot overcome poor teaching. Poor teaching is "actually exacerbated in distance education applications" (U. S. Congress, 1989, p. 87). Therefore, it is important to involve trained, skilled, enthusiastic, and experienced teachers to use this technology. Teachers' knowledge, skills, enthusiasm, and willingness, and their interpretation of what the technology means to them will influence the way they react (Moore & Thompson, 1989). Their commitment to the innovation will allow for the various exciting educational experiences to happen. Also, they will serve as models for other teachers who do not know about the technology.

With regard to teachers' adoption of distance education technologies, research indicates that teachers' attitudes toward the distance education technologies have a significant influence on the success of and the use of this technology (Corporation for Public Broadcasting, 1993; Derr, 1991; Moore & Thompson, 1989; U. S. Congress, 1989). In a study about the relationship between teachers' attitudes about distance education and their willingness to use the technology, teachers' attitudes were identified to be the main predictor of teachers' willingness to use the technology (Abou-Dagga & Herring, 1994). In another study, teacher receptivity to change during the implementation of staff development program was investigated. The results showed that teachers with positive beliefs about an innovation were more likely to intend to use the innovation in the future (Myers, 1991).

Research on faculty adoption of distance education technologies showed that faculty who teach at a distance are positive toward distance teaching (Clark, 1993; Dillon, 1989; Mani, 1988; Taylor & White, 1991) and that their attitudes tend to improve as experience with distance education increases and as they become more familiar with the technology and the logistics of the technology (Clark, 1993; Gilcher & Johnstone, 1989). The main predictor of faculty willingness to teach over a distance was identified to be the level of instructor control (Steinhart, 1988). For experienced faculty, familiarity and experience with technology were moderately predictive of faculty receptivity or willingness to teach at a distance (Steinhart, 1988; Clark, 1993). A relationship was found between the attitudes of faculty who are using telecourse and the perceived attitudes of their faculty colleagues toward telecourse teaching (Dillon, 1989). Glicher & Johnstone (1989) stated that the faculty most satisfied with distance education were those "who felt they had clear support from the individuals they defined important" (p. 55).

Individual factors may influence teachers' adoption of distance education technologies. An analysis of these factors can play an important role in increasing the utilization of the technology. Without having willing teachers to try the interactive distance education technology, the technology itself will not accomplish anything. Therefore, it is very important that educators understand the underlying forces that motivate teachers to adopt or reject the new technology.

The present research will examine the models/theories of diffusion of innovation and the attitude-behavior change that will help in understanding the factors that influence adoption of the ICN by Iowa teachers. The research is based on two distinct, yet theoretically linked, bodies of research. These are the diffusion of innovations paradigm and the attitudes paradigm.

Diffusion of innovations paradigm

For researchers making first contact with the literature on diffusion, its most daunting feature is its size. Research on diffusion theory has been extensive with regard to the adoption of innovations (Rogers, 1983). Rogers' observation that some independent diffusion of innovation research efforts were coming to similar conclusions motivated him to publish in 1962 a book entitled Diffusion of Innovations (Rogers, 1962). In this work, Rogers analyzed 400 research reports and constructed what has become known as the classical theory of the diffusion of innovations.

In 1971, Rogers and Shoemaker updated their review of the research; together they found the number of research studies had grown to over 1400 (Rogers & Shoemaker, 1971). In his latest book, Rogers refers to 3100 studies, and cites nine research traditions that account for most of the research: anthropology, education, marketing, geography, general sociology, public health and medical sociology, rural sociology, and journalism and mass communication (Rogers, 1983). Rogers' model of adoption focuses on the demand side of the diffusion; how and why individuals adopt or do not adopt a practical innovation. Other perspectives in the diffusion literature ignored the adoption process, choosing instead to concentrate on the supply side of the diffusion (Brown, 1981).

The term innovation has been used in a variety of contexts with a corresponding variety of meanings. Existing definitions of innovation range from "highly specific foci on technical innovation to very broad generalizations, too imprecise to enable operationalization" (West & Farr, 1990, p. 9). The most commonly used definition is the one given by Rogers, in which he defined innovation as

> ... an idea, practice, or object that is perceived as new by an individual. It matters little, so far as human behavior is concerned, whether or not an idea is 'objectively' new as measured by the lapse of time since its first use or discovery. The perceived newness of the idea for the individual determines his or her reaction to it. If the idea is new to the individual, it is an innovation (p. 11).

An innovation moves through a population by diffusion, which is defined as the "process by which an innovation is communicated through channels over time among members of a social system" (Rogers, 1983, p. 5). Rogers' diffusion model posits that a new technology diffuses through a social system, where individuals learn about the technology through formal and informal communication channels. Access to these information channels provides potential adopters with data about the new technology and the various options available to them. Among the information sources that influence adoption behavior are the mass media, commercial entities, formal organizations, educational institutions, and personal interaction. Individuals evaluate information about an innovation; if favorable attitudes toward the technologies emerge, Rogers' model assumes adoption will follow (Rogers, 1983).

In Rogers' theory, four types of adoption decisions are possible. The first three are collective, authority, and optional, while the fourth, a contingent decision, occurs when one adoption decision is contingent on another. Contingent decision is defined as "a choice to adopt or reject which can be made only after a prior innovation-decision" (Rogers & Shoemaker, 1971, p. 37). In an organization, the adoption and implementation of an innovation involves a two-level decision process. Members of the organization authority identify, evaluate, modify, and implement the technology into the organization. Individual users of the innovation must also become aware of, evaluate, and decide to use the evaluation. When the success of the innovation is dependent on these individuals decisions, a model of the individual adoption-decision process is required.

As shown in Figure 1, the individual's decision about an innovation is not an instantaneous act. It is a process that occurs over time and consists of a series of actions. The individual passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject the innovation, to implementation of the new idea, and to confirmation of this decision (Rogers, 1983). There are five stages in Rogers' model of the innovation-decision process. Knowledge occurs when an individual is exposed to the innovation and gains some understanding of how it functions. Persuasion occurs when an individual forms a favorable or unfavorable attitude toward the innovation. Rogers (1983) stated:

> At the persuasion stage, the individual becomes more psychologically involved with the innovation; he or she actively seeks information about the new idea. Here the important behaviors are where he or she seeks information, what messages he or she receives, and how he or she interprets the information that is received. Thus selective perception is important in determining the individual's behavior at the persuasion stage, for it is at the persuasion stage that a general perception of the innovation is developed. Such perceived attributes of an innovation as its relative advantage, compatibility, and complexity are especially important at this stage (p. 170).

Decision is the stage in which the individual engages in activities that lead to a choice to adopt or reject the innovation. Implementation occurs when individuals use the innovation. Confirmation is the last stage, in which individuals seek reinforcement of an innovation-decision that has already been made, but they may reverse the decision if exposed to conflicting messages about the innovation. The innovation-decision process can lead to a variety of decisions, ranging from making full use of an innovation to a decision not to adopt an innovation.

Several variables have been hypothesized to affect the various stages of the innovation-decision process. One of them is the adopter's communication network, that includes source, message, channel, and recipient effects. Another is the adopter's personal characteristics, such as socio-economic characteristics, personality variables, and communication behavior. A third is the perceived characteristics of the innovation (Rogers, 1983). Rogers and Shoemaker (1971) also identified five attributes of the innovation that affect its adoptability. Relative advantage is the degree to which an adopter perceives an innovation as an advantage. Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, past experience, and needs of potential adopters. Complexity is the degree to which an innovation is perceived as difficult to understand and use. Trialability is the degree to which an innovation may be experimented with on a limited basis. Observability is the degree to which the results of an innovation are visible to others.

Rogers' model has been subjected to empirical tests in several disciplines. In a meta-analytic analysis of 75 diffusion studies of the attributes model, Tornatzky and Klein (1982) found that compatibility, relative advantage, and complexity have been found consistently to have the hypothesized relationship with adoption. They were unable to confirm or reject the relationships hypothesized for observability and trialability because of poor reporting of results by researchers. The majority of the research concerning differential perceptions of the attributes of innovations concentrated on these five attributes (Lancaster & Taylor, 1986).

Because the persuasion stage of the innovation-decision model involves the formation of attitudes towards the innovation, the attitude-behavior literature was examined to provide further theoretical understandings. Knowledge of the factors that affect the adoptive behavior provides a better guidelines for diffusion programs (Bandura, 1987).

Attitude paradigm

Many theories have been proposed over the years to explain the attitude-behavior relationship. The theory of reasoned action provides the best-known model of placing attitudes in relation to behavior (Eagly & Chaiken, 1993). It appeared first in the published literature in the 1960s by Fishbein (1967) and was modified in 1975 and 1980 by Ajzen and Fishbein. The theory of reasoned action was presented well over twenty years and provided a model of the psychological processes that mediate observed relations between attitudes and behaviors (Eagly & Chaiken, 1993). Ajzen and Fishbein (1980) stated that with this theory they can "account for behavior of various kinds by reference to a relatively small number of concepts" (p. 4).

The theory of reasoned action specifies the relationships between beliefs, attitudes, intentions and behaviors. It says that people behave as they intend to behave. People intend to behave in ways that allow them to obtain favorable outcomes and that at the same time meet the expectations of others who are important to them (Ajzen & Fishbein, 1980). One important assumption in the theory of reasoned action is that it addresses behaviors that are under volitional control, by which Ajzen (1985) meant "people can easily perform the behavior if they are inclined to do so" (p. 12).

According to the theory of reasoned action, the best predictor of whether or not that a person will perform a behavior is that person's intention to perform the behavior. Intention can be predicted from two motivational factors: the person's attitude toward performing the behavior and the person's subjective norm. Attitude toward performing the behavior is the person's feelings of favorableness or unfavorableness toward performing the behavior. Subjective norm is one's perception that one's important others are pressuring one to perform or not to perform the behavior in question.

According to the theory of reasoned action, attitudes are a function of beliefs. For example, if a person believes that performing a given behavior will lead to mostly positive outcomes, he or she will hold a favorable attitude toward performing the behavior. If a person believes that performing a behavior will lead mostly to negative outcomes, she or he will hold an unfavorable attitude. These beliefs that underlie a person's attitude are termed by Ajzen and Fishbein as behavioral beliefs.

Subjective norms also are a function of beliefs, but of a different kind of beliefs -- beliefs about the opinion of those with whom one is motivated to comply. A person who believes that these individuals think that he or she should perform a behavior, will perceive social pressure to do so. Also, a person who believes that these individuals think that he or she should not perform the behavior, will have a subjective norm that puts pressure to avoid performing the behavior (Ajzen & Fishbein, 1980). In their book, Understanding Attitudes and Predicting Social Behavior, Ajzen and Fishbein (1980) provide clear instructions for implementing the theory of reasoned action.

The theory has been criticized for consisting of simple volitional behaviors that require little in the way of resources and cooperation. It was also criticized for the non-existence of a large set of variables to predict intentions other than the attitude toward behavior and subjective norms (Liska, 1984). Prediction improved when moral obligation or self-identity or past behavior was taken into account with attitude toward the act and subjective norms (Beck & Ajzen, 1991; Bentler & Speckarts, 1979; Charng, Piliavin, & Callero, 1988).

To explain behaviors not "completely" under volitional control, Ajzen introduced the theory of planned behavior (Eagly & Chaiken, 1993). The theory of planned behavior is identical to the theory of reasoned action, except that the construct of perceived behavioral control has been introduced and that the behavior explained refers to actions subject to interference by internal and external forces. Perceived behavioral control was defined as one's perception of how easy or difficult it is to perform the behavior (Ajzen & Madden, 1986). This concept is close to Bandura' s notion of self-efficacy, which is defined as the individual's confidence that he or she can perform a particular behavior (Bandura, 1982). Perceived behavioral control affects behavior in two ways: it influences intention to perform the behavior and it influences behavior directly. The theory assumes that people tend to engage in behaviors to the extent they believe they have confidence in their ability to perform the behavior.

The theory of planned behavior was supported by several studies (Ajzen, 1991). Despite the obvious success of the theory in those domains for which the theory of reasoned action is less appropriate, it was criticized for several aspects. One of them is that the theory did not provide a sufficient model of behavior by introducing just one variable, perceived behavioral control (Eagly & Chaiken, 1993).

In their recent book, The Psychology of Attitudes, Eagly and Chaiken (1993) reviewed research that delineated the conditions under which relatively good prediction of behavior can be achieved. Their main concern was to understand the psychological processes that mediate the link between attitudes and behavior. Eagly and Chaiken examined several theories, including the theory of reasoned action and the theory of planned behavior. In regard to the theory of reasoned action, Eagly and Chaiken stated that the limited range of the theory was appreciated fully, and the approach no longer appeared viable except for relatively simple and easily executed behaviors that were under one's own control but were not strongly habitual. Moreover, they added that, in focusing on the proximal determinants of behavior, the theory of reasoned action did not give explicit consideration to attitudes towards targets as potential causes of behavior. In their reaction to the theory of planned behavior and some other theories, Eagly and Chaiken stated that, regardless of being very different from the theory of reasoned action, none of the newer theories "considers in much depth the sense in which behavior may be caused by attitudes toward entities to which behaviors are directed" (p. 192). Consequently, Eagly and Chaiken constructed a new model using the theory of reasoned action components in addition to their syntheses of attitude-behavior research (Figure 2). They called this model the composite model of the attitude-behavior relation. Eagly and Chaiken believe that "once broader models of this type have been fully examined and tested, social psychologists will have made a fundamental contribution to the essential endeavor of all psychologists understanding the causes of behavior" (p. 671).

Eagly and Chaiken's (1993) model takes habit, attitudes toward targets, utilitarian outcomes, normative outcomes, self-identity outcomes, attitudes toward behaviors, and intention into account when predicting behavior (Figure 2, see introduction). Eagly & Chaiken (1993) defined habit as the sequences of behaviors that have become relatively automatic, in the sense that they occur without self-instruction. Attitudes toward targets are the evaluations of targets of behavior formulated at any level of abstraction. Utilitarian outcomes are those rewards and punishments that are anticipated to follow from engaging in the behavior. Utilitarian outcomes, in Fishbein and Ajzen's (1980) terms, are behavioral beliefs. Normative outcomes refer to the approval and disapproval that significant others are expected to express in relation to a behavior, as well as self-administered rewards and punishments that follow from internalized moral rules. Self-identity outcomes refer to affirmations of self-concept that are anticipated to follow from engaging in the behavior. Attitude toward the behavior is the evaluation of the respondent toward the behavior. Intention is the decision to act in a particular way.

In the composite model of the attitude-behavior relation, habit, attitudes toward the behavior, and intention influence behavior directly. Attitudes toward behavior and intentions are the mediating factors between habit, attitudes toward targets, utilitarian outcomes, normative outcomes, self-identity outcomes, and the behavior. Intention is determined directly by the attitude toward behavior and by normative and self-identity outcomes, and indirectly by the attitudes towards target, habit, and the anticipated utilitarian, normative, and self-identity outcomes (Eagly & Chaiken, 1993).

As shown in Figure 2, the composite model of the attitude-behavior relation takes both attitudes towards targets and attitudes toward behaviors into account, but does that at different points in a sequence of processes. Behavior originates in the activation of habit, attitudes toward targets, and the anticipated outcomes of behavior. People's attitudes toward targets, habit, utilitarian outcomes, normative outcomes, and self-identity outcomes directly affect people's attitude toward behaviors. Accordingly, the attitude toward behavior impacts the behavior itself directly or indirectly through intention (Eagly & Chaiken, 1993). According to this model, behavior is determined by both attitudes towards the target and attitudes toward behaviors. Also the model posits that the relation between attitudes and behavior is "best understood by placing attitudes in the context of other psychological factors that also determine behavior" (Eagly & Chaiken, 1993, p. 211).

The research model

Examining the innovation-decision model (Rogers, 1983) and the composite model of the attitude-behavior relation (Eagly & Chaiken, 1993), it can be seen that links can be made between the two models. Behavior in the composite model would be the actual adoption or rejection of an innovation, and the behavioral intention corresponds to the actual decision either to adopt or to reject the innovation. The process during which the attitudes toward using the innovation is formed corresponds to the persuasion stage of Rogers' (1983) innovation-decision model.

The study of the adoption of an innovation will be facilitated by the use of a model that captures the underlying decision processes of potential adopters. Of primary interest in this study is teachers' likelihood of adopting an interactive distance education technology, and how it is influenced by personal factors. Rogers' (1983) model depicts that exposure to information about the innovation and forming favorable attitudes towards the innovation will facilitate the adoption process, which in turn will impact its actual adoption. The logic behind this is that making teachers aware of something will lead to attitude formation, which will be conducive to acceptance and ultimately result in adoption. Eagly and Chaiken's (1993) model explicitly delineates some of the factors that determine people's attitudes toward engaging in the behavior and accordingly influence their intentions to perform a certain behavior. Habit, attitudes toward the target, and utilitarian, normative, and self-identity outcomes affect people's intentions to do something. Intention is influenced directly and indirectly by many psychological and social factors.

The research model proposes that teachers' likelihood of using the ICN, if it is available, will be influenced directly by their attitude toward using the ICN for classroom instructional activities, their normative outcomes, and their self-identity outcomes. The model (Figure 3) proposes, too, that habit of using innovative technologies for classroom instructional activities, general attitude toward the ICN, utilitarian outcomes, normative outcomes, and self-identity outcomes may determine teachers' attitude at the persuasion stage, in which these factors indirectly influence teachers' likelihood of using the ICN. Since the availability of the ICN constitutes a major factor in the adoption of this innovation, the prediction of the ICN adoption will be improved by measuring the likelihood of using the ICN conditional upon the availability of technology.

Structural equation modeling

Structural equation modeling is a system of linear equations among a set of unobserved variables. It can be viewed as a product of merging two approaches to model fitting: multiple regression and factor analysis. The multiple regression approach expresses the relationship of the dependent variable to a number of regressor variables, while the factors analysis approach finds the number of latent variables that account for the common relationships among a number of observed variables (Ecob & Cuttance, 1987).

