EFFECT OF TECHNOLOGY INTEGRATION EDUCATION ON THE ATTITUDES OF TEACHERS AND THEIR STUDENTS

DISSERTATION

Presented to the Graduate Council of the
University of North Texas in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

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Denton, TX

December, 1997

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This study analyzed the effect of technology integration education on teachers' and students' attitudes toward information technology. Two instruments measuring similar attributes were used to assess teachers' and students' attitudes. Differences in pre- and post-test scores were used to determine changes that occurred during the course of the study.

Approximately sixty teachers in an elementary school in Texas received needs-based instruction in the integration of computers in the classroom. Three hypotheses were explored: (1) Needs-based technology integration education fosters positive attitudes toward information technology among elementary school classroom teachers; (2) Teacher education in needs-based technology integration combined with significant classroom utilization fosters positive student attitudes toward information technology; and (3) Positive teacher attitudes toward information technology foster positive attitudes in their students.

Analysis of the data indicated that: a) teachers at the treatment and comparison sites who reported having received computer integration education tended to exhibit more positive attitudes toward information technology than their non-integration counterparts ; b) teachers at the treatment site changed to a greater extent in the direction of more positive attitudes than did their comparison group peers; and c) the integration education delivered at the treatment site had a significant impact on perceived computer importance (after controlling for frequency of use) while the impact of training at the comparison sight was negligible. Both analysis of variance and regression techniques confirmed the strong impact of the extent of teacher computer use on the attitudes of their students. Time-lag regression

confirmed the existence of a probable causal path from increased teacher integration education to a more positive perception of computer importance for their students.

A series of panel analyses using time-lag regression confirmed that positive teacher perceptions of computer importance influence student perceptions of computer importance in a positive manner.

These findings, taken as a whole, led to the acceptance of hypothesis 1, the conditional acceptance of hypothesis 2, and the acceptance of hypothesis 3.

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CHAPTER 1

INTRODUCTION

This study analyzed the effect of technology integration education on teachers' and students' attitudes toward information technology. Two instruments measuring similar attributes were used to assess teachers' and students' attitudes. Differences in pre- and posttest scores were used to determine changes that may have occurred during the course of the study. Approximately 60 teachers in an elementary school in Texas received needs-based instruction in the integration of computers in the classroom. Two similar schools in the same school district were used as the comparison groups. It was anticipated that properly instructing teachers to use information technology in the classroom would positively affect, not only their attitudes toward information technology, but also the attitudes of their students.

Problem Statement

The problem addressed in this study was whether technology integration education positively influences teacher attitudes and the attitudes of their students toward information technology.

Research Question

What is the relationship between technology integration education of teachers, their attitudes toward information technology, and their students' attitudes? It is generally accepted in the literature that appropriate training of teachers should include the ability to use the computer for personal use (i.e., word processing, gradebook, etc.) and with students in the classroom (Burkholder, 1995; Hignite & Echternacht, 1992; Hochman, Maurer & Roebuck, 1993; Kearns, 1992; Ritchie & Wiburg, 1994; Todd, 1993; Wetzel, 1993; Woodrow, 1992). The instructor who has learned to integrate technology into existing curricula may teach differently than the instructor who has received no training of this type. The difference in classroom technique and the extent of technology utilization should have a positive impact on the teachers' and students' attitudes toward information technology. Because previous research has shown that positive attitudes are a precursor to effective utilization, verification of this outcome could have a major impact on the way teachers are educated to use computers in the classroom.

Significance of the Study

Significant resources have been expended to place computers in the schools. Many educators are recognizing the effects of this influx of technology on student learning. As plans are made for the increased use of technology, it is important for policy makers, educators, and researchers to understand how teachers and children relate to this technology (Martin, Heller, & Mahmoud, 1992). Data from a 1995 national survey of school district technology budget allocations revealed that approximately 55% of the technology money was being spent on hardware and 30% on software. Teacher education accounted for only 15% of the allocated funds (U.S. Congress, 1995). Agencies such as the Texas Education Agency (TEA) recently recommended that districts allocate 30% of their technology budgets to staff development activities (U.S. Congress, 1995). With a predicted increase of funds allocated to technology staff development, studies are needed to determine the type of instruction that leads to effective use of technology in the classroom.

Limitations of the Study

This study focused on elementary school teachers. Therefore, the results may not be generalizable to teachers at other levels. Because the teachers were not randomly selected from the population of teachers, the results may not be generalizable to all teacher populations. Students in all three schools went to a computer laboratory once a week for approximately 45 minutes, where they were instructed by both their classroom teacher and a computer laboratory aide. Therefore, this study cannot assess the impact of technology integration education in comparison to classrooms in which students have no computer exposure. Teachers and students in all the schools studied had had access to computers for approximately 5 years and thus were not typically novice users.

Delimitations of the Study

Although it is likely that the amount of home computer use may affect children's and teachers' attitudes toward information technology, the issue was not addressed in this study.

Definition of Terms

technology integration education - instruction in how to use information technology to enhance classroom curricula

information technology - includes traditional computer applications (CAI, tools) and communication tools such as e-mail and www resources

effective training - instruction that has been demonstrated to have a positive impact

appropriate training - instruction that includes the ability to use the computer for professional productivity as well as student exploration and learning activities

staff development - instruction of currently practicing teachers typically mandated from the school district or local administration

teacher training - instruction that can include preservice or inservice teachers

teacher professional development - continuing education to develop professional knowledge and/or skills

preservice teachers - students in a teacher education preparation program

inservice teachers - practicing teachers

Title I - federally funded program that awards funding to schools based on factors such as the number of socioeconomically and physically disadvantaged students

Chapter I - reading program for low-scoring students (funded by Title I)

CHAPTER 2

REVIEW OF RELATED LITERATURE

Teacher Education

Since the 1983 publication of A Nation at Risk by the National Commission on Excellence, there has been a strong emphasis on restructuring education. Despite funding for the transformation of schools through technology, the classroom of the early 1990s was still driven by lectures, textbooks, and passive learning (Kromhout & Butzin, 1993).