There are five steps that characterize the applications of structural equation modeling: (1) model specification, (2) identification, (3) estimation, (4) testing fit, and (5) respecification (Bollen & Long, 1992). Model specification refers to the initial model that is formulated on the bases of theory and related literature by the researcher prior to estimation. Identification is the process that determines whether it is possible to find unique values for the parameters of the specified model. Estimation is the process of obtaining estimates of the free parameters of the model. There are several estimation methods such as: ML(Maximum Likelihood), ULS (Unweighted Least Squares), GLS (Generalized Least Squares). The ML estimation function possesses desirable statistical properties if the data are continuous and follow a multivariate normal distribution. ML produces large-sample goodness-of-fit tests as well as minimum variance estimators. Parameter estimates of ML are fairly accurate even with normality violations (Newcomb, 1990).

After the estimates are obtained, testing the model is the next step. The purpose of testing is to check whether the model is consistent with the data. The testing process involves reproducing the covariance matrix of the data using the estimates of the model. The estimated covariance matrix is designated as Σ. The covariance matrix that is based on the data is called S. The null hypothesis in structural equation modeling is that the model as specified by the data is similar to the model as specified by the theory ($\Sigma = S$). The alternative hypothesis is that there is no model underlying the data ($\Sigma \neq S$). If the model is consistent with the data, the process can stop, which is not the case usually. More typically, the fit of the model could be improved through respecification.

It is not uncommon in educational applications to find that structural models do not fit the data (Kaplan, 1992). Modifying the model so as to obtain a better fit is often necessary. There are two ways to do that. One way is through adding constraints and making the model more restricted. The other way is through releasing constraints and making the model less restricted, or more general. The most important thing is that the constraints to be added or dropped should be identified based on theory (Bentler & Chou, 1987).

One of the most common model overall fit indices that is used is Chi-square associated with a p-value. The Chi-square value is generated by comparing the elements of the model covariance matrix with those of the sample covariance matrix. The more closely the two covariance matrices match, the lower the resulting Chi-square and the greater its p-value will be. On the contrary, the greater the discrepancy between the two matrices, the larger the Chi-square and the smaller its p-value. Therefore, for a model to fit, a high p-value is desirable (i. e., greater than .05, or whatever criterion is chosen). The value of the Chi-square is sensitive to the number of variables and sample size, therefore, it is extremely unlikely that a large model with many subjects to fit initially according to the p-value (Newcomb, 1990). Bollen & Long (1992) emphasized that the Chi-square test statistic should not be the sole basis for determining the fit of any model. They supported their argument with the following reasons:

> First, the null hypothesis underlying the test statistic is overly rigid in most cases. It assumes that the hypothesized model leads to an implied covariance matrix that exactly reproduces the covariance matrix of the observed variables in the population. There is no allowance made for the approximate nature of virtually all social science models. Second, the chi-square test statistic as usually applied ignores the statistical power of the test. Tests with excessive power can lead to the rejection of good models, or low statistical power can mislead us into retaining poor models. Third, failure of the variables to satisfy the distributional

> assumptions of the test statistic can lead to the rejection of correct models or the failure to reject incorrect models (p. 127).

Bollen & Long (1992) pointed out that no single measure of overall fit should be relied on exclusively. They suggested that researchers should not ignore the fits of the components of the model such as the R-squares of equations, the magnitudes of the coefficient estimates, whether the estimates are of the correct sign, the presence of improper solutions, or other unusual results. They emphasized that researchers should report multiple fit indices, rather than reporting just one fit index.

There are several overall model fit indices that can be used to test the model, in addition to the Chi-square and its associated p-value. Some of the indices are:

- The ratio of Chi-square to its degrees of freedom. The recommended criterion for a good fit using this Chi-square divided by its ratio varied widely from as five to as low as two or three (Bollen & Long, 1992).
- Goodness of fit index (GFI), which measures the relative amount of variances in S that are predicted by Σ. The values of GFI range from zero to one, with higher values (i. e., above 0.90) indicating a better fit (Newcomb, 1990).
- Adjusted goodness of fit index (AGFI), which adjusts for the degrees of freedom of a model relative to the number of variables. The values of AGFI range from zero to one, with the higher values (i. e., above 0.90) indicating a better fit (Newcomb, 1990).
- Root mean-square residual (RMR). Ideally RMR should be near zero for a "good" model.
- Hoelters' Critical N (CN). This is a formula that involves the approximation for a Chi-square variate when degrees of freedom are very large. A cutoff of CN $\geq$ 200

was suggested. The formula is CN=(Critical Chi-square /F) + 1. The CN is used mainly for large samples (Bollen, 1989).

- Standardized Chi-square which measures the deviation of the Chi-square estimator from its expected value in standard deviation units. There is no clear cutoff point for a good fit, but a smaller value indicates a better fit (Bollen, 1989).

In addition to previous overall model fit indices, Bollen & Long (1992) stated that it is better to consider several alternative models than to examine only a single model. Estimating several models allows researchers to determine the model with the best fit, rather than attempting to assess a single model's fit in some absolute sense. The difference between Chi-square statistic values for nested models provides successive fit information for the nested models.

LISREL is the most general program that is widely available for estimating structural equation models (Hayduk, 1987). Bentler and Chou (1987) discussed some of the conceptual, statistical and practical issues that were related to the use of the structural equation modeling. They cautioned that :

> It is so easy to get carried away with the beautiful simplicity with which path diagrams can capture a theory, and with the awesome stacks of computer printouts that epitomize alternative theory-guided views of one's data, thereby losing sight of the fundamental issue of whether some basic conditions for structural modeling have been met (p. 80).

Bentler and Chou (1987) stated that some of the conceptual requirements to do structural modeling are: (1) being sure that sample at hand comes from a population that is relevant to the theoretical ideas being evaluated, (2) being sure that data are collected under appropriate conditions, (3) being sure that the theoretical concepts must make sense in a given domain and are operationalized appropriately.

Along with the conceptual requirements associated with structural modeling, there are some technical or statistical requirements that must be met for the results to be meaningful. The first is the independence of observations, which means that each observation has been gathered from independent observations, so that responses given by one person will not influence the responses given by another. Second, is the issue of identical distributions: "the basic theory of structural modeling holds that the same process that describes influences of variables on each other is operating in each and every individual observation or case" (Bentler & Chou, 1987, p. 84). Third, is the issue of random sampling. Bentler and Chou (1987) added that "existing methods in structural modeling are based on the assumption that each of the units or cases in the population has an equal opportunity of being included in the sample to be studied" (p. 85). Fourth, is that the functional form of relations among variables is linear. Fifth, is the distribution of variables. Structural equation modeling methods are sample-sensitive procedures, and require many subjects: "the ratio of sample size to the number of free parameters may be able to go as low as 5:1 under normal and elliptical theory, especially when there are many indicators of latent variables and the associated factor loadings are large" (Bentler & Chou, 1987, p. 91).

Among the practical issues that have been addressed by Bentler and Chou (1987) is the number of variables in the model. They suggested that it is better not to incorporate more than 20 variables in a model. They also stated that it is important not to exclude key variables that may influence a model.

Summary

Distance education is not a new field of study. It has existed for more than 150 years. Researchers in the field of distance education have not been able to agree upon one common definition. Their definitions were influenced by their experiences and philosophies of education. The two characteristics that have marked the development of distance education are the adoption of increasingly sophisticated telecommunication technologies as they become available and the development of distance education according to the local resources of the organization providing instruction. The establishment of the Iowa Communication Network (ICN) in Iowa is a notable example of the introduction of recent educational technology in the K-12 settings. Several factors may influence teachers' adoption of distance education technologies. Some of these factors are external and others are personal.

The diffusion of innovations and attitudes paradigms were investigated. Rogers' (1983) innovation-decision model posits that an individual passes from knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject the innovation, to implementation of the new idea, and to confirmation of this decision (Rogers, 1983). Eagly and Chaiken's (1993) composite model of the attitude-behavior relation takes habit, attitudes toward targets, utilitarian outcomes, normative outcomes, self-identity outcomes, attitudes toward behaviors, and intention into account when predicting behavior. Since Eagly & Chaiken's model described more fully than Rogers' the personal factors that predict people's decisions to adopt, a research model was proposed to delineate the factors that influence teachers' likelihood of using the ICN for classroom instructional activities if it were available.

Structural equation models are general statistical techniques to allow consideration of simultaneous equations with many endogenous variables. They allow measurement error in the exogenous and endogenous variables and permit multiple indicators of latent construct. Researchers in the field indicated that to evaluate a model, researchers must "know their substantive area before assessing fit, do not rely on the Chi-square test statistic; report multiple fit indices; examine the components of fit as well as the overall model fit; and estimate several plausible model structures as a means of determining the best fit" (Bollen & Long, 1992, p. 129).

CHAPTER III. METHODOLOGY

Introduction

In this chapter the methodology of the study is explained. The chapter begins with a description of the subjects, followed by information about the instrument. The procedures and data analysis methods are also outlined.

This study was constructed as part of the Iowa Distance Education Alliance (IDEA) project. Several research and evaluation studies were conducted a result of this project. In this study, the researcher developed the research instrument (see Appendix B), collected the data, analyzed the data, and wrote the research report. Support for data collection was provided by the U. S. Department of Education Star Schools grant (#R203 B 20001-93). Demographic data about the inservice participants were available at the Research Institute for Studies in Education; therefore, there were no demographic questions on the research instrument.

Subjects

The subjects consisted of all K-12 teachers who attended inservice training in distance education provided by the IDEA in the spring, summer and fall of 1993, and in the spring and summer of 1994. A total of 710 teachers were surveyed. Of the 325 (46%) teachers who returned the survey 37.3% (n = 119) teachers attended the inservice training in 1993, 53.6% (n = 171) attended the training in 1994, and 9.1% (n = 29) attended the training in both 1993 and 1994.

Of the total sample, 27.7% (n = 82) attended the inservice workshops in which the emphasis was on the technical use of the ICN. Twenty-nine percent (n = 92) attended the curriculum institutes in which the emphasis was on the use of the ICN for innovative instructional technologies. Forty-four percent (n = 140) attended both the inservice workshops and the curriculum institutes.

Demographic characteristics of the sample are shown in Table 1. As can be seen, 36.8% (n = 119) teachers were males and 63.2% (n = 204) were females. The majority (75.7%) of the sample had been educators for more than 12 years. About two-thirds (61%) of the sample had BA or BS degrees. Most (68.7%) were high school teachers, and about half (47.8%) taught math and science. Only 28.1% (n = 88) had the ICN at their school building.

Table 1. Demographic characteristics of the sample

Variable names	Categories	% (n)
Sex	Males	36.8% (n=119)
	Females	63.2% (n=204)
Years of being an educator	0 - 5	11.5% (n=36)
	6 - 11	12.8% (n=40)
	12 - 17	16.9% (n=53)
	18 - 23	30.4% (n=95)
	24 - 41	28.4% (n=89)
Educational degrees	BA/BS	60.8% (n=191)
	MA/MS and above	39.2% (n=123)
Teachers' teaching levels	Elementary	17.6% (n=57)
	Middle	13.6% (n=44)
	High school	68.7% (n=222)
Teachers' subject areas	Math and Science	47.8% (n=155)
	Foreign language	11.7% (n=38)
	Literacy	20.1% (n=65)
	Vocational education	17.0% (n=55)
	Other subject areas	3.4% (n=11)
Having ICN at school building	Yes	28.1% (n=88)
	No	71.9% (n=225)

Instrument

The instrument is shown in Appendix B. Not all the items in the survey were used in this study. Items 1 through 38, and items 98 and 99, were developed by the Star School evaluators as part of an evaluation study they were conducting. Items 39 through 97, and items 100 and 101, were designed by the researcher to gather data for this study. Because demographic data about the inservice participants were available at the Research Institute for Studies in Education, there were no questions on the survey about demographic characteristics.

Items that were designed for this study reflected seven of the constructs of the composite model of the attitude-behavior relation (Eagly & Chaiken, 1993). The generated instrument was used to test the research model (Figure 3). The constructs of the model were habit, attitude toward the ICN, utilitarian outcomes, normative outcomes, self-identity outcomes, attitude toward using the ICN for classroom activities, and the likelihood of using the ICN, if it were available.

As shown in Table 2, the researcher developed a working definition for each research construct, explained how each construct was measured, and displayed the items in each construct. Items were modeled using the Ajzen & Fishbein's (1980) sample questionnaire that was presented in their book Understanding Attitudes and Predicting Social Behavior. Items in the habit and self-identity outcomes constructs were generated by the researcher after reviewing related literature (Bentler & Speckart, 1979; Charng, Piliavin & Callero, 1988; Grandberg & Holmberg, 1990).

To establish content-related evidence, the items for each construct were reviewed critically by two experts: a professor at Iowa State University whose area of expertise is attitude theories and a research associate in the Research Institute of Studies in Education whose area of expertise is distance education. After

Table 2. Research constructs, working definitions, measurement, and items

Construct name	Working definition	How the construct is measured	Final set of items
Attitude toward target	Attitude toward the ICN refers to teachers' perceptions about the ICN in general.	On the basis of the evaluation results for the distance education inservices (IDEA, 1994) and consulting with Star School educators at Iowa State University, several general beliefs about the ICN were identified. The most frequently mentioned beliefs were used for this study (items 39 through item 47). Item 49 is a direct measure of teachers' attitudes toward the ICN as a system. <u>Response format</u> Items were assessed on a 7-point disagree /agree scale.	39. The ICN will increase educational learning opportunities for Iowans. 40. The ICN is too costly. 41. The ICN will allow schools to share resources. 42. There are many problems associated with the operation of the ICN (e. g., scheduling, access, support, etc.). 43. The ICN is poorly designed. 44. The ICN will provide greater educational opportunities to students in districts of all sizes. 45. Expanding the use of the ICN to government and other related services (e. g., hospitals) will limit its use for education. 46. The operation of the ICN is troublesome. 47. The ICN will encourage Iowans to interact with people in other parts of the state, country and world. 49. Overall, my attitude toward the ICN as a system is positive.
Habit	Habit in this study is defined as teachers' tendency to use innovative technologies for classroom instructional activities.	The concept was operationalized by a four-item scale. Items were developed by the researcher. <u>Response format</u> Items were assessed using a 7 point disagree/agree scale.	50. I typically teach using innovative technologies for classroom instructional activities. 51. Using innovative technology for classroom instructional activities is something I rarely do. 52. I have always been one to try new teaching methods. 53. I am in the habit of using audio /visual technologies in the classroom.

Table 2. (Continued)

Construct name	Working definition	How the construct is measured	Final set of items
Self-identity outcomes	Self-identity outcomes is defined as teachers' perceptions of self-affirmations that are anticipated to follow from their using innovative technologies such as the ICN for classroom instructional activities.	Self-identity items (items 54 through 58) were generated after reviewing some related literature (Charng, Piliavin & Callero, 1988). Response format Self-identity items were assessed on 7-point disagree/agree scale.	54. The idea of using innovative technologies such as the ICN for classroom instructional technology is compatible with my view of myself as a teacher. 55. For me, being an effective teacher means being open to the use of innovative technologies such as the ICN for classroom instructional activities. 56. I can't see myself using innovative technology like the ICN for classroom instructional activities. 57. I would be a better teacher if I used the ICN for classroom instructional activities. 58. In the future, I can't see myself teaching without using innovative technologies for classroom instructional activities.
Attitude toward the behavior	Attitude toward the behavior refers to teachers' judgments that using the ICN for classroom instructional technologies is good or bad, that she or he is in favor or against using it.	The items for the construct attitude toward using the ICN for classroom instructional activities were generated using the Fishbein & Ajzen's (1980) sample questionnaire. Response format Items were assessed on a 7-point disagree /agree scale.	59. For me, using the ICN for classroom instructional activities would be a good idea. 60. For me, using the ICN for classroom instructional activities would be beneficial. 61. As a teacher, I think that using the ICN for classroom instructional activities would be not convenient. 62. As a teacher, I think that using the ICN for classroom instructional activities would be cumbersome. 63. Generally, my attitude toward the ICN for classroom instructional activities is favorable.

Table 2. (Continued)

Construct name	Working definition	How the construct is measured	Final set of items
Normative outcomes	Normative outcomes refers to teachers' perceptions of the expectations of important others in relation to the use of the ICN for classroom instruction, taking into account their motivation to comply with what others think.	Two sets of items were generated: normative belief items and motivation to comply items. Items included on this scale were generated using Ajzen & Fishbein's (1980) sample questionnaire. Subjects were asked to rate 4 items to measure if specific referents (teachers, students, parents and administrators) think that they should use the ICN for classroom instructional activity. Then subjects were asked to rate another 4 items to measure their motivation to comply with what their referent thought they should do. Each normative belief item was multiplied by the corresponding motivation to comply item. <u>Response format</u> Items were assessed on a 7-point agree/disagree scale.	**Normative beliefs items** 64. Teachers in my school think I should use the ICN for classroom instructional activities. 65. Parents of my students would be in favor of me using the ICN or classroom instructional activities. 66. Administrators in my school think I should use the ICN for classroom instructional activities. 67. Students would like me to use the ICN for classroom instructional activities. **Motivation to comply items** 68. Generally speaking, I want to do what other teachers in my school think I should do. 69. Generally speaking, I want to do what administrators in my school think I should do. 70. Generally speaking, I want to do what students think I should do. 71. Generally speaking, I want to do what parents think I should do.

Table 2. (Continued)

Construct name	Working Definition	How the construct is measured	Final set of items
Utilitarian outcomes	Utilitarian outcomes refer to teachers' perceptions of the consequences of using the ICN for classroom instruction, taking into account their evaluation of the consequences.	On the basis of the evaluation results for the distance education inservices (IDEA, 1994)) and a preliminary study about the distance education inservices (Abou-Dagga & Herring, 1994), several salient beliefs about the use of the ICN in the classroom were identified. Two sets of items were generated to measure this construct using Ajzen & Fishbein's (1980) sample questionnaire. These were: behavioral beliefs and the outcomes evaluation for each belief. The first set of items indicated the subjects' behavioral beliefs (items 72 through 82). <u>Response format</u> The belief items were assessed using a 7-point unlikely/likely scale.	**Behavioral beliefs items** 72. Using the ICN for classroom instructional activities would increase the time I need for planning and preparation. 73. Using the ICN for classroom instructional activities would enhance the quality of students' learning. 74. Using the ICN for classroom instructional activities would help me reach more students. 75. Using the ICN for classroom instructional activities would make student-teacher interaction impersonal. 76. Using the ICN for classroom instructional activities would add resources to my classroom (e. g., experts, materials, databases, etc.) 77. Using the ICN for classroom instructional activities would help prepare students for a technological future. 78. Using the ICN for classroom instructional activities would create lots of student discipline problems. 79. Using the ICN for classroom instructional activities would decrease one-on- one communication. 80. Using the ICN for classroom instructional activities would allow students to interact with each other without having to travel big distances. 81. Using the ICN for classroom instructional activities would allow for the use of appropriate media materials. 82. Using the ICN for classroom instructional activities would result in technical problems while teaching.

Table 2. (Continued)

Construct Name	Working Definition	How the construct is measured	Final set of items
Utilitarian outcomes **(Con'd)**	See previous page	The second set of items indicated the evaluation of the behavioral beliefs (items 85 through 95). Response format Items 85 through 95 were assessed on a 7-point undesirable/ undesirable scale. Each of the 11 behavioral belief items was multiplied by the corresponding outcome evaluation item.	**Outcome evaluation items** 85. Increasing the time for classroom planning and preparation. 86. Enhancing the quality of students' learning. 87. Helping to reach more students. 88. Making student-teacher interaction impersonal. 89. Adding resources to the classroom (e. g., experts, materials, databases, networking etc.). 90. Helping prepare students for a technological future. 91. Student discipline problems in the classroom. 92. Decreasing one-on-one communication. 93. Allowing students to interact with each other without having to travel great distances. 94. The use of appropriate media materials while teaching. 95. The existence of technical problems while teaching.
Intention	Intention is teachers' likelihood to use the ICN for classroom instructional activities in the 1994/1995 academic year, if it is available.	Q84 is a conditional intention item. Prediction of using the ICN for classroom instructional activities can be improved by taking into account the availability of the resources. Response format The intention item was assessed on 7-point likely/unlikely scale.	84. If the ICN were available to me, I would use it for classroom instructional activities during the 1994/1995 academic year.

eliminating and/reclassifying certain items, the remaining items were subjected to a pretest involving a panel of experts of other two research associates in the Research Institute for Studies in Education and two other professors at Iowa State University. They were provided with construct definitions and were asked to examine the items and see if they reflect the research constructs. Problematic items were modified to eliminate any inappropriately worded and ambiguous items.

A pilot testing for the instrument was conducted next. The instrument was distributed to a sample of 15 graduate students at Iowa State University for further check for any problematic items. Students were told to critique the ease of comprehension of the items and suggest changes to improve the wording. Following the testing, a total of 56 items remained (Table 2).

Three types of response formats for the instrument items were used. For items 1 through 71, a 7-point scale of disagree/agree was used. For items 72 through 84, a 7-point unlikely/likely scale was used. For items 85 through 95, a 7-point scale of undesirable/desirable was used (Table 2). Several items (e.g., items 40, 43, 46, 51, 56, 58, 61, 62, 78, 79, 82) were worded negatively to detect item response bias.

As shown in Appendix B, some questions in the instrument also cover the following topics: perception of the availability and accessibility of the ICN (item 48), having the ICN at the school building or not (item 96), use of the ICN for classroom instructional activities (item 97), attendance to the to specific inservice training activity (item 100), and year of attendance to the inservice training (item 101).

Procedures

The research instrument and the Star Schools' instrument were combined together in one form (see Appendix B). The resulting instrument was mailed with a cover letter (see Appendix A) and a machine-scored answer sheet to all teachers who attended distance education inservice training. It was mailed at the beginning of the fall semester 1994 at which time all would have completed their inservice training in distance education. A reminder postcard was mailed to teachers two weeks after the first mailing (see Appendix C). Another copy of the survey with a new cover letter was mailed to teachers three weeks after the second mailing (see Appendix D). A total of 325 usable surveys were returned by the teachers; the return rate was 46%.

Data analysis

Data were collected on machine-scored answer sheets and were scanned into the mainframe computer of Iowa State University. The statistical Package for the Social Sciences (SPSS) was used to analyze the data. Frequencies were calculated to ensure data accuracy and obtain demographic and descriptive data.

Preliminary analyses were conducted to check whether there were significant differences among the level of each of the demographic variables in relation to the dependent variable in this study (the likelihood of using the ICN if it is available). These variables include sex, year of being an educator, educational level, teaching level, subject area, schools being connected to the ICN, the type of participants' attendance for the inservice training, and year of attending the inservice training. Discussion of the analysis is presented in chapter IV.

For each utilitarian outcome item, a product score was computed by multiplying the perceived likelihood that using the ICN will be associated with certain outcomes by the desirability of that outcome. This resulted in a score that reflects the strength of teachers' beliefs about the consequences of using the ICN for classroom instructional activities. Similarly, for each normative outcome item, a product score was computed by multiplying teachers' perceptions of what important others think about the use of the ICN by the extent of teachers' motivation to comply with these opinions. This resulted in a score that reflects the strength of teachers' beliefs about the influence important others.

Factor analysis was conducted to examine the validity of the research instrument. Factor analysis is an analytic technique that permits the reduction of a large number of interrelated variables to a smaller number of latent variables. Factor analysis uses the smallest number of explanatory concepts to explain the maximum amount of variance in a correlation matrix (Tinsley & Tinsley, 1987). Varimax rotation was used. A factor loading of 0.40 was used a cutoff point for the elimination of items. Several items were eliminated based on the results of the factor analysis.

For each factor, a scale was developed using remaining items. A total scale score was computed by summing scores on the items and dividing by the number of items. The research model was modified based on the scales identified in the factors analytic results. A reliability coefficient was assessed for each scale. Correlations among the scales were computed. Discussion of these analyses is presented in chapter IV.

The research hypotheses and the model were tested using structural equation modeling. In this study, LISREL was used to assess the model parameter estimates and to assess the fit of the model. The structural equations were solved using the maximum likelihood (ML) approach. Standardized path coefficients were used to evaluate the model paths and to test the research hypotheses. The t-tests associated with each path coefficient were used to assess statistical significance. Direct and indirect effects were reported, too.

A Chi-square p-value was not used as the sole index to test the fit of the overall model. Several overall model fit indices were presented to measure the closeness of S to Σ, such as GFI, AGFI, RMR, and the ratio of Chi-square to its degrees of freedom. The fits of the components of the model were examined. These were the R-squares of individual equations, the magnitudes of the coefficient estimates, whether the estimates are of the correct sign, the presence of improper solutions, or other unusual results.

In addition, several nested models were compared and evaluated. The strategy for model evaluations was based on comparing a sequence of nested models against either the null model or the baseline model. The comparisons were tested using the difference in Chi-square statistic values between models.

CHAPTER IV. RESULTS

Introduction

The purpose of this chapter is to present the results of the statistical analysis of the data. Preliminary analysis and the analysis of the research construct measures, including validity and reliability, are presented first . The remaining part of the chapter is about testing the research hypotheses and the model.

Preliminary analysis

The purpose of the preliminary analysis was to check whether there were significant differences among the level of each of the demographic variables in relation to the dependent variable in this study. The dependent variable was the likelihood that teachers will use the ICN for classroom instructional activities. It was stated as follows: "If the ICN were available to me, I would use it for classroom instructional activities during the 1994/1995 academic year."

The results showed no significant differences in teachers' decision to use the ICN for classroom instructional activities in relation their sex, t (311) = .3916, p = .2936; years of being an educator, F (4, 299) = 1.5257, p = .1946; educational degree, t (303) = .01995, p =. 4209; subject area, F (4, 313) = 1.9697, p = .0990; type of training, F (2, 311) = .5833, p = .5587; and year of attending the inservice training, F (2, 209) = 1.959, p = .1427. Differences in the degrees of freedom are due to missing values.

There was a significant difference between those teachers who had the ICN in their school building and those who did not have it in their building, t (307) = 14.3875, $p \leq 0.001$, in relation to their likelihood of using it. Those teachers who did

Table 3. Likelihood of using the ICN, if it were available, by its presence/absence in school building

Variable	Group	N	Mean	SD
Presence of ICN in school building	Yes	87	4.4023	1.7879
	No	222	5.4910	1.5273

scale: 1=extremely unlikley; 2=quite unlikely; 3=slighty unlikely; 4=neither; 5=slighlty likely; 6=quite likely; 7=extremely likely.

not have the ICN at their school building had a higher mean score in their likelihood of using the ICN, if it were available, than the other group who had the ICN at their school building (Table 3).

There was also a significant difference in likelihood of using the ICN, if it were available, among those who taught at the elementary level, middle level and high school, $\underline{F}$ (2, 311) = 9.6219, $\underline{p} \leq .001$. Using the Scheffé post hoc test at the .05 level of significance, the results showed that teachers who taught at the elementary level had a higher mean score in their likelihood of using the ICN, if it were available, than those who were teaching at the high school level. Those teachers who taught at the middle level had a higher mean score in their likelihood of using the ICN, if it were available, than those who taught at the high school level (Table 4).

Table 4. Likelihood of using the ICN, if it were available, by teachers' level of teaching

Variable	Group	N	Mean	SD
Level of teaching	Elementary	55	5.7818	1.3702
	Middle	43	5.7674	.2880
	High School	216	4.9120	1.7271

scale: 1=extremely unlikley; 2=quite unlikely; 3=slighty unlikely; 4=neither; 5=slighlty likely; 6=quite likely; 7=extremely likely.

To examine whether there was a relationship between the two variables that were significant in the previous analyses, presence/absence of the ICN at school building, and level of teaching, a Chi-square analysis was conducted. The analysis showed that having the ICN at the school building is related to teachers' level of teaching, X^2 (2, N = 311) = 43.407, p ≤ .001 (Table 5). To determine which of the categories are major contributors to the Chi-square significance, the standardized residual was computed for each of the categories (Hinkle, Wiersma, & Jurs, 1988). The cell that contributed the most to the Chi-square was elementary teachers who have the ICN in their school building. Teachers who do not have the ICN at their schools mostly were elementary teachers. This result is supported by the fact that the ICN is located mainly at the high schools.

Table 5. The relationship between presence/absence of the ICN at school building and teaching level.

	Have the ICN at school		Do not have the ICN at school	
	Obs.	Exp.	Obs.	Exp.
Elementary	1**	15.1	53	38.9
Middle	2	12.0	41	31.0
High school	84	59.9	130	154.1
Total	87		224	

** This cell contributes the significant Chi-square value.

In general, the preliminary analysis showed no significant differences in teachers' likelihood of using the ICN, if it were available, in relation to their sex, years of being an educator, educational degree, teaching level, subject area, type of training, and year of attending the inservice training. There was a significant difference in teachers' likelihood of using the ICN, if it were available, in relation to the presence/absence of the ICN, and in relation to their teaching level. Teachers who taught at the elementary or middle level (most of whom did not have the ICN at school) had a higher likelihood of using the ICN than those who taught at the high school level.

Analysis of the research constructs measures

Measurement scales are defined as collection of items intended to reveal latent variables (DeVellis, 1991). Two desirable criteria to have in any instrument are validity and reliability. In this section, factor analysis is used to evaluate the validity of the research instrument. Cronbach's alpha was used as a reliability estimate for each subscale. A modified research model was proposed at the end of this section.

Validity

The validity of an instrument was defined by Messick (1989) as "an integrated evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of inferences and actions based on test scores or other modes of measurement" (p. 13). To accumulate evidence of validity, three different types of evidences are generally considered: content related-evidence, criterion-related evidence, and construct-related evidence. The construct validity for the research constructs of this study was evaluated by factor analyzing the items that reflect the research constructs.

Six subscales were used to reflect the theoretical model in addition to the item that measured intention: habit, attitude toward the ICN, utilitarian outcomes, normative outcomes, self-identity outcomes, and attitude toward using the ICN for classroom instructional technology.

As mentioned in the chapter III, a product score was computed for every utilitarian outcome item. This product score reflects the strength of teachers' beliefs about the desirable and undesirable consequences of using the ICN for classroom instructional activities. Similarly, a product score was computed for every normative outcome item. The product score reflects the strength of teachers' beliefs about the influence of important others.

An overall factor analysis using Unweighted Least Squares (ULS) extraction, followed by a varimax rotation, was performed, including all the items except the item that measures intention. The factor loading of each item was examined, and any item with a factor loading below 0.40 or with a similar loading on more than one factor was eliminated. This resulted in the deletion of several items:

- The ICN is too costly (Q40).
- Expanding the use of the ICN to government and other related services (e. g., hospitals) will limit its use for education (Q45).
- In the future, I can't see myself teaching without using innovative technologies for classroom instructional activities (Q58).
- Using the ICN for classroom instructional activities would increase the time I need for planning and preparation (Q72).
- As a teacher, I think that using the ICN for classroom instructional activities would be not convenient (Q61).
- As a teacher, I think that using the ICN for classroom instructional activities would be cumbersome (Q62).

Table 6 summarizes the factor loadings, means, and standard deviations for each item.

Table 6. Factor loadings, means, and standard deviations for the research items (n=311)

Item #	Factors & items	Factor loading	Mean	SD
	Factor 1:			
	Attitude toward using the ICN for classroom instructional activities			
Q59	For me, using the ICN for classroom instructional activities would be a good idea.	.77	5.14	1.24
Q60	For me, using the ICN for classroom instructional activities would be beneficial.	.72	5.18	1.20
Q63	Generally, my attitude toward the ICN for classroom instructional activities is favorable.	.65	5.69	1.04
Q54	The idea of using innovative technologies such as the ICN for classroom instructional technology is compatible with my view of myself as a teacher.	.63	5.69	1.09
Q56	I can't see myself using innovative technology like the ICN for classroom instructional activities.	-.58	2.18	1.23
Q57	I would be a better teacher if I used the ICN for classroom instructional activities.	.56	4.17	1.51
Q55	For me, being an effective teacher means being open to the use of innovative technologies such as the ICN for classroom instructional activities.	.51	5.72	1.15

Table 6. Continued

Item #	Factors & items	Factor loading	Mean	SD
	Factor 2:			
	Attitude toward the educational promise of the ICN			
Q39	The ICN will increase educational learning opportunities for Iowans.	0.66	5.98	.90
Q41	The ICN will allow schools to share resources.	0.65	5.84	.98
Q47	The ICN will encourage Iowans to interact with people in other parts of the state, country and world.	0.59	5.72	1.05
Q44	The ICN will provide greater educational opportunities to students in districts of all sizes.	0.54	5.61	1.33
Q49	Overall, my attitude toward the ICN as a system is positive.	0.50	5.70	1.19
	Factor 3:			
	Habit of using innovative technologies			
Q50	I typically teach using innovative technologies for classroom instructional activities.	0.85	5.22	1.25
Q51	Using innovative technology for classroom instructional activities is something I rarely do.	- 0.79	2.54	1.36
Q53	I am in the habit of using audio/visual technologies in the classroom.	0.57	5.52	1.33
Q52	I have always been one to try new teaching methods.	0.55	5.67	1.06

Table 6. Continued

Item #	Factors & items	Factor loading	Mean	SD
	Factor 4:			
	Strength of beliefs about positive consequences of using the ICN			
Q77XQ90	The likelihood of using the ICN for classroom instructional activities would help prepare students for a technological future X the extent of desirability /undesirability of that outcome.	.64	35.26	10.12
Q76XQ89	The likelihood of using the ICN for classroom instructional activities would add resources to my classroom (e. g., experts, materials) X the extent of desirability /undesirability of that outcome.	.59	37.30	9.56
Q81X94	The likelihood of using the ICN for classroom instructional activities would allow for the use of appropriate media materials X the extent of desirability /undesirability of that outcome.	.59	31.25	9.97
Q73XQ86	The likelihood of using the ICN for classroom instructional activities would enhance the quality of students' learning X the extent of desirability /undesirability of that outcome.	.56	30.93	10.65
Q74XQ87	The likelihood of using the ICN for classroom instructional activities would help me reach more students X the extent of desirability /undesirability of that outcome.	.41	34.19	9.45
Q80XQ93	The likelihood of using the ICN for classroom instructional activities would allow students to interact with each other without having to travel great distances X the extent of desirability /undesirability of that outcome.	.40	37.74	9.56

Table 6. Continued

Item #	Factors & items	Factor loading	Mean	SD
	Factor 5:			
	Strength of beliefs about the influence of important others			
Q65XQ71	Extent of agreement /disagreement with "parents of my students would be in favor of me using the ICN or classroom instructional activities" X extent of agreement /disagreement with "generally speaking, I want to do what parents think I should do."	.80	19.59	8.64
Q64XQ68	Extent of agreement /disagreement with "teachers in my school think I should use the ICN for classroom instructional activities" X extent of agreement /disagreement with "generally speaking, I want to do what teachers in my school think I should do."	.72	13.06	8.04
Q67XQ70	Extent of agreement /disagreement with "students would like me to use the ICN for classroom instructional activities" X extent of agreement /disagreement with "generally speaking, I want to do what students think I should do."	.67	19.61	9.30
Q66XQ69	Extent of agreement /disagreement with "administrators in my school think I should use the ICN for classroom instructional activities" X extent of agreement /disagreement with "generally speaking, I want to do what administrators in my school think I should do."	.63	19.76	8.52

Table 6. Continued

Item #	Factors & items	Factor loading	Mean	SD
	Factor 6:			
	Strength of beliefs about negative consequences of using the ICN			
Q78XQ91	The likelihood of using the ICN for classroom instructional activities would create lots of student discipline problems X the extent of desirability /undesirability of that outcome.	.79	10.20	5.84
Q79XQ92	The likelihood of using the ICN for classroom instructional activities would decrease one-on-one communication X the extent of desirability /undesirability of that outcome.	.73	11.88	6.40
Q82XQ95	The likelihood of using the ICN for classroom instructional activities would result in technical problems while teaching X the extent of desirability /undesirability of that outcome.	.66	11.98	6.75
Q75XQ88	The likelihood of using the ICN for classroom instructional activities would make student-teacher interaction impersonal X the extent of desirability /undesirability of that outcome.	.48	11.75	6.82
	Factor 7:			
	Attitude toward the logistical constraints of the ICN			
Q46	The operation of the ICN is troublesome.	-.70	3.28	1.41
Q43	The ICN is poorly designed.	-.56	2.87	1.33
Q42	There are problems associated with the operation of the ICN (e.g., scheduling, etc.).	-.49	5.33	1.23

As shown in Table 6, seven factors emerged as a result of the factor analysis. The total amount of variance accounted by the seven factors was 55.2%. Factor three and factor five reflected the latent variables of habit and normative outcomes. These two latent variables were both unidimensional. In the case of the latent variables "attitude toward the ICN" and "utilitarian outcomes," two factors emerged for each of them. The researcher was able to interpret the emerged new factors and to assign meaning to them. The scales that reflect the latent variables "attitude toward using the ICN for classroom instructional activities" and "self-identity outcomes" constituted one factor.