Findings of recent research (Marcinkiewicz, 1993/1994) showed that, regardless of the number of computers available in the schools, teachers have typically underutilized them. This fact supports the modification of current teacher training programs. To achieve integration of technology into the classroom, understanding the ways in which teachers can effectively use computers is essential.

Inservice Practices

According to Ritchie and Wiburg (1994), one of the characteristics that set exemplary computer-using teachers apart from others was their access to staff development activities that included instruction in using teacher productivity programs (gradebook, word processing, spreadsheets) and instruction that included using computers with specific subject matter taught by teachers.

> There are at least three reasons why information received during an in-service workshop is not implemented in the classroom situations. These include: (a) failure to conduct a needs analysis to identify knowledge

> required by users; (b) presentations limited to factual knowledge which omit higher level thinking strategies; and (c) failure to incorporate activities which are relevant to the audience in a collaborative, problem solving approach. (Ritchie & Wiburg, 1994, p. 148)

Ritchie and Wiburg also stated that one-shot inservice is not sufficient to enable teachers to implement technology in the classroom. Research gathered by the Office of Technology Assessment indicated the following:

> Staff development is most effective when it is individualized. This means matching learning opportunities to the needs of specific teachers so they can choose what they need to know, how they wish to learn and the time frame in which they will learn it. Follow up support and coaching after the initial learning experience are essential to effective staff development. (U. S. Congress, 1995, p. 159)

Preservice Practices

How should technology be introduced and taught in undergraduate teacher education programs? Evidence supports the teaching of specific foundation courses as well as technology integration throughout the methods and elective courses (Todd, 1993; Wetzel, 1993). Findings in a study done by Koohang (1987) suggested that computer experience be provided for preservice teachers prior to their involvement in teaching. Studies have shown that teachers who are trained in technology coursework are more likely to use computers for their personal use and are also more likely to integrate them into their classroom (Hochman, Maurer, & Roebuck, 1993; Kearns, 1992).

Woodrow (1990) and others suggested that courses for novice users should focus on "user-friendly" computers and software. Students should leave their first class being able to do something that is practical and that will have an immediate application. Word processing and student record-keeping software are two good beginning packages

(Woodrow, 1990). These introductory courses should promote positive computer attitudes, and they should assure that students (preservice teachers) are successful. If the students finish the class with a positive attitude toward computers, they are more likely to apply their newly acquired skills.

Technology Integration

The integration of computers into education requires an improvement in the instruction of teachers. Teachers require education in the use of technology as an instructional as well as a professional tool (Woodrow, 1992). Throughout the literature, the recurring solution to integration of technology in the classroom is teacher education (Burkholder, 1995; Kearsley & Lynch, 1994; Shermis, 1990; Stoddart & Niederhauser, 1993). Burkholder observed that since the teachers are the ones who will implement the technology, training should focus on them. He contended that training should include strategic plans necessary to integrate the use of technology in the classroom rather than introducing teacher productivity tools alone (Burkholder, 1995).

Although there may not be agreement on how to involve technology in curricula, one common goal is to foster favorable attitudes toward computers. If positive attitudes are developed in students (preservice teachers), other objectives may become secondary (Bear, Richards, & Lancaster, 1987). Measures for assessing teacher development are also needed because it appears to be an important part of the change process (Riel & Harasim, 1994).

Teachers' Attitudes Toward Technology

Loyd and Gressard (1986) showed that positive attitudes toward computers are positively correlated with teachers' experiences. With familiarity, anxieties and fears tend to decrease and confidence increases. Lillard (1985) found that knowledge has a positive impact on teacher attitudes toward technology. Summers (1990) stated that one of the most common reasons for teachers' negative attitudes toward technology is the lack of knowledge and experience in this area. Gressard and Loyd (1985) also established that perceptions of the potential usefulness of computers can influence attitudes toward computers. The amount of confidence a teacher possesses in using technology may greatly influence his/her effective implementation in the classroom. Positive teacher attitudes toward computers are widely recognized as a necessary condition for effective use of information technology in the classroom (Woodrow, 1992).

Gardner, Discenza, and Dukes (1993) have determined that computer anxiety is a major cause of resistance to using computers. This and other research indicates that increased computer experience reduces computer anxiety in many student teachers. However, it may depend on the type of computer experience (McInerney, McInerney, & Sinclair, 1994). Beasley and Sutton (1993) found that at least 30 hours of instruction and practice were required just to reduce anxiety about technology. These authors contended that reducing uncertainty is just the first step to becoming confident and competent users of technology.

The successful use of computers in the classroom is dependent on the teachers' attitudes toward computers (Lawton & Gerschner, 1982). Educators are often resistant to using computer technology in the classroom, so changing teachers' attitudes is a key factor in fostering computer integration (Marcinkiewicz, 1993/1994). Stevens (1980, as cited in Violato, Mariniz, & Hunter, 1989) identified teachers' attitudes as well as expertise in using computers as major factors in the adoption of computers in the classroom. Koohang's (1989) research also found computer experience to be significant regarding attitudes toward computers. Although teachers' attitudes have not typically been considered in the introduction of computers into the classroom, future successful implementation will need to address teachers' attitudes toward computers (Hunter & deLeeuw, 1988, as cited in Violato et al., 1989). According to a research study examining the relationship between teacher attitudes and computer skills, it is critical that teachers possess both positive attitudes and adequate computer literacy skills to successfully incorporate technology into the classroom (Hignite & Echternacht, 1992).

Children's Attitudes Toward Computers

Several studies have suggested that attitudes may be an important element in teaching children about computers (Woodrow, 1990). As stated by Todman and Dick (1993), "An important factor affecting the quality of the child's experience of computers at school may be the teacher's attitude toward computers".