Based on the results of the factor analysis, a modified research model was developed by the researcher (Figure 4). The model latent variables were: habit of using innovative technologies, attitude toward the educational promise of the ICN, attitude toward the logistical constraints of the ICN, strength of beliefs about positive consequences of using the ICN, strength of beliefs about negative consequences of using the ICN, strength of beliefs about the influence of important others, attitude toward using the ICN for classroom instructional technology, and likelihood of using the ICN, if it were available.

Reliability

Four methods can be used to assess the reliability of empirical measurements: (1) the retest method, (2) the alternative form method, (3) the split-halves method, and (4) the internal consistency method (Nunnally, 1967). Of these, the first three have major limitations, such as requiring two independent administrations of the instrument on the same group of people or requiring two alternate forms of the measuring instrument. In contrast, the internal consistency method works quite

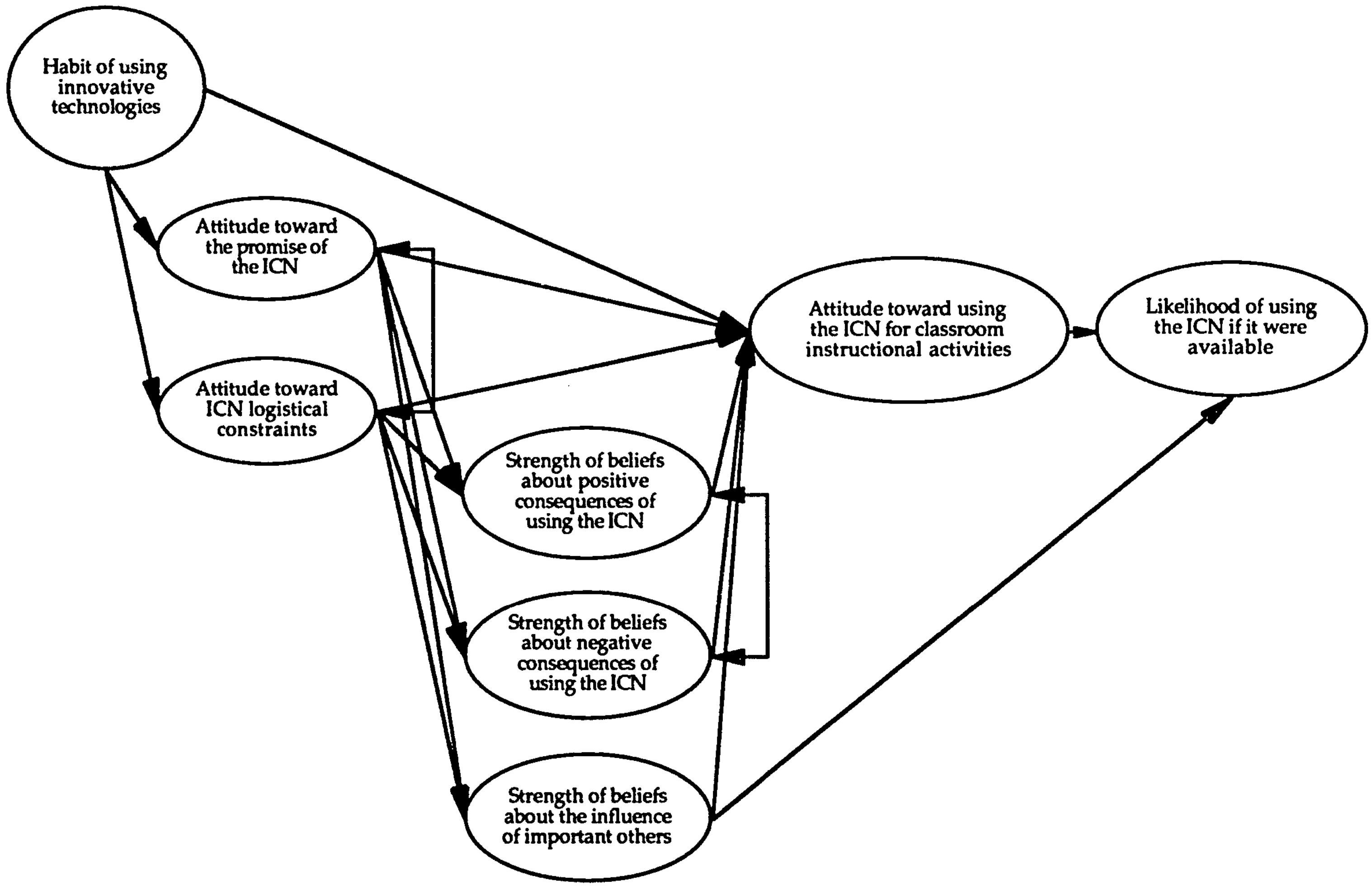


Figure 4. Modified research model

well in field studies because it requires only one administration. It is also the most general form of reliability estimate, and is concerned with the homogeneity of the items compromising a scale. A strong correlation among the items may imply strong links between the items and the latent variable. Hence, this method was chosen for this study.

The internal consistency of a set of scale items refers to the degree to which the items in the scale are homogeneous. Internal consistency can be estimated using a reliability estimate such as Cronbach's alpha. Using the SPSS reliability program, an internal consistency analysis was performed separately for the items for each of the factors that emerged from the factor analysis.

Table 7 shows the standardized Cronbach's alpha coefficients for the seven factors. Typically, a reliability coefficient of 0.70 or more is considered adequate to study group differences (Cronbach, 1951; Nunnally, 1967).

In order to better understand the nature of the data used in model testing, descriptive statistics were calculated. An index of the total score divided by the number of questions in each scale was computed. Means, standard deviations, and

Table 7. Reliability estimates for the scales.

Scales	# of items in scale	Cronbach's alpha	n
Attitude toward using the ICN for classroom instruction	7 items	0.90	316
Attitude toward the educational promise of the ICN	5 items	0.81	319
Strength of beliefs about positive consequences of using ICN	6 items	0.86	304
Habit of using innovative technologies	4 item	0.80	320
Strength of beliefs about the influence of important others	4 items	0.83	305
Strength of beliefs about negative consequences of using ICN	4 items	0.78	308
Attitude toward the ICN logistical constraints	3 items	0.65	319

scale ranges are shown in Table 8. The means of the "habit," "attitude toward the educational promise of the ICN," "attitude toward using the ICN for classroom instructional activities," "strength of beliefs about positive consequences of using the ICN," "strength of beliefs about the influence of important others" and the "likelihood of using the ICN for classroom instructional activities if it were available" were high. This indicates that on the average teachers were in the habit of using innovative technologies and that they possessed strong positive perceptions about several factors associated with the ICN: its educational promise, its use for classroom instructional activities, the positive consequences of using it, and the influence of important others on their behavior. The data also indicated a general likelihood of deciding to use the ICN for classroom instructional activities if it were available.

On the other hand, means for "attitude toward the logistical constraints of the ICN," and "strength of beliefs about negative consequences of using the ICN" were low. This suggest that teachers on the average did not have strong beliefs about the logistical constraints of the ICN or the negative consequences that might be anticipated to follow from the use of the ICN.

Table 8. Means, standard deviations and scales ranges (n = 311)

Scales	Mean	SD	Scale range
1. Habit of using innovative technologies	5.4775	0.9835	1-7
2. Attitude toward the educational promise of the ICN	5.7672	0.8087	1-7
3. Attitude toward the ICN logistical constraints	3.8135	1.0090	1-7
4. Strength of beliefs about positive consequences of using ICN	34.4574	7.6080	1-49
5. Strength of beliefs about negative consequences of using ICN	11.5271	5.1818	1-49
6. Strength of beliefs about the influence of important others	17.9118	7.0868	1-49
7. Attitude toward using the ICN for instruction	5.3467	0.9585	1-7
8. Likelihood of using the ICN, if it were available	5.1961	1.6471	1-7

A correlation matrix was obtained between the following scales: habit of using innovative technologies, attitude toward the educational promise of the ICN, attitude toward the logistical constraints of the ICN, strength of beliefs about positive consequences of using the ICN, strength of beliefs about negative consequences of using the ICN, strength of beliefs about the influence of important others, attitude toward using ICN for classroom instructional activities, and likelihood of using the ICN for classroom instructional activities if it were available (Table 9).

As shown in Table 9, the magnitude of the correlation coefficients ranged between zero and 0.67. Some of the correlation coefficients were positive, others were negative. Correlations were computed using the listwise deletion procedure to exclude any case that has a missing value on any of the variables. A total of 311 cases were included in the computation of the correlation matrix.

As expected, several of the correlation coefficients between the latent variables were significant and positive. Teachers' attitude toward using the ICN for classroom instructional activities were correlated positively and moderately with (1) teachers' attitude toward the educational promise of the ICN, (2) teachers' habits of using innovative technologies for classroom instructional activities, (3) strength of teachers' beliefs about positive consequences of using the ICN, and (4) teachers' likelihood of using the ICN for classroom instructional activities if it were available.

Teachers' attitude towards the logistical constraints of the ICN and strength of their beliefs about negative consequences of using the ICN were correlated negatively with teachers' attitude toward using the ICN for classroom instructional activities. Moreover, teachers' likelihood of using the ICN, if it were available, was correlated negatively with their attitude toward the logistical constraints of the ICN.

Table 9. Correlations between the scales (N=311)

Scales	1	2	3	4	5	6	7	8
1. Habit of using innovative technologies	1.00							
2. Attitude toward the educational promise of the ICN	.3130**	1.00						
3. Attitude toward the ICN logistical constraints	-.1622**	-.3976**	1.00					
4. Strength of beliefs about positive consequences of ICN	.3402**	.6490**	-.3559**	1.00				
5. Strength of beliefs about negative consequences of ICN	-.0381	-.0984	.1197*	-.2790**	1.00			
6. Strength of beliefs about influence of important others	.2646**	.2920**	-.2975**	.3307**	-.0035	1.00		
7. Attitude toward using the ICN for classroom activities	.5129**	.6183**	-.3626**	.6660**	-.1313*	.4090**	1.00	
8. Likelihood of using the ICN if it were available	.3019**	.3492**	-.2173**	.4873**	-.0739	.3303**	.5779**	1.0

* Correlations statistically significant at .05 level.
** Correlations statistically significant at .01 level.

Evaluating the research model

The initial step in using LISREL is to establish the various components to be included in the model and linkages among them. The research model is primarily theory driven. The model to be tested for this study was developed after the preliminary analyses (Figure 4). As can be seen, it is a modification of the general research model illustrated in Figure 3.

The major changes were: (1) splitting the latent variable of attitude toward the ICN into two components: attitude toward the educational promise of the ICN, and attitude toward the logistical constraints of the ICN; (2) splitting the latent variable of "strength of beliefs about the consequences of using the ICN" into "strength of beliefs about positive consequences of using the ICN" and "strength of beliefs about negative consequences of using the ICN;" (3) combining the two latent variables of attitude toward using the ICN for classroom instructional activities and self-identity outcomes together in one latent variable; (4) correlating the errors of four latent variables. One path is between the errors for the latent variables attitude toward the educational promise of the ICN and attitude toward the logistical constraints of the ICN; another path is between the errors for the latent variables strength of beliefs about positive and negative consequences of using the ICN.

The model to be tested (Figure 4) depicts that teachers' habit of using innovative technologies, attitude toward the educational promise of the ICN, attitude toward the logistical constraints of the ICN, strength of beliefs about positive consequences of using the ICN, strength of beliefs about negative consequences of using the ICN, and strength of beliefs about the influence of important others indirectly influence their likelihood of using the ICN if it were available. Moreover, the research model depicts that strength of beliefs about the influence of important others and attitude toward the using the ICN for classroom instructional activities directly influence teachers' likelihood of using the ICN if it were available.

There is one exogenous latent variable (habit) in this study, and there are seven endogenous latent variables: attitude toward the educational promise of the ICN, attitude toward the logistical constraints of the ICN, strength of beliefs about positive consequences of using the ICN, strength of beliefs about negative consequences of using the ICN, strength of beliefs about the influence of important others, attitude toward using the ICN for classroom instructional activities, and the likelihood of using the ICN if it were available.

The model includes explicit allowance for the differential precision of measurement of the concepts based on the Cronbach alphas described in Table 7. This allows the structural parameters, which are of primary interest, to reflect best estimates of the true effects unconfounded by random measurement error. The error was computed by subtracting the reliability estimates from 1 for each of the following subscales: attitude toward the educational promise of the ICN, attitude toward the logistical constraints of the ICN, strength of beliefs about positive consequences of using the ICN, strength of beliefs about negative consequences of using the ICN, strength of beliefs about the influence of important others, attitude toward using ICN for classroom instructional activities, and incorporating the error in the LISREL program.

Testing the Null Hypotheses

Several null hypotheses were tested in this study. The hypotheses were rewritten to match the modifications that has been added to the model.

Standardized estimates for the paths of the structural model are contained in Table 10. Direct and indirect effects are shown in Table 11. Examination of the parameters estimates, standard errors and t-values for each path was conducted to test the following null hypotheses. Figure 5 shows the significant and non significant paths.

Null hypothesis one

Teachers' likelihood of using the ICN for classroom instructional activities, if it were available, was not affected directly by their attitude toward using the ICN and the strength of their beliefs about the influence of important others .

An examination of this hypothesis suggests that teachers' likelihood of using the ICN, if it were available, was influenced directly and significantly by their attitude toward using the ICN for classroom instructional activities, but not by strength of their beliefs about the influence of important other.

Null hypothesis two

Teachers' attitude toward using the ICN for classroom instructional activities was not affected directly by their habit of using innovative technologies, their attitude toward the educational promise of the ICN, their attitude toward the logistical constraints of the ICN, the strength of their beliefs about positive consequences of using the ICN, the strength of their beliefs about negative consequences of using the ICN, the strength of their beliefs about the influence of important others.

An examination of this hypothesis suggests that teachers' attitude toward using the ICN for classroom instructional activities was influenced significantly and

Table 10. Estimates of the structural model.

Parameters	Standardized estimates	Standard error	t-value
β 3 1 [positive consequences & attitude promise]	.748***	.073	10.684
β 4 1 [negative consequences & attitude promise]	-.048	.094	-0.506
β 5 1 [influence of important others & attitude promise]	.249**	.086	2.930
β 3 2 [positive consequences & attitude logistical]	-.080	.087	-1.055
β 4 2 [negative consequence & attitude logistical]	.132	.114	1.271
β 5 2 [important others & attitude logistical]	-.271**	.107	-2.860
β 6 1 [attitude toward using ICN & attitude promise]	.231*	.109	2.224
β 6 2 [attitude toward using ICN & attitude logistical]	-.040	.076	-0.614
β 6 3 [attitude toward using ICN & positive consequences]	.433***	.099	4.445
β 6 4 [attitude toward using ICN & negative consequences]	.038	.055	0.729
β 6 5 [attitude toward using ICN & influence-important others]	.136**	.051	2.733
β 7 5 [likelihood of using ICN & influence of important others]	.091	.063	1.581
β 7 6 [likelihood of using ICN & attitude using ICN]	.565***	.059	10.192
γ 1 1 [attitude promise & habit]	.381***	.052	6.532
γ 2 1 [attitude logistical & habit]	-.225***	.056	-3.259
γ 6 1 [attitude using ICN & habit]	.263***	.040	6.237
ψ 1 1 [error - attitude toward educational promise]	.855***	.070	9.816
ψ 2 2 [error - attitude toward logistical constraints]	.950***	.078	7.934
ψ 3 3 [error - positive consequences]	.369***	.046	6.947
ψ 4 4 [error - negative consequences]]	.973***	.079	9.566
ψ 5 5 [error - influence of important others]]	.791***	.070	9.407
ψ 6 6 [error - attitude toward using the ICN]	.299***	.032	8.136
ψ 7 7 [error - likelihood of using the ICN if available]	.629***	.053	11.832
ψ 2 1 [error - attitude promise & attitude logistical]	-.458***	.055	-5.966
ψ 4 3 [error - positive & negative consequences]	-.238***	.044	-4.423

* $p < .05$
** $p < .01$
*** $p < .001$

Table 11. Direct and indirect effects of the model paths.