Many researchers reported that children like computers and are positively motivated to use them (Shade, 1994). A review of the literature on attitudes toward computers by Lawton and Gerschner (1982) showed that children found computers to have infinite patience, never to get tired, never to forget to correct or praise, to be impartial to ethnicity and gender, and to be great motivators. In the same review, it was shown that students liked computers because they were self-paced, gave immediate feedback, and did not embarrass them when they made mistakes. The early studies found that negative attitudes and fears about computers were exhibited mostly by teachers, not children (Martin et al., 1992). Barba and Mason (1994) found that children do not see computer technology as a science but as a tool to be used in everyday life.

According to a report by the Office of Technology Assessment (OTA), there is a major problem with the existing research assessing the impact of technology. Most research relies on existing measures of student achievement. An important factor that needs to be included goes beyond student achievement and includes attitudinal measures. Student achievement is likely affected by students' attitudes about school and learning (U.S. Congress, 1995).

The research literature reflects much controversy over appropriate types of computer applications. Papert (1993), a well-known researcher on children and computers, feels that computers should be integrated into the curriculum. He stated, "Computer labs are not integration across the curriculum, they are integration across the hall. As such, they isolate the computer and make it [a separate] part of the very curriculum it should be supporting."

Although drill and practice software is roughly 80% of the software available for children ages 3 to 8 (Haugland & Shade, 1992), it has been shown to be inconsistent with National Association for the Education of Young Children (NAEYC) standards (Haugland & Shade, 1990). There is a need to ascertain the appropriate uses of computers in the classroom and to assess the effect on teachers' and students' attitudes toward computers.

Other variables possibly influence children's attitudes toward computers. One variable is the amount of home computer use. In addition, the type of applications students have used in the past may play an important part in their attitudes. If children have used computers for drill and practice activities, they may perceive computers as being in control and boring to use. With more open-ended applications, they may feel that they are in control and allowed to be creative (Shade, 1994).

Another important variable may be the environment for student instruction in computers. In some cases the classroom teacher is in charge of computer instruction in the lab and in the classroom. However, having visited numerous elementary schools, this researcher has observed that it is common for the students to go to a separate computer lab in which the teacher may or may not integrate computer use with classroom instruction.

Measures of Teacher Acceptance

Increase in Knowledge and Skills

A research study examining the relationship between teacher attitudes and computer skills concluded that it is critical for teachers to possess both positive attitudes and adequate computer literacy skills successfully to incorporate technology into the classroom (Hignite & Echternacht, 1992). Other research has shown that both knowledge of computers and computer experience have a positive impact on teachers' attitudes (Dupagne & Krendl, 1992).

In this study, two instruments were used to assess what the teachers knew as well as what they did not know. The Computer Inservice Needs Assessment (Davies, 1993/1994) (see Appendix A) includes open-ended questions regarding what teachers need to know, a self-rated categorical scheme representing computer use level as well as where they perceive themselves to be on a skills-based level. The Skills Check List contains specific items that will be included in the staff development sessions. This should show whether there is an increase in skill level regarding the use of technology.

Social Distance Theory

In a study comparing functional distance and the attitudes of educators toward computers, Norris and Lumsden (1984) found that teachers are more accepting of computers when they are perceived to be at a distance. In other words, teachers may accept that computers are valuable for education in general, but they are not so accepting of computers in their own classroom. Their questionnaire was adapted from the Bogardus Social Distance Scale used to measure social distance regarding nationalities of people. As evidenced in a collection of studies reported by the OTA, some nontechnology-using teachers endorse the necessity of students' having access to information technology in the classroom. However, many of the teachers do not see why it should be in their classroom or what it offers them in pursuit of their instructional goals (U.S. Congress, 1995).

The Teachers' Views of Technology and Teaching (see Appendix B) is a composite of social distance measures used by Norris and Lumsden (1984) as well as items selected from an ILS evaluation instrument (Poirot, et al., 1992). It was used to measure how teachers felt about their teaching environment as well as how they felt about computers in their environment.

Stages of Adoption

Hadley and Sheingold (1993) conducted a nationwide survey of teachers experienced at integrating computers in the classroom. Based on an analysis of patterns, they developed five profiles based on characteristics of the participating teachers. These profiles include (a) enthusiastic beginners, (b) supported integrators, (c) high school naturals, (d) unsupported achievers, and (e) struggling aspirers.

A research study by Evans-Andris (1995) that involved teachers whose schools had possessed computers for at least 5 years revealed that teachers shape their interaction with computers through their style of computing. Three styles were shown to include almost all the participating teachers. These were avoidance (60%), integration (28%), and technical specialization (8%).

Cafolla and Knee (1995) presented Welliver's instructional transformation model describing stages that reflect the level of technology integration. The five stages are (a) familiarization, (b) utilization, (c) integration, (d) reorientation, and (e) evolution.

Similar to Welliver's stages, Russell (1995) presented stages of technology adoption. According to research conducted by Russell, adults learning new technology pass through six stages on their way to becoming confident technology users. These learners may begin at any point and progress through at their own rates. The stages include (a) awareness, (b) learning the process, (c) understanding and application of the process, (d) familiarity and confidence, (e) adaptation to other contexts, and (f) creative applications to new contexts.

The Stages of Adoption of Technology instrument (see Appendix C) was developed based on Russell's (1995) stages. It was selected for use in this study to determine the pre- and poststages of the teacher-learners.

Diffusion of Innovation

Research by Rogers (1983) has found that adoption of new innovations is an active process that involves much reinvention. Adopters must reinvent the innovation and make it their own if they are to continue using it. Similarly, in the education of teachers, teachers must be encouraged to reinvent activities and make them their own (Harris, 1994).

In a study comparing levels of adoption of technology and personality types, Rude-Parkins, Baugh, and Petroako (1993) defined three levels. At the "high level," teachers were enthusiastic and integrated technology into the classroom. The "medium level" teachers used some technology for personal use and some with students. The "low level" adopters used technology neither with their students nor for personal uses.

Havelock (1973) identified three roles as predictors of adoption of an innovation. Innovators are risk takers and are the first to adopt. Resisters are active critics of new innovations and are the last to adopt. Leaders size up the situation but will move ahead swiftly when they determine that the time has come. Although the leaders are the key to growth of any adoption, they are not usually in the first wave of adopters.

Based on an international study involving children, teachers, and computers, Pelgrum and Plomp (Collis, Knezek, Lai, Miyashita, Pelgrum, Plomp, & Sakamoto, 1996) stated the following:

> Teachers are the main gatekeepers in allowing educational innovations to diffuse into the classrooms. Therefore one of the key factors for effecting an integration of computers in the school curriculum is adequate training of teachers in handling and managing these new tools in their daily practices (as cited in Collis et al., 1996, p. 31).

They found that the "degree of classroom computers was closely tied to extent of training in integration techniques" (Collis et al., 1996, p. 32). Assessing teachers' stages of adoption of technology allows the teacher educator to adapt the instruction to fit the learner's needs.

CHAPTER 3

METHODOLOGY

Hypotheses

This study sought to test the following hypotheses:

Hypothesis 1: Needs-based technology integration education fosters positive attitudes toward information technology among elementary school classroom teachers.

Hypothesis 2: Teacher education in needs-based technology integration, combined with significant classroom utilization, fosters positive student attitudes toward information technology.

Hypothesis 3: Positive teacher attitudes toward information technology foster positive attitudes in their students.

Research Design

The research design for this study was quasi-experimental, with one treatment group and two comparison groups (Campbell & Stanley, 1963).

Treatment	O_1 (TAC)	X_1 (Intensive Training)	O_2 (TAC/YCCI)	X_2 (Ongoing training)	O_3 (TAC/YCCI)
Comparison(1)			O_1 (TAC/YCCI)		O_2 (TAC/YCCI)
Comparison(2)			O_1 (TAC/YCCI)		O_2 (TAC/YCCI)

Figure 1. Research design for treatment and comparison groups

The independent variable in this study was technology integration education. The dependent variables were the teacher attitude measures and the student attitude measures.

Instrumentation

Measures for Teachers' Attitudes Toward Information Technology

The Teachers' Attitudes Toward Computers Questionnaire (TAC) (see Appendix D) was developed to measure teachers' attitudes in this study. The TAC was originally constructed as a 10-part composite instrument that included 284 items spanning 32 Likert subscales (Christensen & Knezek, 1996).

The following 14 computer attitude questionnaires contributed to the TAC:

1. The Computer Attitude Scale (Gressard & Loyd, 1986) measures confidence, liking, anxiety, and usefulness.

2. The Computer Use Questionnaire (Griswold, 1983) tests awareness.

3. The Attitudes Toward Computers Scale (Reece & Gable, 1982) measures general attitudes toward computers.

4. The Computer Survey Scale (Stevens, 1982) measures efficacy and anxiety.

5. The Computer Anxiety Rating Scale (CARS) (Heinssen, Glass, & Knight, 1987) identifies technical capability, appeal of learning and using computers, being controlled by computers, learning computer skills, and traits to overcome anxiety.

6. The ATC (Attitudes Toward Computers) (Raub, 1981) measures computer usage, computer appreciation, and societal impact.

7. The CAIN (Computer Anxiety Index) (Maurer & Simonson, 1984) examines avoidance of, negative attitudes toward, caution with, and disinterest in computers (anxiety and comfort).

8. The BELCAT (Blombert-Erickson-Lowery Computer Attitude Task) (Erickson, 1987) assesses attitudes toward learning about computers and towards computers themselves.

9. The Attitude Toward Computer Scale (Francis, 1993) measures the affective domain.

10. The Computer Attitude Measure (CAM) (Kay, 1993) assesses cognitive (student, personal, general), affective, behavioral (classroom and home), and perceived control components of computer attitudes.

11. The Computer Attitude Questionnaire (CAQ) (G.A. Knezek & Miyashita, 1993) rates computer importance, computer enjoyment, computer anxiety, and computer seclusion.

12. The Computer Attitude Items (Pelgrum, Janssen Reinen, & Plomp, 1993) measures computer relevance, and computer enjoyment.

13. The Computer Attitudes Scale for Secondary Students (CASS) (Jones & Clarke,1994) examines avoidance of, negative attitudes toward, and caution with computers, as well as cognitive, affective and behavioral attitudes.

14. E-Mail (D'Souza, 1992) measures attitudes toward classroom use of E-mail.

Construct Validity and Internal Consistency Reliability

Six hundred and twenty-one educators in Texas, Florida, New York, and California completed the TAC during 1995-96. A factor analysis of the 284 individual items on the questionnaire, using the 621 responses, indicated that between 4 and 22 different attributes were actually measured by the items collected from the 32 previously published subscales. Examination of the factor structures for all 4-22 feasible solutions resulted in selections of 7-factor, 10-factor, and 16-factor structures as the most meaningful representations of the domain. The names assigned to the factors identified and the measurement indices produced by summing the responses to items closely related to each factor are listed in Tables 1 to 3 (G. Knezek & Christensen, 1996).