Latent Variables	Total effect	=	Direct effect	+	Indirect effect
Likelihood of using the ICN if it were available					
Attitude toward using ICN for classroom instructional activities	0.598***	=	0.598***	+	0.000
Strength of beliefs about the influence of important others	0.184**	=	0.100	+	0.084**
Attitude toward using the ICN for classroom instructional activities					
Habit of using innovative technologies	0.480***	=	0.248***	+	0.232***
Attitude toward the promise of the ICN	0.615***	=	0.242*	+	0.373***
Attitude toward ICN logistical constraints	-0.124	=	-0.047	+	-0.077
Strength of beliefs about positive consequences	0.438***	=	0.438***	+	0.000
Strength of beliefs about negative consequences	0.040	=	0.040	+	0.000
Strength of beliefs about the influence of important others	0.140**	=	0.140**	+	0.000
Strength of beliefs about the influence of important others					
Attitude toward the promise of the ICN	0.253**	=	0.253**	+	0.000
Attitude toward the ICN logistical constraints	-0.307**	=	-0.307**	+	0.000
Strength of beliefs about negative consequences of using the ICN					
Attitude toward the promise of the ICN	-0.092	=	-0.092	+	0.000
Attitude toward the ICN logistical constraints	0.145	=	0.145	+	0.000
Strength of beliefs about positive consequences of using the ICN					
Attitude toward the promise of the ICN	0.775***	=	0.775***	+	0.000
Attitude toward the ICN logistical constraints	-0.047	=	0.047	+	0.000
Attitude toward the ICN logistical constraints					
Habit	-0.181**	=	-0.181**	+	0.000
Attitude toward the educational promise of the ICN					
Habit	0.341***	=	0.341***	+	0.000

* $p < .05$
** $p < .01$
*** $p < .001$

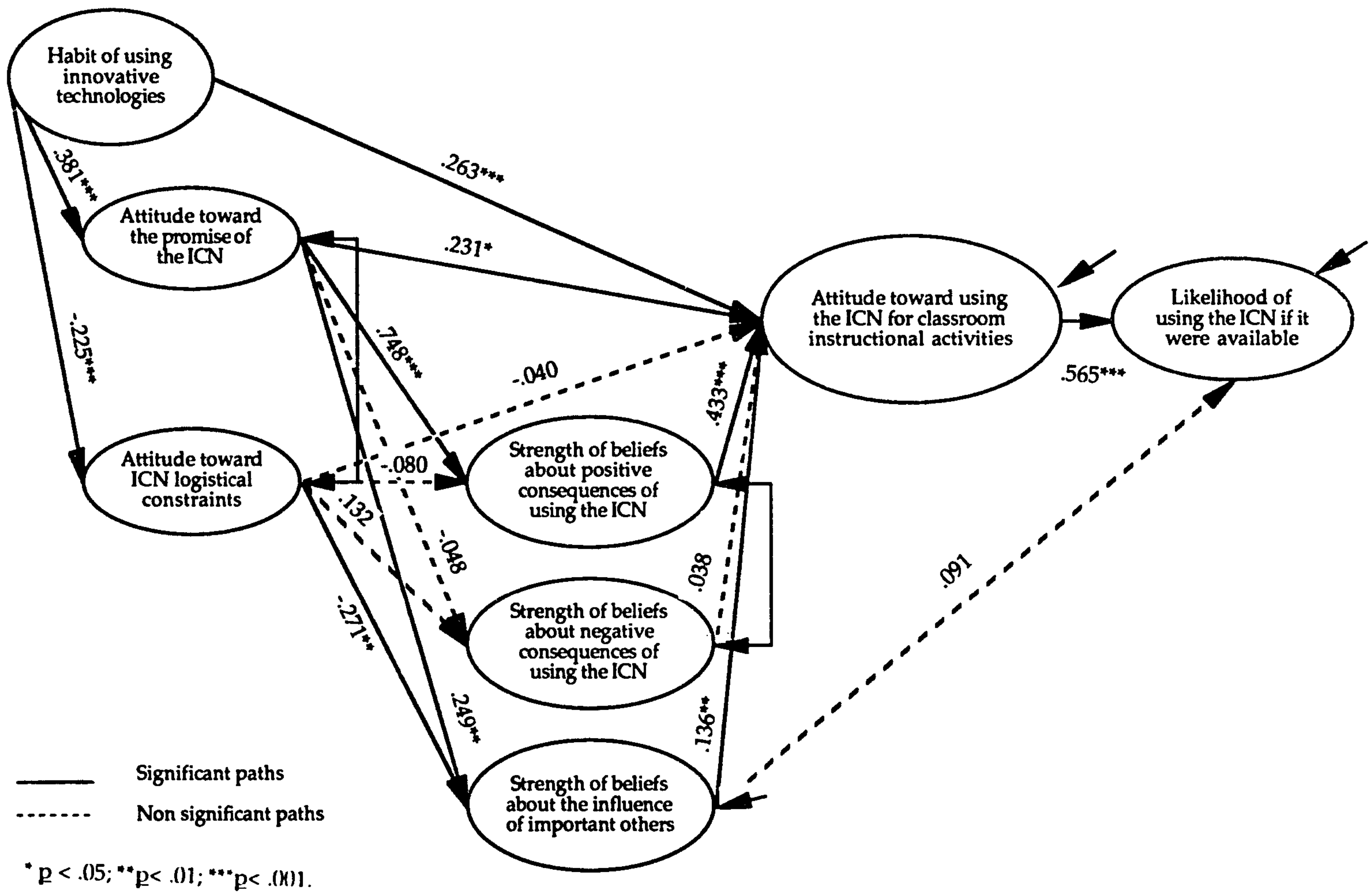


Figure 5. Significant and non significant paths

directly by their habit of using innovative technology, their attitude toward the educational promise of the ICN, the strength of their beliefs about positive consequences of using the ICN, and the strength of their beliefs about the influence of important others. It was not influenced by teachers' attitude toward the ICN's logistical constraints or by the strength of their beliefs about negative consequences of using the ICN.

Null hypothesis three

The strength of teachers' beliefs about the influence of important others was not affected directly by their attitude toward the educational promise of the ICN and their attitude toward the logistical constraints of the ICN.

Both teachers' attitude toward the educational promise of the ICN and their attitude toward the logistical constraints of the ICN had significant direct effects on the strength of teachers' beliefs about the influence of important others. Teachers with more positive attitude toward the educational promise of the ICN were more likely to have strong beliefs about the influence of the opinions of important others. Teachers who more strongly agreed that there were the logistical constraints in using the ICN were less likely to have strong beliefs about the influence of the opinions of important others. Thus, the null hypothesis was rejected.

Null hypothesis four

The strength of teachers' beliefs about negative consequences of using the ICN was not affected directly by their attitude toward the educational promise of ICN and their attitude toward the logistical constraints of the ICN.

Neither teachers' attitude toward the educational promise of the ICN nor their attitude toward the logistical constraints of the ICN had a direct effect on the strength of their beliefs about negative consequences of using the ICN. Therefore, the null hypothesis was not rejected.

Null hypothesis five

The strength of teachers' beliefs about positive consequences of using the ICN was not affected directly by their attitude toward the educational promise of the ICN and their attitude toward the logistical constraints of the ICN .

The more likely teachers were to have positive attitude about the educational promise of the ICN, the more likely they develop strong beliefs about positive consequences of using the ICN. On the other hand, their attitude about the logistical constraints of the ICN was not related to their expectation of using the ICN.

Null hypothesis six

Teachers' attitude toward the logistical constraints of the ICN was not affected directly by their habit of using innovative technologies for classroom instructional activities.

Teachers' habit of using innovative technologies for classroom instructional activities significantly and directly influenced teachers' attitude about the ICN in relation to its logistical constraints. Teachers who had stronger habits regarding the use of innovative technologies, were less likely to have a negative attitude toward the logistical constraints of the ICN. The null hypothesis was rejected.

Null hypothesis seven

Teachers' attitude toward the educational promise of the ICN was not affected directly by their habit of using innovative technologies for classroom instructional activities.

Teachers' habit of using innovative technologies for classroom instructional activities significantly affected teachers' attitude toward the promise of the ICN. Therefore, the null hypothesis was rejected. Teachers who had stronger habits regarding the use of innovative technologies were more likely to have a positive attitude toward the educational promise of the ICN.

Testing the over all fit of the model

The next step in testing the model is to examine the overall indices of goodness of fit. Several of those indices were used in this study. These are: Chi-square with an associated p value, Chi-square divided by its degrees of freedom, GFI, AGFI, and RMR. Specialists in the field of structural equation modeling have recommended reporting the Chi-square estimate along with several of the other fit indices (Bollen, 1989; Bollen & Long, 1992). None of the many indices has been endorsed as the best index by the majority of researchers (Gerbing & Anderson, 1992). Researchers added that we should not ignore the fits of the components of the model such as the R-squares of equations, the magnitudes of the coefficient estimates, whether estimates are of the correct sign, and the existence of improper solutions for GFI and AGFI.

The Chi-square value was 27.24 with 10 degrees of freedom, p was 0.002. This showed a poor fit of the model. For a model to fit, a high p-value is desirable. However, since Chi-square is sensitive to the number of variables and to sample size, it is extremely unlikely that a large model with many subjects will fit according to the p-value. Dividing the Chi-square value by its degrees of freedom was used as an alternative measure for overall fit model. The recommended criterion for a good fit using this ratio varies widely from as high as five to as low as two or three. For this model, Chi-square /df was approximately 2.7, which indicates a reasonably good fit of the model to the data.

Other overall fit indices, such as the goodness-of-fit index (GFI) at 0.983 and the adjusted goodness-of-fit (AGFI) at 0.924, indicated a very good fit of the model. The root mean square residual (RMR) for the model was 0.033. The summary statistics for the standardized residuals showed no serious departure from normality. All the estimates were of a correct sign. Some of the magnitudes of the coefficient estimates were low; others were moderate. The coefficient of determination (R^2) for the whole model was 0.29.

The squared multiple correlations for the structural equations for attitude toward the educational promise of the ICN, attitude toward the logistical constraints of the ICN, strength of beliefs about positive consequences of using the ICN, strength of beliefs about negative consequences of using the ICN, strength of beliefs about the influence of important others, attitude toward using ICN for classroom instructional activities, and likelihood of using the ICN if it were available, were as follows: 0.15, 0.05, 0.63, 0.03, 0.21, 0.70, 0.37. It is clear that the R^2 for the constructs "attitude toward the logistical constraints of the ICN," and "strength of beliefs about negative consequences of using the ICN" were fairly small. This may indicate that the equations for those two constructs were not necessary, or that other variables exist that weren't included in the model.

Model comparisons

Usually, if the model fits the data, it does not mean it is the "best" model. There can be many equivalent models all of which will fit the data equally as well as judged by any of the goodness of fit measures. Researchers in the field have agreed that to conclude that the fitted model is the "best," one must assess the theoretical model in comparison with other nested models (Anderson & Gerbing, 1988; Bentler & Chou, 1987; Bollen, 1989; Bollen & Long, 1992; Hayduk, 1987; Kaplan, 1992; Jöreskog, 1992; Newcomb, 1990).

A common practice in structural equation modeling is to specify a set of nested comparisons, so that each model is tested against each previous model and the null model of complete independence among the observed variables. The null model is considered in this case as the baseline model.

Bentler & Bonett (1980) developed an index called norm fit index (NFI) to indicate the amount of information gained by moving from one nested model to another compared to the null model. This index is calculated by dividing the Chi-square difference between every two nested models by the Chi-square of value the null model.

Sobel & Bohrnstedt (1985) criticized this NFI index, arguing that the choice of the baseline model or the referent model should be based on the state of prior theoretical knowledge, not on the use of a null model that may be of little scientific interest. In this study several nested models (Table 12) were used to evaluate the fit of the modified research model using Chi-square difference, Bentler & Bonett's (1980) index and Sobel & Bohrnstedt's (1985) index.

As shown in Table 12, the null model was estimated first. The overall goodness of fit value of the model was X^2 =789.95 with 28 degrees of freedom. A

Table 12. Model comparisons

Model	X^2 (df)	ΔX^2 (df)	Bentler & Bonett	Sobel & Bohrnstedt
Null model	789.95 (28)			
Baseline model	142.25 (16)	647.70 (12)	.82	
Model 2	76.99 (14)	65.26 (2)	.08	.46
Model 3	75.08 (13)	1.91 (2)	.002	.01
Model 4	65.71 (12)	9.37 (1)	.01	.07
Model 5	63.45 (11)	2.26 (1)	.003	.02
Theoretical model	27.24 (10)	36.21 (1)	.05	.25
Suggested model	35.77 (16)	8.53 (6)	.01	.06
			PRE = .98	PRE = .87

baseline model was estimated next by hypothesizing some relations between the research constructs (Figure 6). The baseline model was modified by correlating the errors of the latent variables attitude toward the educational promise of the ICN, and attitude toward the logistical constraints of the ICN; another path was added between the errors for the latent variables "strength of beliefs about positive consequences of using the ICN" and "strength of beliefs about negative consequences of using the ICN" (Figure 7). The change in Chi-square was large and significant. Then, this model was modified by adding one path between attitude toward the logistical constraints of the ICN and attitude toward using the ICN for classroom instructional activities (Figure 8). The Chi-square change was not significant.

Next the model was modified by adding another path between attitude toward the educational promise of the ICN and attitude toward using the ICN for classroom instructional activities (Figure 9). The Chi-square change was significant. An additional path was added between strength of beliefs about the influence of important others and likelihood of using the ICN if it were available (Figure 10).

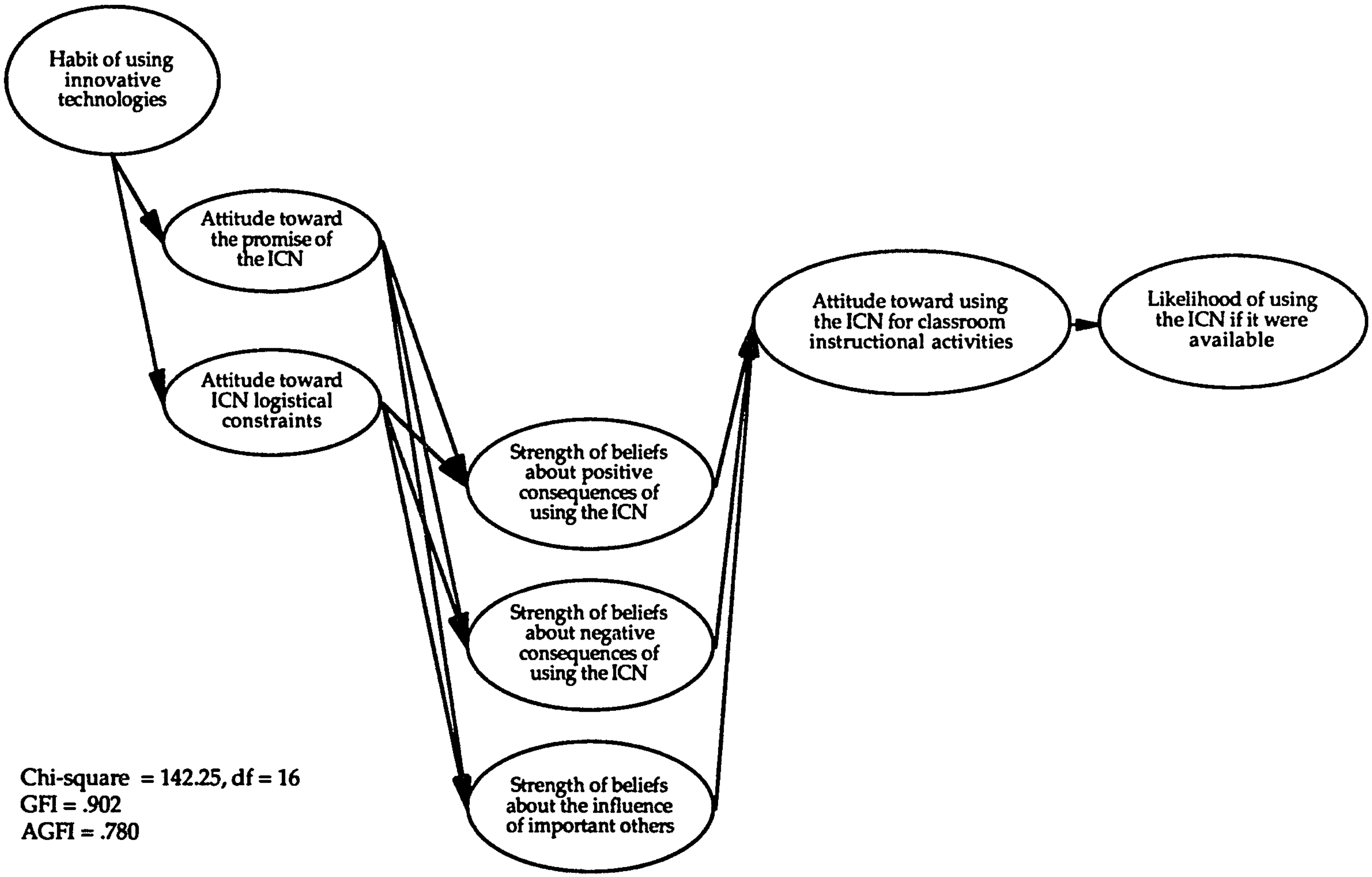
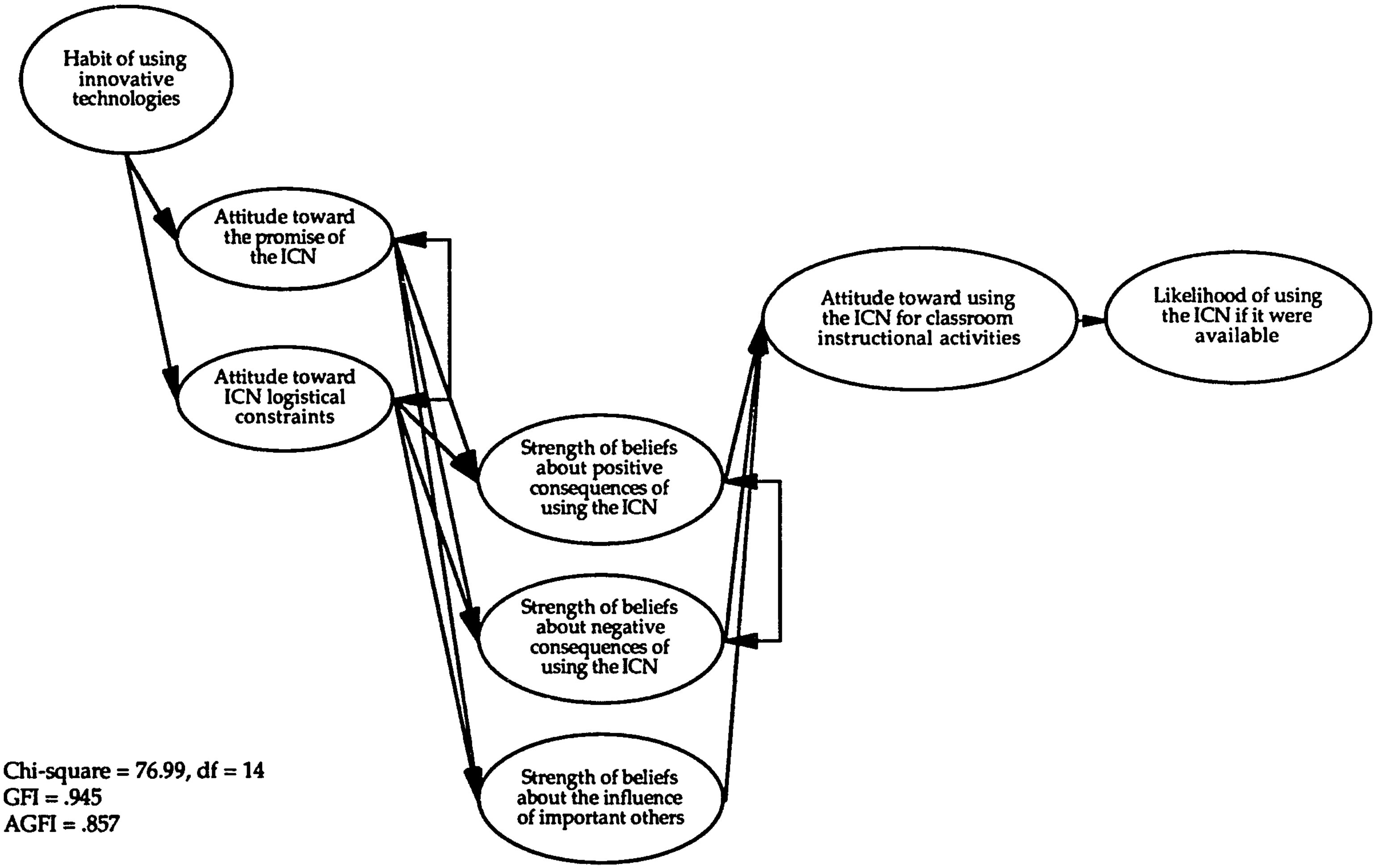