Table 1

Internal Consistency Reliability for 7-Factor Structure of the TAC

	Alpha	No. of variables
F1(Enthusiasm/Enjoyment)	.98	30
F2(Anxiety)	.98	30
F3(Avoidance/Acceptance)	.90	13
F4(Email for Classroom Learning)	.95	11
F5(Negative Impact on Society)	.85	11
F6(Productivity)	.96	30
F7(KaySemantic)	.94	10

Table 2

Internal Consistency Reliability for 10-Factor Structure of the TAC

	Alpha	No. of variables
F1 (Enthusiasm/Enjoyment)	.96	15
F2 (Anxiety)	.97	15
F3 (Relevance)	.91	15
F4 (Email)	.95	11
F5 (Negative Impact on Society)	.86	15
F6 (Productivity)	.95	15
F7 (KaySemantic)	.94	10
F8 (Vocation)	.93	15
F9 (Prestige)	.88	10
F10 (Gender Bias)	.81	6

Table 3

Internal Consistency for 16-Factor Structure of the TAC

Subscales	Alpha	No. of variables
F1 (Enthusiasm)	.96	15
F2 (Anxiety)	.98	15
F3 (Acceptance)	.75	4
F4 (Email)	.95	11
F5 (Negative Impact on Society)	.84	10
F6 (Classroom Learning Productivity)	.90	14
F7 (KaySemantic)	.94	10
F8 (Vocation)	.92	13
F9 (Prestige)	.75	7
F10 (Teacher Productivity)	.94	14
F11 (Aversion)	.74	6
F12 (Gender Bias)	.81	6
F13 (K&M Importance)	.83	8
F14 (L&G Confidence)	.83	6
F15 (Relevance)	.89	10
F16 (P&P Importance)	.90	9

The TAC was administered as a pilot test at a district training program in Port Arthur, Texas. Complete data were collected from 91 teachers prior to and after their 6-week training sessions. (See Appendix E for a sample of the course content.) The paired data were viewed in many ways, including the originally published subscales, 7-factor, 10-factor, and 16-factor structures. Common to all views of the data was strong evidence that a reduction in anxiety about computers occurred in participants during the course of their training sessions. Equally compelling was evidence that the trainees came to perceive a more positive role for E-mail (and perhaps other information technologies) in classroom learning (G. Knezek & Christensen, 1996).

These findings were viewed as successful confirmation of the discriminant validity of the TAC. The 16-factor structure was selected for use in this study because of its comprehensiveness. Its scoring procedure is to sum the numeric values of the responses for the related items to produce a Likert or semantic differential subscale score for each factor. These subscale scores, rather than individual items, were used as the basis for the findings in this study.

Measures for Students' Attitudes

The Young Children's Computer Inventory (YCCI) (see Appendix F) was used to measure students' attitudes and dispositions toward computers on the following subscales: Computer Importance, Computer Enjoyment, Motivation/Persistence, Study Habits, Empathy, and Creative Tendencies (G.A. Knezek & Miyashita, 1993). The six subscales have been defined by Knezek and Miyashita as follows: computer importance: perceived value or significance of knowing how to use computers; computer enjoyment: amount of pleasure derived from using computers; study habits: mode of pursuing academic exercises within and outside class; empathy: a caring identification with the thoughts or feelings of others; motivation/persistence: unceasing effort; perseverance -- never giving up; and creative tendencies: inclinations toward exploring the unknown, taking individual initiative, finding unique solutions.

The YCCI is a 48-item, Likert-type self-report questionnaire. Students record their perceptions of the extent to which they agree, disagree, or are undecided for each item. The students are supervised by their teacher in a classroom environment. In the case of young children who have difficulty reading, the teacher reads the questions aloud. The scoring procedure for the YCCI is to sum the numeric values of the responses for the related items to produce six subscale scores.

Content validity, construct validity, and criterion-related validity were tested in the development and refinement of the Young Children's Computer Inventory (YCCI) (G. A. Knezek & Miyashita, 1993). In addition, the YCCI has been administered to young children in Japan, Mexico, and the U. S.

Attitudes Toward School

Computer use by children has been shown to improve students' attitudes toward both school and computers (Lever, Sherrod, & Bransford, 1989). Four items from the Computer/School Attitudes Survey (CSAS) (Lever et al., 1989) were given to the students to assess their attitudes toward school. These four items were added to the YCCI (see Appendix F) to compare whether attitudes toward school are influenced by technology integration education and classroom utilization by the teacher.

The CSAS has been pilot tested in two schools. Four of the items appear to measure children's attitudes toward school with good reliability. In the spring of 1996, the instrument was given to 134 second- through fifth-grade students attending parochial schools in Amarillo, Texas. The reliability for the four-item scale was .77. A similar instrument was given to 223 third- through eighth-grade students in a parochial school in Dallas, Texas. The reliability for the four-item scale was .75, which is consistent with the findings for Amarillo.

Subjects and Procedures

Subjects for the current study were from three different sites in Irving, Texas. One school, Keyes Elementary, was used for the treatment group, while the other schools, Gilbert Elementary and Brown Elementary served as comparison groups. The treatment group consisted of approximately 25 classroom teachers (1st -5th) and their students. Approximately 40 teachers and 650 students from Gilbert Elementary and Brown Elementary participated.

Keyes Elementary is a public school located in the Irving Independent School District (ISD). There are approximately 900 pre-K through fifth-grade students enrolled at Keyes. The population is 82% minority -- 65% Hispanic, 10% African-American, and 7% from other ethnic groups. Of the students, 76.8% are eligible for free or reduced lunches. Keyes qualifies as a Title I-funded school and also has a Chapter I reading program. Most of the computers in the school were funded by Title I. Some computers were purchased with funds from the normal school budget at Keyes, while 10 of the computers were awarded by the district to teachers through the teacher incentive program. To be eligible for a classroom computer in the district incentive program, teachers must attend an additional 18 hours of district computer inservice.

Gilbert Elementary is located near Keyes in the Irving ISD. Of the 800 students enrolled at Gilbert 71% were Hispanic, which is comparable to Keyes Elementary. The population at Gilbert includes 73% of students qualifying for free and reduced meals. Gilbert had a computer lab as well as five computers in each second- to fifth-grade classroom, four computers in first grade, and a mini-lab in Pre-K and Kindergarten.

Brown Elementary is close in proximity to Keyes in the Irving ISD. Approximately 800 K- fifth-grade students were enrolled at Brown. The ethnicity of the population included approximately 65% white, 17% Hispanic, 12% African-American, and 6% from other ethnic groups. They did not qualify as a Title I-funded school based on the 44.2% of students who received free or reduced lunches.

The TAC was administered as a pre- and posttest to the teachers at these schools. The pre-post differences were used to assess changes in attitudes that occurred during the school year.

The YCCI questionnaire was also administered as a pre- and post-test. It was given in January and in May 1997. Students' attitudes were assessed to see whether any changes occurred and whether integration-type teacher education had an effect on student attitudes toward computers.

The use of these two instruments ensured that changes in teacher and student attitudes were assessed on common grounds. Specifically, the subscales of Computer Enjoyment and Computer Importance have been validated for both students (YCCI) (G. A. Knezek, Miyashita, & Sakamoto, 1994) and teachers (TAC) (Christensen & Knezek, 1996). This enabled a more detailed examination of the causes for changes in teacher and student attitudes and the relationship between the two.

The Computer Inservice Needs Assessment was administered at Keyes prior to the first instructional session. The needs assessment was used to determine the initial self-rated classification of the learner, as well as to determine immediate and future inservice needs. The Skills Checklist (Appendix G) was administered before the 1st day of an intensive 2-day training, at the end of the 1st day, and at the end of the 2nd day as well as at the time of the TAC posttest (end of the school year). The skills checklist was used to determine weak areas as well as to track the attainment of skills taught during the training.

The Stages of Adoption of Technology (Russell, 1995) was administered at the time of the TAC pretest and posttest. In addition, the Teachers' Views of Technology and Teaching instrument was administered pre- and posttest.

Demographic information such as gender, years of experience, age, and amount and type of previous computer training was requested. The survey instrument also assessed whether computers were integrated or whether computers were taught in isolation from the curriculum. In May the teachers were also asked to estimate how many hours they used the computer in May 1997 in the classroom and also how many hours they used the computer at the beginning of the school year (August 1996). Information regarding how often computers were used in a computer lab, in the classroom, or both, was also requested from the school.

Irving Independent School District granted permission to conduct this project in its schools (see Appendix H). The schools obtained permission from the parents of the students before the student instruments were administered (see Appendix I). A request was submitted to the University of North Texas and approved for permission to use human subjects.

Description of integration education provided to the treatment group

A needs assessment of the teachers, along with discussion with the assistant principal, helped determine the type of technology staff development that was needed at Keyes (treatment site). All staff development took place on-site at Keyes Elementary using only the software and hardware that was available to the teachers. The intensive staff development sessions in August included an opening session with general overview of some computer basics that most teachers did not feel comfortable performing. The next session that day included a hands-on activity in the labs where teachers learned how to use the computer for their professional productivity, for example newsletter templates, class rosters, etc. At the end of the first day, a short evaluation was given to the teachers which included asking them to choose which of available sessions they would like to attend the following day.

Some adjustments were necessary to accommodate the teachers in the sessions they preferred. These sessions included previewing software to use in their classrooms, teacher utility programs such as Print Shop and BannerMania, and using MicroSoft Works integration activities (in the classroom). The sessions were concurrent. Those who assisted this researcher with the training included personnel from UNT, the computer lab aide at Keyes and other district personnel such as the assistant principal.

In the afternoon, all teachers were introduced to telecommunications using the Texas Educational Network (TENET). However very little follow-up ensued due to the delay of equipment to the building. Kid Pix was also introduced with examples of integration. A hands-on session allowed teachers to produce slide shows that were based on curricula they taught.

Subsequent sessions continued every 6 to 8 weeks throughout the school year at Keyes. These sessions included choices of several break-out sessions. Some of the subsequent visits were in small grade level groupings to meet needs of grade level teams.

Although the focus of this study was technology integration education, it was also necessary to include some tool-based training to raise the skill and comfort level of some teachers before teaching them to integrate technology. The technology integration sessions included examining classroom curriculum and finding ways to integrate computer technology. Instructional sessions focused on examples of activities such as using databases for classroom comparison activities and curriculum-based telecommunications projects. For example, teachers learned how to use a spreadsheet to graph math concepts. They were shown how, as well as encouraged, to create a slide show in Kid Pix Companion. The teachers worked on projects that were appropriate for their classrooms, such as book reports and other language arts projects, and they were shown how to make simple pictographs for younger children using Kid Pix. They were expected to develop lesson plans that apply to the curriculum in their classroom. (A sample of the staff development schedule for the treatment group can be found in Appendix J.)

The structure of this training approach is consistent with other teacher training programs that have been successfully implemented in the state of Texas. For example, the Eisenhower Math/Science Program now requires a similar training schedule for all projects funded in the state of Texas (N. A. Broussard, personal communication, January 5, 1996).

Data Analysis

Statistical analyses were performed using SPSS (Statistical Package for the Social Sciences) in order to compare the different groups. SPSS is a comprehensive and integrated statistical program for data description and hypothesis testing in the social sciences (Mueller, 1986).

Descriptive statistics were used to describe the type and amount of training, number of years of experience teaching, amount of use, applications used, whether the educator has a home computer, and whether computers are used in isolation or integrated into the curriculum.

A MANOVA was done to compare the students and teachers at Keyes, Gilbert, and Brown to determine whether they were significantly different from each other in January 1997. The statistical methods used for hypothesis testing in this study are presented in the context of each hypothesis.

Hypothesis 1: Needs-based technology integration education fosters positive attitudes toward information technology among elementary school classroom teachers.

Independent Variable - technology integration education

Dependent Variable - teacher attitudes measures

	Time 1 (Aug)	Time 2 (Jan)	Time 3(May)
Keyes (treatment)	TAC-pretest	TAC -pretest	TAC - posttest
Gilbert/Brown (comparison)		TAC - pretest	TAC -posttest

Figure 2. Questionnaire administration timeline

Because the comparison schools were unable to gather pretest data in August 1996, only teacher data from the treatment school were gathered at that time. As shown in Figure 2, data from teachers at both treatment and comparison schools were gathered in January 1997 and May 1997. This made it possible to test the hypotheses from a posttest design perspective for August - May and a pre-post perspective for January - May.