Figure 6. Baseline model



Chi-square = 76.99, df = 14
GFI = .945
AGFI = .857

Figure 7. Model 2

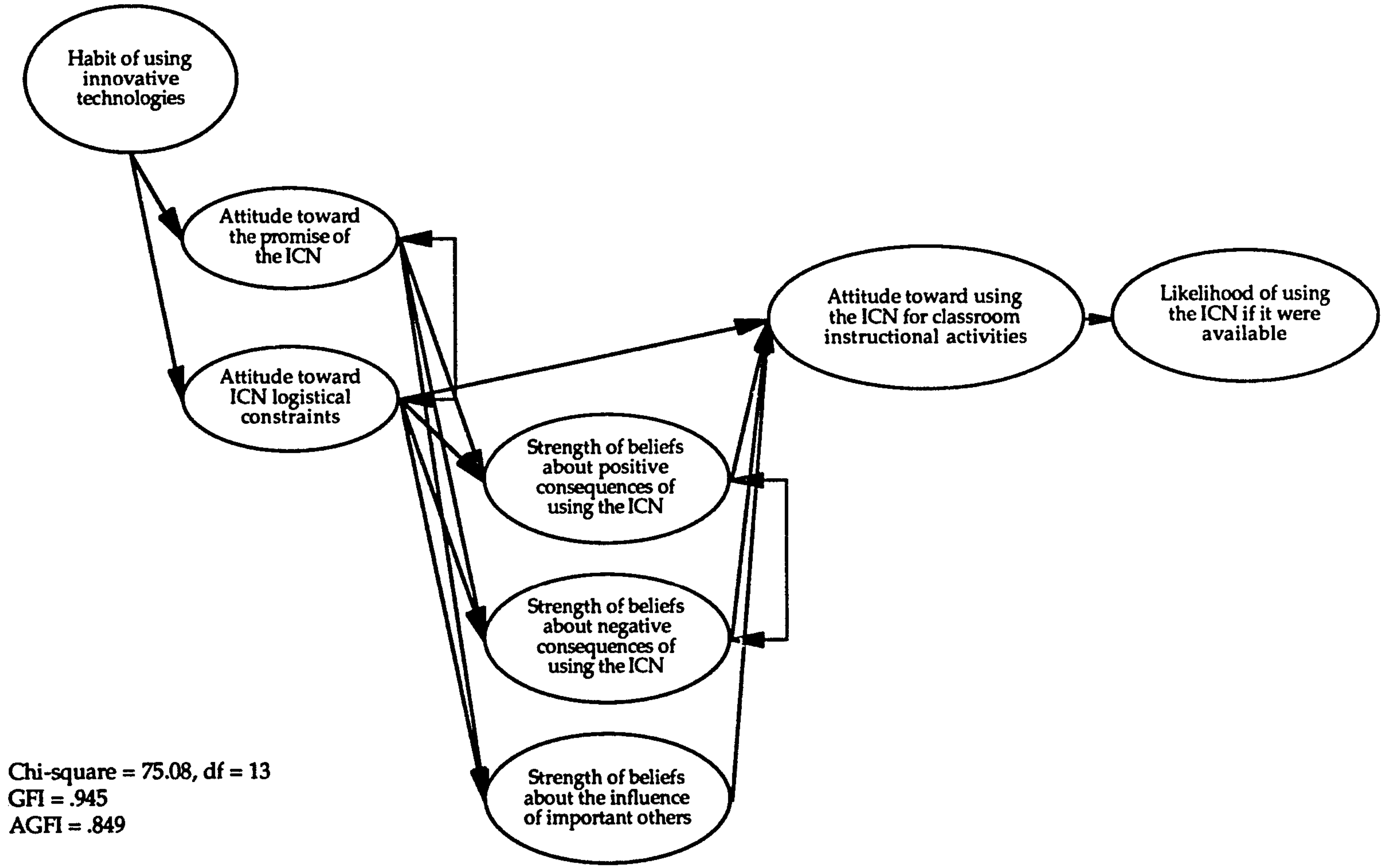


Figure 8. Model 3

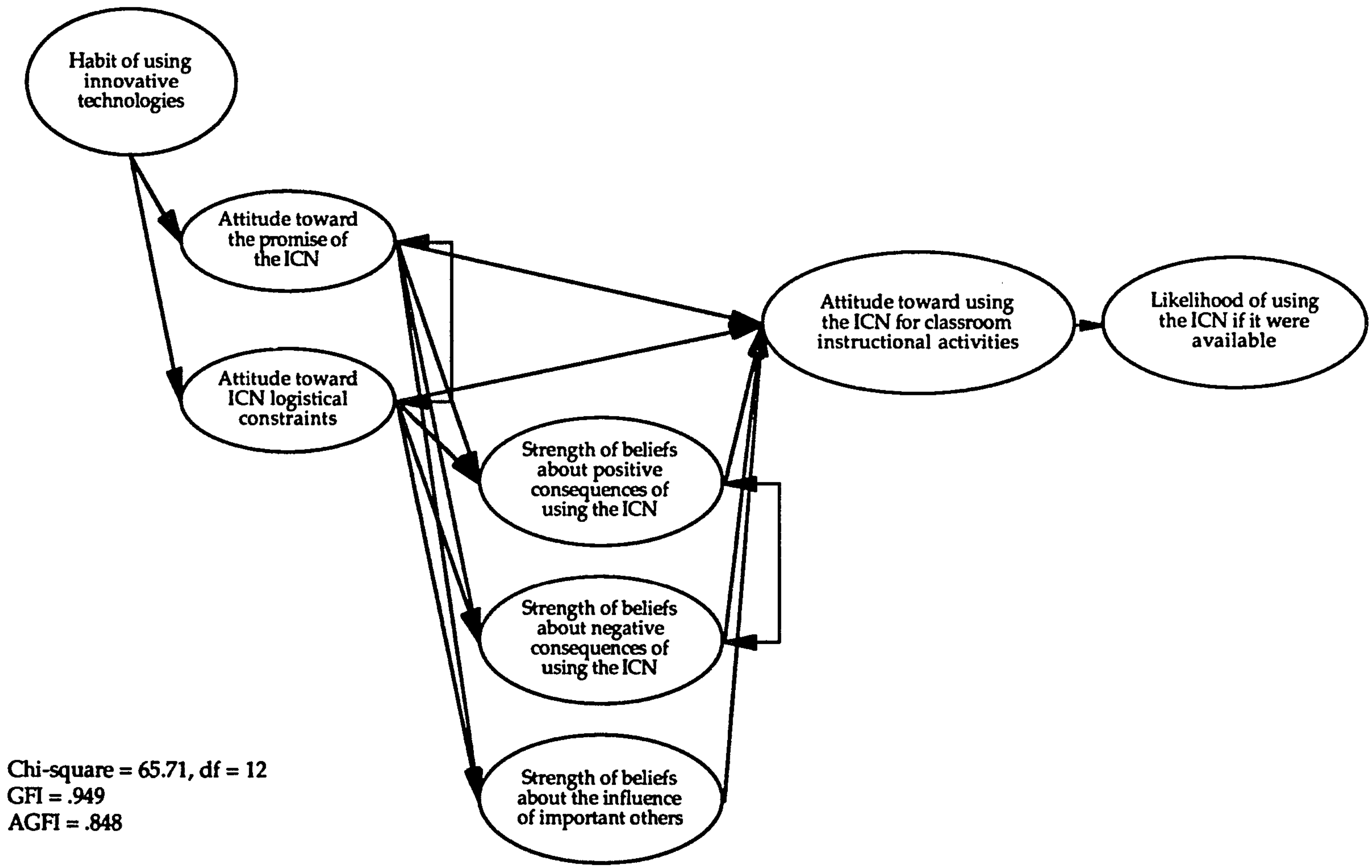


Figure 9. Model 4

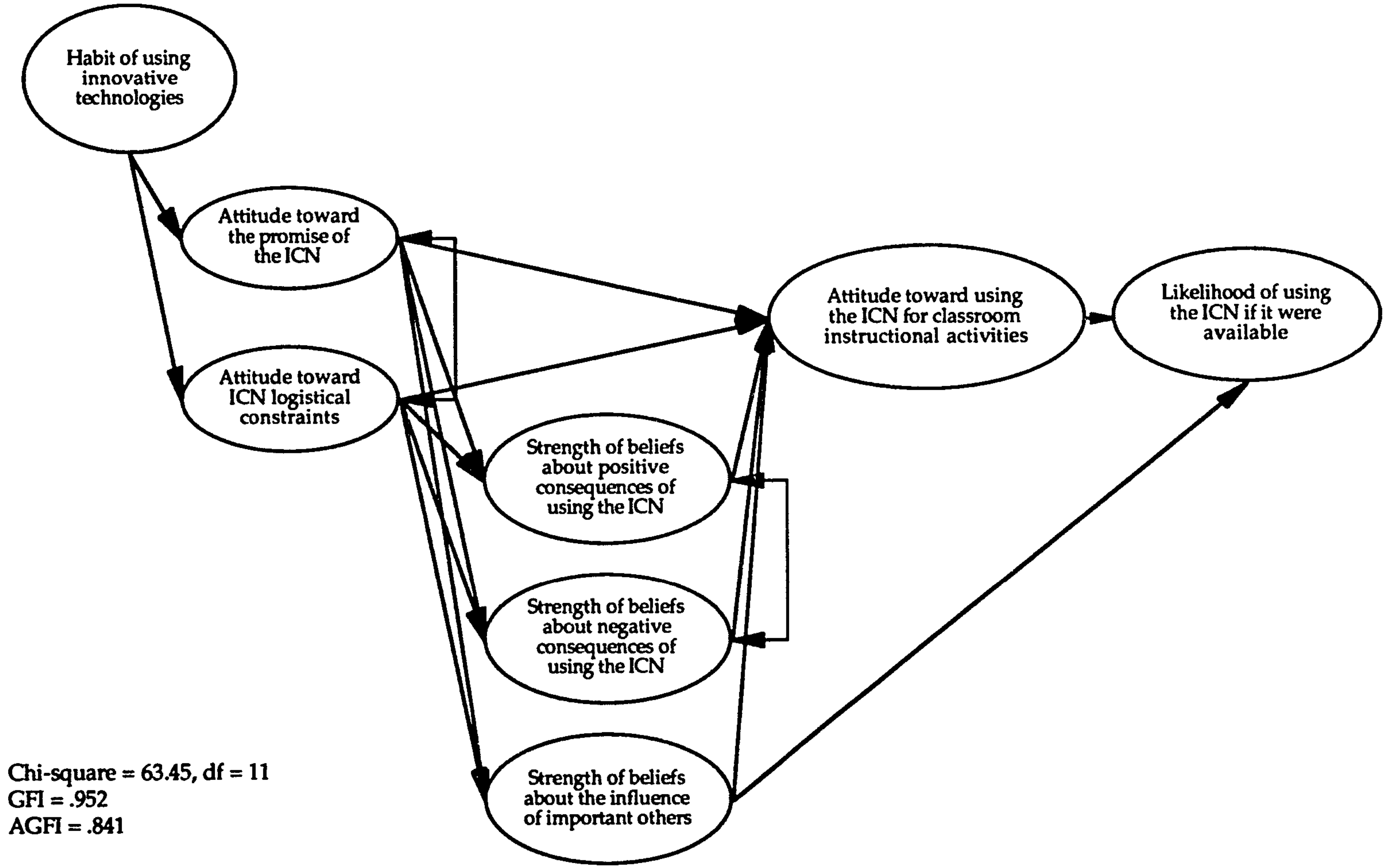


Figure 10. Model 5

The Chi-square change was not significant. In the next model, which is the theoretically interesting model, one last path was added between habit of using innovative technologies and attitude toward using the ICN for classroom instructional activities (Figure 11). The change in Chi-square was large and significant.

Finally, as shown in Figure 12, a suggested model with fewer paths was estimated. It is a typical procedure to remove non significant parameter estimates from a model for obtaining the most parsimonious model possible. The Chi-square change was not significant. Another possible suggested model could be a model without the two constructs "attitude toward the logistical constraints of the ICN" and" "strength of beliefs about negative consequences of using the ICN".

As shown in Table 12, Bentler & Bonett's (1980) index shows that there is 98% improvement by considering the suggested model over the null model. For example, the Proportion Reduction in Error (PRE) between the baseline model and the null model was (789.95-142.25)/(789.95) = .82. This index indicates that there was 82% improvement by having the baseline model over the null model.

Using the Sobel & Bohrnstedt's index, it is clear that there is 87% improvement by considering the suggested model over the baseline model. The comparison between the nested models was conducted in relation to the baseline model instead of the null model. For example, the PRE between the baseline model and model 2 was (142.25-76.99)/(142.25)= .46. This index indicates that there is 46% improvement by having model 2 over the baseline model.

In general, the research model was supported by the LISREL analysis. Goodness of fit indices and model comparisons indicated that the data reasonably fit the model. Since the plot of the standardized residuals showed no serious departure from normality, it is reasonable to accept that the parameters have been estimated accurately. The effects were all in the right direction. The theoretical model was compared to other nested models and was accepted as the "best" model.

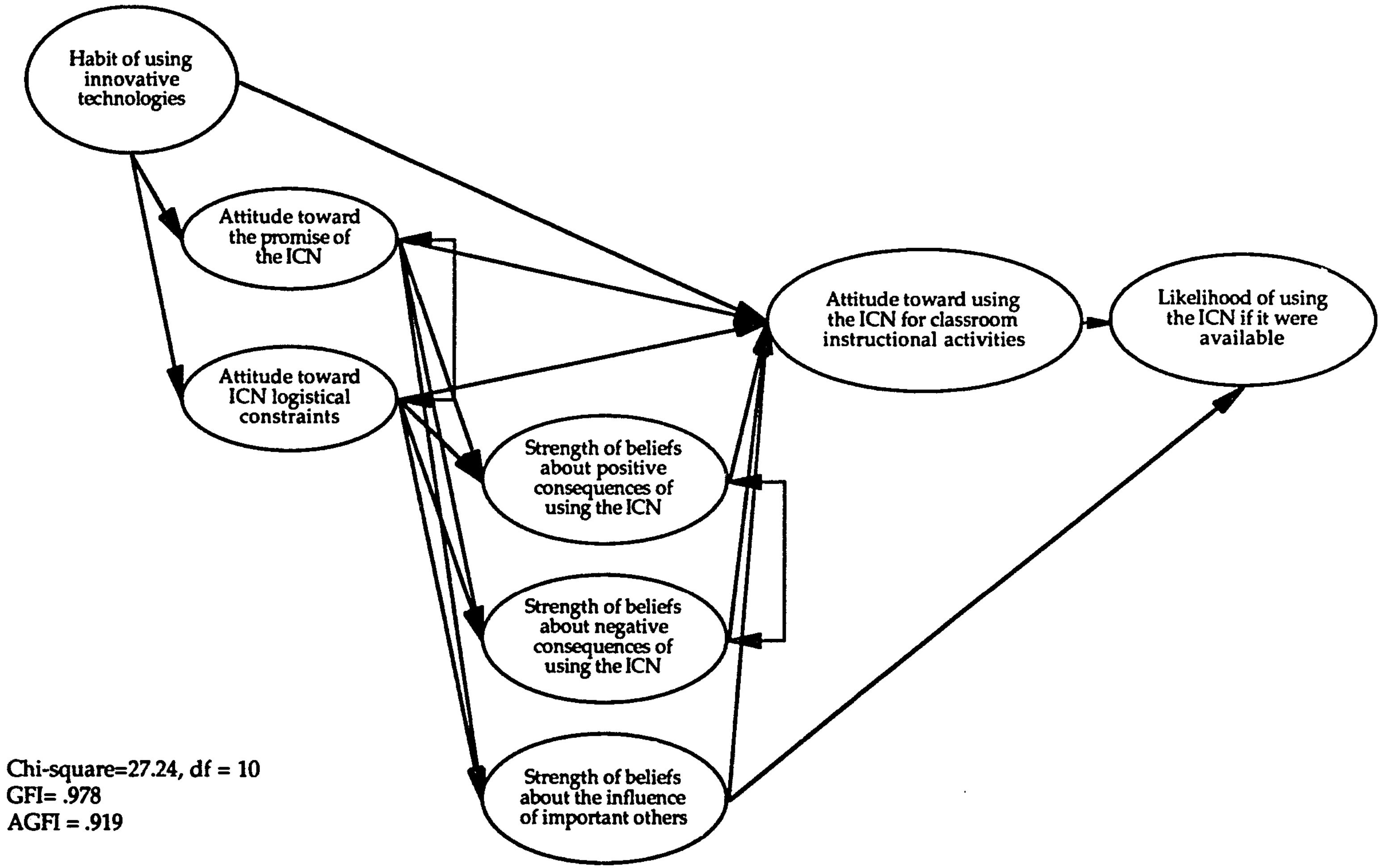
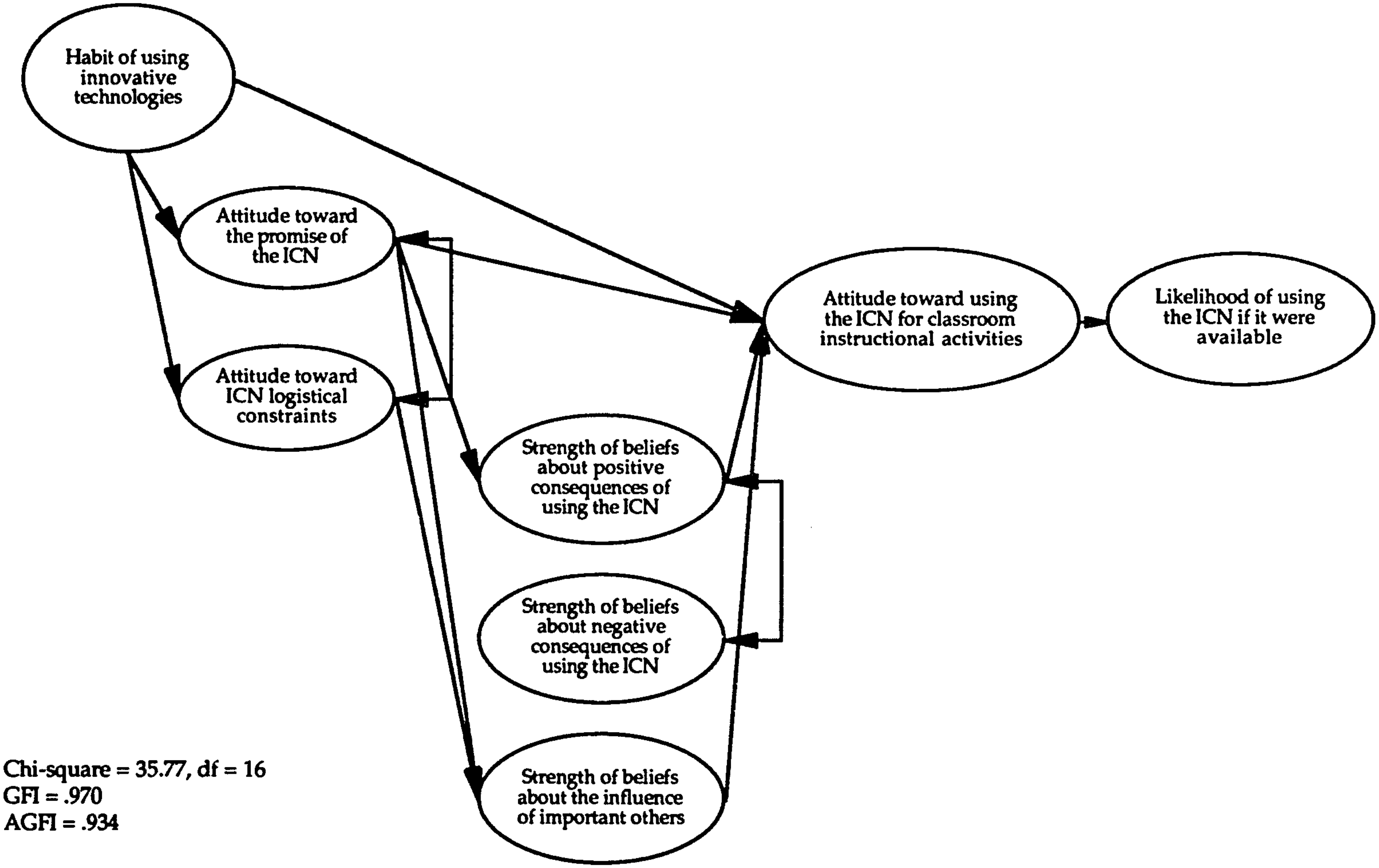