The following data analysis procedures were carried out:

1. A paired t-test was used to compare differences in the treatment and combined comparison group at time 2 (January) and time 3 (May).

2. A one-way analysis of variance was performed using January data for the treatment and comparison group, separating teachers who reported receiving integration training from those who reported having received no integration training. The same procedure was also performed using the May data.

3. Regression analysis was used to determine whether teachers' attitudes were a function of the training they had received prior to the August training (Keyes) or the training they received during the school year (treatment).

4. A multiple regression analysis was performed to determine whether teacher integration education and use had an impact on teacher attitudes.

Findings based on these procedures are presented in chapter 4.

Hypothesis 2: Teacher instruction in needs-based technology integration, combined with significant classroom utilization, fosters positive student attitudes toward information technology.

Independent Variables - Amount of use,

- Level of technology integration education

Dependent Variable - student attitude measures

The following data analysis procedures were carried out to test Hypothesis 2:

1. One-way analysis of variance was performed on the student subscales using data from the treatment and comparison group teachers. Classes of students were partitioned according to the following dichotomies created for teachers: (a) integration training versus no integration training, and (b) significant use versus less than significant use. Classes were analyzed by training, by use, and by training combined with use.

2. Because the underlying measurement scale for teacher and student data was actually continuous in nature, a regression analysis was also performed to examine the impact of computer use and technology integration education on student attitudes.

3. A time-lag regression model for student attitudes as a function of teacher training was also carried out to determine whether teacher integration education had a time-delayed impact on student attitudes.

Findings based on these procedures are presented in chapter 4.

Hypothesis 3: Positive teacher attitudes toward information technology foster positive attitudes in their students.

Independent Variables - teacher attitudes

Dependent Variables - student attitudes

A panel analysis (Markus, 1979) was used to determine probable causal relations among student and teacher attitudes. This is a form of time-lag regression analysis in which teachers' attitudes at time 2 (January) were used to predict students' attitudes at time 3 (May). The strength of this relationship was compared to how well teacher attitudes for time 2 can be predicted from student attitudes at time 1, and the stronger relationship was assumed to be the stronger causal path (see Figure 3). Panel analysis has been used for several decades to determine the impact of activities such as watching television on children's attitudes, and it has been successfully applied to studies of the impact of information technology (Sakamoto, 1994).

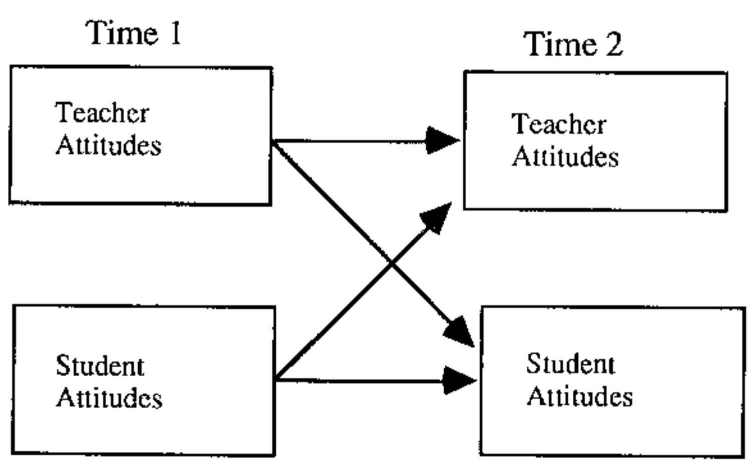

Figure 3. Path analysis depicting the probable causal path of teacher and student attitudes

It was hypothesized that the attitudes of the teachers who receive needs-based training should become more positive toward information technology. When teachers' attitudes become more positive and they are confident in their use of the technology, their classroom utilization should increase. The increase in positive attitudes, along with significant classroom utilization, should, over time, have a positive impact on their students' attitudes toward computers. It seems less plausible that changes in student attitudes will significantly impact the views of their teachers. Findings regarding this hypothesis are presented in chapter 4.

CHAPTER 4

PRESENTATION AND ANALYSIS OF DATA

The findings and interpretation of data analysis are presented in this chapter. Data were gathered to answer the following hypotheses:

Hypothesis 1: Needs-based technology integration education fosters positive attitudes toward information technology among elementary school classroom teachers.

Hypothesis 2: Teacher education in needs-based technology integration, combined with significant classroom utilization, fosters positive student attitudes toward information technology.

Hypothesis 3: Positive teacher attitudes toward information technology foster positive attitudes in their students.

Time Frame

The duration of this study was August 1996 through January 1997. Data were gathered from teachers at the treatment site in August 1996, and teachers and students in January 1997, and May 1997. Data were gathered from the two comparison sites in January and May 1997.

Description of Subjects

Subjects participating in this study consisted of elementary classroom teachers (Grades 1-5) and their students in three public elementary schools in the Irving Independent School District in Irving, Texas. Demographic characteristics of the three schools are provided in Table 4.

Background information for teachers was obtained by questionnaire (see Appendix C) regarding number of years of experience teaching, rate of experience with computers, how often computers are used in their classroom, whether they have received computer training, what type of training and where they received the training, whether they have a computer at home, gender, and age bracket. Table 4 shows the responses of the subjects from Keyes, Gilbert, and Brown Elementary schools in January 1997.