Figure 11. Theoretically interesting model



Chi-square = 35.77, df = 16
GFI = .970
AGFI = .934

Figure 12. Suggested model

CHAPTER V. DISCUSSION AND CONCLUSIONS

Today, there is growing interest in promoting the use of recently developed telecommunications in K-12 settings. Although inservice training in distance education technologies provides an environment that facilitates the adoption process (Moore & Thompson, 1989; U. S. Congress, 1989), many teachers who complete inservice may learn about the technology but not regard it as relevant to their situation. Consequently, they may fail to adopt it. Several personal factors may influence their likelihood of using it, but research is needed to identify those variables that are most influential.

The purpose of this study was to delineate some of the factors that influence teachers' likelihood of using the ICN following inservice training in distance education. Teachers' likelihood of using the ICN for classroom instructional activities was measured conditional to the availability of the ICN. A theory-driven research model was proposed. The research model identified the theoretical relationships among teachers' habit of using innovative technologies, their general attitude toward the ICN, the strength of their beliefs that using the ICN will be associated with certain consequences [utilitarian outcomes], the strength of the perceived influence of important others [normative outcomes], perceptions of self-affirmations that are anticipated to follow from using the ICN [self-identity outcomes], teachers' attitude toward using the ICN for classroom instructional activities, and their likelihood of using the ICN if it were available.

A preliminary analysis was conducted to see if there were significant differences based on demographic variables in relation to teachers' likelihood of using the ICN if it were available. The results showed that there were only two significant differences. One difference was among those who taught at the elementary, middle and high school level. Those who were in the elementary and middle level were more likely to use the ICN if it were available. The other significant difference was between those who had the ICN at their school building and those who did not have it. Those who did not have the ICN at their school building were more likely to intend to use it if it were available. This finding may be due to the fact that those who had immediate access to the ICN in their building may have been more cautious in their predictions than teachers who actually did not have an opportunity to use it. Examining the two demographic variables, it was found that those teachers who did not have the ICN at their school building were primarily elementary or middle school teachers. Thus the two significant demographic variables were not independent.

The model

The proposed research model was modified based on preliminary factor analysis. Teachers' attitudes toward the ICN were divided into two components: (1) teachers' attitudes toward the educational promise of the ICN, and (2) teachers' attitudes towards the logistical constraints of the ICN. Moreover, the utilitarian outcomes construct was divided into two parts: (1) strength of beliefs about positive consequences of using the ICN, such as anticipating that the use of the ICN for classroom instructional activities would add resources to classroom, and (2) strength of beliefs about negative consequences of using the ICN, such as anticipating that the use of the ICN for classroom instructional activities would result in technical problems while teaching.

The construct of self-identity was combined with the construct of attitude toward using the ICN for classroom instructional activities because both loaded on the same factor. This was an unexpected finding, one which has not been found in studies with blood donors (Charng, Piliavin, & Callero, 1988) or with college students (Biddle, Bank, & Slavings, 1987). Compared to the samples, teachers are professional people. Therefore, as professionals in their fields, their self-identity may be related to their judgments of whether to use technology for classroom instructional activities. Teachers who use innovative technologies for classroom instructional activities may experience a new role identity. This new role-identity may influence what they think of themselves as technology educators and accordingly influence their judgments of the use of any educational technology.

The loading of the two constructs on one factor also could be a result of a measurement problem. It is possible that the items in these scales did not sufficiently measure the unique aspects of each construct. For example, item 61 "For me, using the ICN for classroom instructional activities would be beneficial," may refer to aspects of both self-identity and attitude toward using the ICN for classroom instructional activities, rather than to the latter alone.

Although the research model was modified, support was found for parts of the composite model of the attitude-behavior relation that was suggested by Eagly & Chaiken (1993). For example, in this study of the adoption of distance education technology, attitude toward using the ICN was found to be influenced by teachers' habit of using innovative technologies and the strength of their beliefs about the influence of important others on their use of the ICN. Teachers' likelihood of using the ICN, if it were available, was influenced by their attitude toward using the ICN for classroom instructional activities. These findings are similar to Eagly &

Chaiken's proposition that attitude toward engaging in a behavior is influenced by habit and normative outcomes. It is similar to the proposition that attitude toward engaging in the behavior influences intention.

On the other hand, support was not found for the direct relation between normative outcomes and intention. The strength of teachers' perceptions of the influence of important others and their likelihood of using the ICN, if it were available, were not related directly in this study. However, an indirect effect between normative outcomes and intention was supported. Teachers' likelihood of using the ICN, if it were available, was found to be influenced indirectly by the strength of their beliefs about the influence of important others.

Direct and indirect effects on the likelihood of using the ICN

As hypothesized, teachers' likelihood of using the ICN, if it were available, was influenced directly by their attitude towards using the ICN for classroom instructional activities. This result provides strong evidence that attitude toward using the ICN for classroom instructional activities is what predicts teachers' future use of the ICN after inservice training. This supports a study by Abou-Dagga & Herring (1994) in which teachers' attitude toward distance education technology was the main predictor of their adoption. Ajzen & Fishbein (1980) state that for some behaviors attitudinal considerations are more important in determining behavioral intentions than are normative considerations.

The strength of teachers' beliefs about the influence of important others on their use of the ICN had no direct effect on their adoption decisions. This indicates that teachers' intent to use the ICN for classroom instructional activities is affected primarily by their attitude toward using the ICN for classroom instruction, not by the opinions of important others (e.g. other teachers at the school, administrators, students and parents). Teachers' adoption of innovations is related to a large extent to what teachers' think themselves and how they judge the innovation. Fullan (1982) stated that "educational change depends on what teachers think and do -- it's as simple and as complex as that" (p. 107).

However there is an indirect effect of teachers' beliefs about the influence of important others on teachers' likelihood of adoption through the mediating factor "attitude toward the ICN for classroom instructional activities." Teachers with strong beliefs about the influence of the opinions of important others, are more likely than those with weaker beliefs, to have favorable attitudes toward using the ICN, and accordingly, they are more likely to use the ICN.

Direct and indirect effects on attitude toward using the ICN

Teachers' attitude toward using the ICN for classroom instructional activities was influenced by several direct and indirect predictors in this study. In fact, a large portion of the variance (70%) in teachers' attitude toward using the ICN classroom for instructional activities was explained by the direct and indirect effects of their habit of using innovative technologies for classroom instructional activities, their attitude toward the educational promise of the ICN, the strength of their beliefs about positive consequences of using the ICN, and the strength of their beliefs about the influence of important others.

Teachers' attitude toward the logistical constraints of the ICN and the strength of their beliefs about negative consequences of using the ICN had no influence on their attitude toward using the ICN for classroom instructional activities. This may be attributed to the fact that teachers who believe in the educational promise of the ICN and anticipate positive consequences of using the ICN will rationalize the negative aspects of the ICN in their minds and see only those that are positive. Rogers (1983) stated that individuals in general tend to expose themselves to ideas that are in accordance with their interests, needs or existing attitudes. People consciously or unconsciously avoid messages that are in conflict with their predispositions. Rogers called this "selective exposure" (p. 166).

The habit of using innovative technologies for classroom instructional activities also indirectly influenced teachers' attitude toward using the ICN. This is supported by the higher education literature in which faculty attitudes toward using technology tended to improve as their experience with distance education and educational technology increased (Clark, 1993; Glicher & Johnstone, 1989). Habit also was found to influence positively teachers' attitude toward the promise of the ICN, and to influence negatively teachers' attitude toward the logistical constraints of the ICN. The more teachers worked with technology for classroom instructional activities, the more they formed positive attitude about other educational technologies, and the less concerned they were about logistical technological problems.

Also, teachers' attitude toward the educational promise of the ICN influenced indirectly their attitude toward using the ICN for classroom instructional activities. Those who had strong beliefs about the educational promise of the ICN were more likely to have strong beliefs about the positive consequences of using the ICN and about the influence of important others; accordingly, they were more likely to form a positive attitude toward using the ICN for classroom instructional activities. In terms of predicting attitude toward using the ICN for classroom instructional activities, this indirect effect of attitude toward the educational promise of the ICN, was stronger ($\beta = .373$) than the direct effect of attitude toward the educational promise of the ICN ($\beta = .242$). This supports Eagly & Chaiken's (1993) proposition that attitude toward engaging in a behavior can be determined by a direct effect from attitude toward target or by the indirect effect of attitude toward target through the strength of beliefs about the anticipated outcomes of the behavior.

Implications

Technological innovations are not always diffused and adopted rapidly, even when the innovation has obvious and proven advantages (Rogers, 1983). Educators or staff developers need to encourage teachers to adopt innovations. To do that, they have to be aware of how the innovation is perceived, evaluated, and judged by teachers. Moreover, educators need to understand how the innovation is related to teachers' previous teaching experiences. Teachers' interpretation of what the innovation means to them influences not only what they do subsequently, but also how they do it (Fullan & Hargreaves, 1992).

The results of this study indicated that teachers' likelihood of using distance education technologies was promoted by their attitude toward using the technology and not by the strength of their beliefs about the influence of important others on their use of it. Therefore, distance educators should consider the attitudes of their attendees when they conduct any training. Teachers' favorable or unfavorable attitude toward the innovation means that they are mentally applying the innovation to their present or anticipated future situation before deciding whether or not to try. If they are unable to promote a favorable attitude toward using the technology, staff developers' attempts to persuade and encourage teachers to adopt the new technology may fail.

In this study, teachers' attitude toward using a distance education technology was determined by their habit of using innovative technologies, the strength of their beliefs about positive consequences of using the ICN, their perceptions about the promise of the technology, and the strength of beliefs about the influence of important others. They were not determined by teachers' perceptions of the logistical constraints of the ICN or by the strength of their beliefs about negative consequences of using the ICN.

This means that staff developers need to provide the opportunity for attendees to discuss their general perceptions about the promise of the technology, their perceptions about the benefits of the use of technology , and their perceptions of the opinions of parents, administrators, students and other teachers about classroom use of the technology, and their teaching habits at the beginning of the inservice training. This discussion will help staff developers expose teachers to information that may promote a positive attitude toward using the technology in instruction. Accordingly, teachers will be encouraged to try the new technology and think about incorporating it within their teaching activities. Fullan (1990) states that those involved in staff development must "think and act more holistically about the personal and professional lives of teachers as individuals" (p. 22).

Limitations

A limitation of this study is the use of self-report instruments to measure the research constructs. Results are accurate only to the degree that participants' self-perceptions are accurate and to the degree that they were willing to express them honestly.

Cautious interpretations of causality are warranted due to the cross-sectional nature of the data. To attribute cause and effect between two variables, three kinds of evidence are necessary: isolation, association between the two variables, and the direction of the relationship (Bollen, 1989). The third assumption was violated by the cross-sectional nature of the data collection procedure. In addition, structural equation modeling results assume that the causal direction flows as indicated by theory. The fact that the model is theoretically reasonable and fits well provides support for the model, but does not say that causality works as the model suggests. For example, in the model the strength of teachers' beliefs about the positive consequences of using the ICN was found to be influenced by their attitude toward the educational promise of the ICN. However, it is possible that teachers' attitude toward the educational promise of the ICN is influenced by the strength of their beliefs about positive consequences of using the ICN.

It would also be possible to make the case for reciprocal causation between the constructs of "attitude toward the educational promise of the ICN" and "strength of beliefs about positive consequences of using the ICN." The stronger teachers' anticipated beliefs about positive consequences of using the ICN, the more likely they may have a positive attitude toward the educational promise of the ICN. And in addition, as teachers develop more positive attitudes about the educational promise of the ICN, the stronger their beliefs about the anticipated positive consequences of using the ICN may become.

A final limitation of the study is the fact that the surveys were mailed only to those who attended the training. This is a limiting factor in two aspects. First, teachers who attended the training were not representative of Iowa teachers in that most (69%) were high school teachers who attended the training because they chose to do so. This limits the generalizability of the study. Second, findings of this study may not apply to those who didn't attend the training. For example, among teachers who have not had inservice training, strength of their beliefs about the negative consequences of using the ICN and their perceptions of the logistical constraints of the ICN might have an effect on their attitude toward using the ICN.

Future research and recommendations

The emerging of two dimensions for both the general attitude toward the ICN and utilitarian outcomes constructs was unexpected. Therefore, the findings of this study need to be validated by conducting further research using this research instrument or a modified research instrument with other samples.

The correlation between the construct self-identity and the construct attitude toward using the ICN for classroom instructional activities was unexpected also. It was attributed to the fact that teachers are professional people and their self identities may not be separate from their professional activities. Using the research instrument or another modified research instrument with samples of professional and unprofessional people in other fields will help in validating the results of this study.

More research is needed to explore the relationships that have been hypothesized in the model with other samples of teachers such as those who have not had the inservice in distance education.

Further research is needed to explore similar models with different causal structure. This will provide additional evidence and insights about the causal relationship of the model. Moreover, additional research should provide revisions and refinements to the developed model tested in this study.

According to the composite model of the attitude-behavior relation by Eagly & Chaiken (1993) several factors influence the behavior including habit, attitude toward engaging in the behavior and intention. Future research should focus on exploring the factors that might influence teachers' actual use of the innovation. This research focused on the attitude-intention relationship and not on the attitude-behavior relationship. Thus, the results that were found may not generalize to the prediction of teachers' actual adoption behavior.

Research in the educational field indicates that there are other external and personal factors, not addressed in this study, that might influence teachers' actual use of the technology. Some of the external factors include the availability of the technology, administrative and environmental support, the context in which teachers get the training, the context in which teachers work, and the culture of the teaching community within the school (Hargreaves, 1994; Sheingold, 1991). Some of the personal factors that may influence teachers' actual use of technology might be teachers' sense of purpose which drives what that the teacher does. It might be also what kind of persons the teachers are in their personal as well as professional lives (Fullan, 1990). Examining the effect of the these external and personal factors will contribute to the understanding of the adoption and implementation of technological innovations within the K-12 settings. It will also help in improving staff development programs to meet teachers' needs.

Summary

The research model was developed using existing models in the diffusion of innovation literature, as well as in the attitude-behavior literature. It was modified based on preliminary analyses. Seven factors emerged: teachers' habit of using innovative technologies, attitude toward the educational promise of the ICN, attitude towards the ICN's logistical constraints, strength of beliefs about positive consequences of using the ICN, strength of beliefs about negative consequences of using the ICN, strength of beliefs about the influence of important others, and attitude toward using the ICN for classroom instructional activities.

Although the research model was modified, support was found for parts of the composite model of the attitude-behavior relation that was suggested by Eagly & Chaiken (1993). Eagly & Chaiken's proposition that attitude toward engaging in the behavior is influenced directly by habit and normative outcomes was supported. Moreover, the proposition that attitude toward engaging in the behavior influences intention was supported. Support was not found for the direct relation between normative outcomes and intention. However, support was found for the indirect relation between the two constructs.

It was found that teachers' attitude regarding the use of the ICN was the primary predictor of their likelihood of using the ICN for classroom instructional activities if it were available. Teachers' attitude toward using the ICN was influenced significantly by their habit of using innovative technology, attitude toward the educational promise of the ICN, strength of beliefs about positive consequences of using the ICN, and strength of beliefs about the influence of important others. It was not influenced by teachers' attitude toward the ICN's logistical constraints or by the strength of their beliefs about negative consequences of using the ICN.

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APPENDIX A. COVER LETTER

TEACHER EDUCATION ALLIANCE

IOWA DISTANCE EDUCATION ALLIANCE
Iowa's Star Schools Project

September 12, 1994

Dear Workshop Institute Participant,

During the last two years, the Iowa Distance Education Alliance (IDEA), Iowa's Star Schools Project, has provided opportunities across the state for educators to participate in inservice workshops on distance education and in curriculum institutes focusing on content area reform efforts and the use of distance technologies. As we conclude the Star Schools Project, we feel it is extremely important that we evaluate the impact of these activities on those who participated and that we assess the future needs of educators in the area of distance education. The opinions of those teachers and educators who have experienced distance education are most valuable in determining the future of distance instruction in the state. You are one of the nearly 1,000 Iowa educators who have participated in Star Schools activities over the last two years, and we would like to hear from you.

Your voluntary participation in completing this survey will be greatly appreciated. All responses will be confidential. The identification numbers on the answer sheets are for follow-up purposes. No individual responses will be reported and all data will be reported in aggregate form.

Enclosed you will find a questionnaire and answer sheet (computer scan sheet), a green sheet containing two open-ended questions, and a return envelope. Please mark your questionnaire responses on the enclosed answer sheet using a number 2 pencil. DO NOT USE INK. Darken only ONE circle for each question. If you change your answer, be sure to erase the first answer completely. **Do not complete the sections on the answer sheet labeled "Name", "Grade", "Birth Date", and "Special Codes."** Please be sure to respond to the two open-ended questions on the green sheet. Feel free to use the back of the green sheet for any other comments you would like to make.

After you have completed the survey, **RETURN ONLY THE ANSWER SHEET AND THE GREEN SHEET WITH THE OPEN-ENDED QUESTIONS IN THE POSTAGE-PAID ENVELOPE.** Please return the survey by **September 26, 1994.**

If you have any questions about this survey, please call us at (515) 294-6919. Thank you for your assistance.

Sincerely,

Jan Sweeney	Chris Sorensen	Sanaa Abou-Dagga
IDEA Evaluation Coordinator	IDEA Evaluation Specialist	Graduate Assistant

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APPENDIX B. RESEARCH SURVEY

IOWA STAR SCHOOLS PROJECT
INSERVICE WORKSHOP / CURRICULUM INSTITUTE SURVEY

Note: Iowa Communication Network (ICN) = two way interactive distance education technology

I. Please darken the appropriate circle that indicates the current level of adequacy for the following items related to teachers' use of the Iowa Communications Network (ICN) for K-12 instruction (items 1 through 19).

1	2	3	4	5	6
Very Inadequate	Inadequate	Somewhat Inadequate	Somewhat Adequate	Adequate	Very Adequate

1. Access to quality teaching materials for ICN use.
2. Teacher released time for distance teaching.
3. Extra pay for ICN teaching.
4. Supervision of remote site students.
5. School Board support for distance teaching.
6. Principal support for distance teaching.
7. Superintendent support for distance teaching.
8. Teacher recognition for ICN use.
9. Teacher planning time for distance teaching.
10. Scheduling procedures for the ICN.
11. Copyright policies related to distance education.
12. Confidentiality policies related to distance education.
13. School district policies for ICN use.
14. Methods of exchanging materials between sites.
15. Flexibility of ICN classroom design.
16. Technical support for ICN use.
17. Distance education technical training for teachers.
18. Access to information about the ICN.
19. Proximity of ICN classrooms to school buildings.

II. Please darken the appropriate circle that indicates the importance of each item in terms of what is needed for successful K-12 use of the ICN for instruction (items 20 through 38).

1	2	3	4	5	6
Very Unimportant	Unimportant	Somewhat Unimportant	Somewhat Important	Important	Very Important

20. Access to quality teaching materials for ICN use.
21. Teacher released time for distance teaching.
22. Extra pay for ICN teaching.
23. Supervision of remote site students.
24. School Board support for distance teaching.
25. Principal support for distance teaching.
26. Superintendent support for distance teaching.
27. Teacher recognition for ICN use.
28. Teacher planning time for distance teaching.
29. Scheduling procedures for the ICN.
30. Copyright policies related to distance education.
31. Confidentiality policies related to distance education.
32. School district policies for ICN use.
33. Methods of exchanging materials between sites.
34. Flexibility of ICN classroom design.
35. Technical support for ICN use.
36. Distance education technical training for teachers.
37. Access to information about the ICN.
38. Proximity of ICN classrooms to school buildings.

III. Please darken the appropriate circle using the following scale to indicate your level of agreement with the statements in items 39 through 71. (Reminder, there is a neutral score in the following sections).

___1___ :	___2___ :	___3___ :	___4___ :	___5___ :	___6___ :	___7___
Strongly Disagree	**Disagree**	**Somewhat Disagree**	**Neither**	**Somewhat Agree**	**Agree**	**Strongly Agree**

39. The ICN will increase educational learning opportunities for Iowans.
40. The ICN is too costly.
41. The ICN will allow schools to share resources.
42. There are many problems associated with the operation of the ICN (e.g., scheduling, access, support, etc.).
43. The ICN is poorly designed.
44. The ICN will provide greater educational opportunities to students in districts of all sizes.
45. Expanding the use of the ICN to government and other related services (e. g., hospitals) will limit its use for education.
46. The operation of the ICN is troublesome.
47. The ICN will encourage Iowans to interact with people in other parts of the state, country and world.
48. The ICN will be reasonably available and accessible to me during the 1994/1995 academic year.
49. Overall, my attitude toward the ICN as a system is positive.
50. I typically teach using innovative technologies for classroom instructional activities.
51. Using innovative technology for classroom instructional activities is something I rarely do.
52. I have always been one to try new teaching methods.
53. I am in the habit of using audio/visual technologies in the classroom.
54. The idea of using innovative technologies such as the ICN for classroom instructional technology is compatible with my view of myself as a teacher.
55. For me, being an effective teacher means being open to the use of innovative technologies such as the ICN for classroom instructional activities.
56. I can't see myself using innovative technology like the ICN for classroom instructional activities.
57. I would be a better teacher if I used the ICN for classroom instructional activities.
58. In the future, I can't see myself teaching without using innovative technologies for classroom instructional activities.
59. For me, using the ICN for classroom instructional activities would be a good idea.
60. For me, using the ICN for classroom instructional activities would be beneficial.
61. As a teacher, I think that using the ICN for classroom instructional activities would be not convenient.
62. As a teacher, I think that using the ICN for classroom instructional activities would be cumbersome.
63. Generally, my attitude toward the ICN for classroom instructional activities is favorable.
64. Teachers in my school think I should use the ICN for classroom instructional activities.
65. Parents of my students would be in favor of me using the ICN or classroom instructional activities.
66. Administrators in my school think I should use the ICN for classroom instructional activities.
67. Students would like me to use the ICN for classroom instructional activities.
68. Generally speaking, I want to do what other teachers in my school think I should do.
69. Generally speaking, I want to do what administrators in my school think I should do.
70. Generally speaking, I want to do what students think I should do.
71. Generally speaking, I want to do what parents think I should do.

IV. Please darken the appropriate circle using the following scale to indicate the likelihood of the event in each of the following statements (items 72 through 84).
For example, if you think that it is extremely likely that using the ICN for classroom instructional activities would increase your planning and preparation time, you would darken the extremely likely circle (7).

1	2	3	4	5	6	7
Extremely Unlikely	Quite Unlikely	Slightly Unlikely	Neither	Slightly Likely	Quite Likely	Extremely Likely

72. Using the ICN for classroom instructional activities would increase the time I need for planning and preparation.
73. Using the ICN for classroom instructional activities would enhance the quality of students' learning.
74. Using the ICN for classroom instructional activities would help me reach more students.
75. Using the ICN for classroom instructional activities would make student-teacher interaction impersonal.
76. Using the ICN for classroom instructional activities would add resources to my classroom (e. g., experts, materials, databases, networking, etc.)
77. Using the ICN for classroom instructional activities would help prepare students for a technological future.
78. Using the ICN for classroom instructional activities would create lots of student discipline problems.
79. Using the ICN for classroom instructional activities would decrease one-on- one communication.
80. Using the ICN for classroom instructional activities would allow students to interact with each other without having to travel great distances.
81. Using the ICN for classroom instructional activities would allow for the use of appropriate media materials.
82. Using the ICN for classroom instructional activities would result in technical problems while teaching.
83. I intend to use the ICN for classroom instructional activities during the 1994/1995 academic year.
84. If the ICN were available to me, I would use it for classroom instructional activities during the 1994/1995 academic year.

V. Please darken the appropriate circle using the following scale to indicate your evaluation of the following possible outcomes of using the ICN (items 85 through 95).

1	2	3	4	5	6	7
Extremely Undesirable	Quite Undesirable	Slightly Undesirable	Neither	Slightly Desirable	Quite Desirable	Extremely Desirable

85. Increasing the time for classroom planning and preparation.
86. Enhancing the quality of students' learning.
87. Helping to reach more students.
88. Making student-teacher interaction impersonal.
89. Adding resources to the classroom (e. g., experts, materials, databases, networking etc.).
90. Helping prepare students for a technological future.
91. Student discipline problems in the classroom.
92. Decreasing one-on-one communication.
93. Allowing students to interact with each other without having to travel great distances.
94. The use of appropriate media materials while teaching.
95. The existence of technical problems while teaching.

VI. Please darken the appropriate circle for the following questions.

96. Do you have an ICN classroom in your building?
    1) Yes 2) No

97. Since the inservice/workshop, have you used the ICN for classroom instructional activities?
    1) Yes 2) No

98. Have you attended an Internet training session conducted by the AEA this past year?
    1) Yes 2) No

99. Have you accessed the Iowa Database on Internet?
    1) Yes 2) No

100. Which Star Schools activities have you attended?
    1) Inservice workshop on distance education
    2) Curriculum institute (mathematics, science, foreign language, literacy, vocational education)
    3) Both (a workshop and an institute)

101. When did you attend the Star Schools activities you indicated above?
    1) 1993
    2) 1994
    3) Both years

APPENDIX C. FOLLOW-UP CARD

September 26, 1994

Dear Workshop/Institute Participant:

We are very interested in your opinions about distance education. We very much want to include your responses in our study. If you have recently returned the survey you received, we want to express our thanks. If you have not returned your survey, we would truly appreciate it if you could complete it and return it in the postage paid envelope as soon as possible. If you have questions, please feel free to call the Star Schools Evaluation Team at 515-294-9464.

Thank you!

APPENDIX D. NEW COVER LETTER

October 19, 1994

Dear Workshop/Institute Participant,

Recently we sent you a survey asking for your perceptions about the use of the ICN for K-12 instruction. We have not yet received your response. **We feel that your views, as a teacher, are extremely important** as we look at the needs of teachers across the state in using interactive video instruction. We believe your experiences as a participant in one of the teacher training activities sponsored through the Iowa Star Schools project will make your insights particularly useful.

In the event that the original survey has been lost or misplaced, we are enclosing a second copy for you. The survey consists of a questionnaire and answer sheet (computer scan sheet), and a sheet containing two open-ended questions. **RETURN THE ANSWER SHEET, AND THE SHEET OF OPEN-ENDED QUESTIONS IN THE POSTAGE-PAID ENVELOPE ENCLOSED** by **OCTOBER 31, 1994**.

Please mark your responses on the answer sheet using a number 2 pencil. DO NOT USE INK. Darken only ONE circle for each question. If you change your mind, be sure to erase the first answer completely. **Do not complete the sections on the answer sheet labeled "Name," "Grade," "Birth Date," and "Special Codes."** If you do not wish to use the scan sheet, you may place your responses directly on the survey instrument. However, if you choose this option, be sure to **RETURN THE SURVEY INSTRUMENT AND THE SCAN SHEET**.

Please also be sure to respond to the open-ended questions. Feel free to use the back of the sheet containing the open-ended questions for any additional comments you would like to make.

Your voluntary participation in completing this survey will be greatly appreciated. All responses will be confidential and no individual responses will be reported. If you have any questions about this survey, please call us at (515) 294-6919. **Thank you for your willingness to participate in this research project!**

Sincerely,

Jan Sweeney	Chris Sorensen	Sanaa Abou-Dagga
IDEA Evaluation Coordinator	IDEA Evaluation Specialist	Graduate Assistant

APPENDIX E. HUMAN SUBJECTS FORM

Information for Review of Research Involving Human Subjects
Iowa State University
(Please type and use the attached instructions for completing this form)

1. Title of Project Iowa Distance Education Alliance/Teacher Education Alliance--Iowa's Star Schools Project

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are protected. I will report any adverse reactions to the committee. Additions to or changes in research procedures after the project has been approved will be submitted to the committee for review. I agree to request renewal of approval for any project continuing more than one year.

Michael Simonson	9/27/93	[signature]
Typed Name of Principal Investigator	Date	Signature of Principal Investigator

RISE	E005 Lagomarcino	4-7012
Department	Campus Address	Campus Telephone

3. Signatures of other investigators

Signatures of other investigators	Date	Relationship to Principal Investigator
Jan Sweeney	9/27/93	Coordinator of Evaluation
Mari Kemis	9/27/93	Research and Evaluation Specialist
Chris Sorensen	9/27/93	Evaluation Specialist

SEP 28 1993

4. Principal Investigator(s) (check all that apply)
   - [X] Faculty [X] Staff [ ] Graduate Student [ ] Undergraduate Student

5. Project (check all that apply)
   - [X] Research/Evaluation [ ] Thesis or dissertation [ ] Class project [ ] Independent Study (490, 590, Honors project)

6. Number of subjects (complete all that apply)
   - X # Adults, non-students ___ # ISU student X # minors under 14 X # minors 14 - 17 ___ other (explain)

7. Brief description of proposed research involving human subjects: (See instructions, Item 7. Use an additional page if needed.)

   See attached

(Please do not send research, thesis, or dissertation proposals.)

8. Informed Consent:
   - [ ] Signed informed consent will be obtained. (Attach a copy of your form.)
   - [X] Modified informed consent will be obtained. (See instructions, item 8.)
   - [ ] Not applicable to this project.

Simonson

Checklist for Attachments and Time Schedule

The following are attached (please check):

12. ☒ Letter or written statement to subjects indicating clearly:
    a) purpose of the research
    b) the use of any identifier codes (names, #'s), how they will be used, and when they will be removed (see Item 17)
    c) an estimate of time needed for participation in the research and the place
    d) if applicable, location of the research activity
    e) how you will ensure confidentiality
    f) in a longitudinal study, note when and how you will contact subjects later
    g) participation is voluntary; nonparticipation will not affect evaluations of the subject

13. ☐ Consent form (if applicable)

14. ☐ Letter of approval for research from cooperating organizations or institutions (if applicable)

15. ☒ Data-gathering instruments

16. Anticipated dates for contact with subjects:

First Contact	Last Contact
1/1/93	unsure-project is funded through 9/94
Month / Day / Year	Month / Day / Year

17. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased:

It is expected that identifiers would be removed from data files approximately one year from beginning participation, when follow-up activities are completed.
Month / Day / Year

18. Signature of Departmental Executive Officer — [signature] — Date 9/27/93 — Department or Administrative Unit: R.I.S.E.

19. Decision of the University Human Subjects Review Committee:

X Project Approved ___ Project Not Approved ___ No Action Required

Patricia M. Keith	10-22-93	[signature]
Name of Committee Chairperson	Date	Signature of Committee Chairperson

9. Confidentiality of Data: Describe below the methods to be used to ensure the confidentiality of data obtained. (See instructions, item 9.)

The identifiers are used for matching data files only as data are collected and processed. Cofidentiality is maintained with names and identifiers kept at separate locations. All responses are aggregated and are reported most often as statewide data. No names will be used in reporting results from teachers and students back to schools; in fact, all results from classroom evaluations will be given only to teachers and not to administrators in the buildings.

10. What risks or discomfort will be part of the study? Will subjects in the research be placed at risk or incur discomfort? Describe any risks to the subjects and precautions that will be taken to minimize them. (The concept of risk goes beyond physical risk and includes risks to subjects' dignity and self-respect as well as psychological or emotional risk. See instructions, item 10.)

none

11. CHECK ALL of the following that apply to your research:

- ☐ A. Medical clearance necessary before subjects can participate
- ☐ B. Samples (Blood, tissue, etc.) from subjects
- ☐ C. Administration of substances (foods, drugs, etc.) to subjects
- ☐ D. Physical exercise or conditioning for subjects
- ☐ E. Deception of subjects
- ☒ F. Subjects under 14 years of age and/or ☒ Subjects 14 - 17 years of age
- ☐ G. Subjects in institutions (nursing homes, prisons, etc.)
- ☐ H. Research must be approved by another institution or agency (Attach letters of approval)

If you checked any of the items in 11, please complete the following in the space below (include any attachments):

Items A - D	Describe the procedures and note the safety precautions being taken.
Item E	Describe how subjects will be deceived; justify the deception; indicate the debriefing procedure, including the timing and information to be presented to subjects.
Item F	For subjects under the age of 14, indicate how informed consent from parents or legally authorized representatives as well as from subjects will be obtained.
Items G & H	Specify the agency or institution that must approve the project. If subjects in any outside agency or institution are involved, approval must be obtained prior to beginning the research, and the letter of approval should be filed.

K-12 students may be involved in distance education activities starting in Spring 1994 when the fiber optics network is operational to schools. If elementary and middle school students are receiving instruction over the network, evaluative information will be asked of them after parental consent is given. A simple form will be developed asking parents, etc. to allow participation in the evaluation. It is not expected that identifiers will be needed for this phase of evaluation. Teachers will be provided with materials explaning the evaluation and will be asked to provide this explanation to the students prior to the evaluation. The student's participation will indicate modified informed consent.

September 21, 1994.

Dr. Pat Keith,

For a dissertation *"Distance education and the diffusion of innovations: A model that predicts the factors that will influence teachers' decision to use the ICN"* in the Department of Professional Studies in Education, I will be using some of the data that is being collected by the evaluators of the *" Iowa Distance Education Alliance / Teacher Education Alliance--Iowa's Star Schools Project"*. I have items 39-96, 100-101 added to their survey. There have been no changes in the methods of data collection or the procedures of gathering the information. A copy of the instrument is attached.

If you have questions, please call me at 294-7113. Thank you!

Sincerely,

Sanaa Abou-Dagga

Sanaa Abou-Dagga

Approved
PKeith
9-25-94