Table 4

Background Information for Keyes, Gilbert, and Brown, January 1997

Background questions	Keyes	Gilbert	Brown	Total
How long have you been teaching?				
(1) 0-1 years	3	4	2	9
(2) 2-5 years	1	7	2	10
(3) 6-10 years	5	4	2	11
(4) 11-15 years	4	1	3	8
(5) 16+ years	8	3	9	20
How would you rate your experience with computers?				
(1) I have never used a computer and I don't plan to anytime soon.	0	0	0	0
(2) I have never used a computer but would like to learn	0	1	0	1
(3) I use applications like word processing, spreadsheets, etc.	5	5	9	19
(4) I use computers for instruction in the classroom.	5	4	4	13
(5) Both (3) and (4)	12	9	5	26

(table continues)

Background questions	Keyes	Gilbert	Brown	Total
How often do you use computers for instruction?				
(1) Daily	8	6	5	19
(2) Weekly	6	8	3	17
(3) Occasionally	6	2	2	10
How many hours per week did you use computers at the beginning of the school year? (Aug 96) (average)	2.7	3.1	2.5	
How many hours per week do you use computers now? (May 97) (average)	5.5	6.4	3.4	
If you use computers, what type of training did you receive? (Rank order all that apply)				
(1) No training	0	1	0	0
(2) Basic computer literacy (on/off operations, how to run programs)	1	3	1	2
(3) Computer applications (word processing, etc.)	5	1	4	12
(4) Computer integration (how to use in classroom curriculum)	1	1	0	2
(5) (2) and (3)	4	4	10	15
(6) (2) and (4)	0	3	0	4
(7) (3) and (4)	0	6	0	3
(8) (2), (3) and (4)	11	0	3	20
Where did you receive your training? (Rank order all that apply)				
(1) Self taught	0	0	0	0
(2) School district	12	6	11	29
(3) College or university	0	2	0	2
(4) Other	0	1	0	1
(5) (1) and (2)	7	5	2	14
(6) (1) and (3)	2	3	2	5
(7) (2) and (3)	1	1	3	7
Do you have a computer at home?				
(1) Yes	12	12	11	35
(2) No	10	7	7	24
Gender				
(1) male	0	2	0	2
(2) female	22	17	18	57
Age				
(1) 18-25 years	3	4	2	9
(2) 26-30 years	5	6	2	13
(3) 31-35 years	3	3	3	9
(4) 36-40 years	3	2	2	7
(5) 41-45 years	3	1	0	4
(6) 46 + years	5	3	9	17
	n=22	n=20	n=18	n=60

Assessment Measures

As described in chapter 3, two foundation instruments as well as other measurement indices were used in this study. These provided profiles of data from teachers and their students in several areas, as shown in Table 4.

Technology Integration Education

Although the initial intention of the Keyes instruction was to be technology integration education for all teachers, a needs assessment (see Appendix A) given prior to training determined that many teachers were not ready for integration because they did not feel comfortable using a word processor. Therefore, many school-focused activities involved offering different types of training, including some applications as well as integration training.

On background information collected, teacher subjects responded to the type of training they had received. The categorical choices were (1) No training, (2) Basic Computer Literacy (on/off operations, how to run program, (3) Computer applications (word processing, spreadsheets), and (4) Computer integration (how to use in classroom curriculum). Each was asked to rank order all that applied to him/her. Respondents were categorized as follows: 01 = No training, 02 = Basic literacy, 03 = Application, 04 = Integration, 05 = Literacy and application, 06 = Integration and literacy, 07 = Integration and application, and 08 = Integration, application, and literacy. Those who selected integration among their choices (04, 06, 07, 08) were chosen for inclusion in the statistical analysis.

Many of the educators at Keyes who responded to the questionnaire in August were not classroom teachers, but rather aides, fine arts instructors, physical education instructors, and others. Only those who were classroom teachers were included in the analysis. At Gilbert and Brown, only classroom teachers completed the questionnaires.

In August 1996, 7 Keyes classroom teachers reported having received prior integration education. In January 1997, 13 Gilbert/Brown teachers reported having received integration training (10 were from Gilbert, and 3 were from Brown). By January 1997, 11 Keyes classroom teachers reported having received integration training. In May 1997, 11 Keyes classroom teachers reported having received integration training. Fourteen teachers reported having received integration training from Gilbert and Brown as of May 1997 (10 from Gilbert and 4 from Brown) (see Table 5).

Table 5

Self-reported Teacher Integration Training

	Keyes Integration training	No integration training	Gilbert/Brown Integration training	No integration training
August 1996	7	16		
January 1997	11	11	13	26
May 1997	11	11	14	11

Table 6 shows the 7 subscales for the YCCI and 26 of the subscales used for the teacher attitude assessment. Also included are the types of measures used (Likert, Semantic Differential, etc.) to measure the student and teacher attitudes.

Table 6

Measurement Subscales for Teachers and Students

Student subscales	Type	Teacher subscales	Type
Computer Importance (I)	3-pt Likert	Computer Importance (Tchi)	4-pt Likert
Computer Enjoyment (J)	3-pt Likert	Computer Enjoyment (Tchj)	4-pt Likert
Motivation/Persistence (M)	3-pt Likert		
Study Habits (S)	3-pt Likert		
Empathy (E)	3-pt Likert		
Creativity (C)	3-pt Likert		
Attitudes Toward School (SC)	3-pt Likert		
		Teacher Anxiety (Tchanx)	4-pt Likert
		Computer Attitude Scale Anxiety (CASA)	5-pt Likert
		Computer Attitude Scale Confidence(CASC)	5-pt Likert
		Computer Attitude Scale Liking (CASL)	5-pt Likert
		Computer Attitude Scale Use (CASU)	5-pt Likert
		Enthusiasm (F1)	5-pt Likert
		Anxiety (F2)	5-pt Likert
		Acceptance (F3)	5-pt Likert
		Email (F4)	5-pt Likert
		Negative Impact on society (F5)	5-pt Likert
		Class productivity for teacher (F6)	5-pt Likert
		Kay's Semantic (F7	7 pt semantic
		Vocation (F8)	5-pt Likert
		Prestige (F9)	5-pt Likert
		Teacher productivity (F10)	5-pt Likert
		Aversion (F11)	5-pt Likert
		K&M Importance (F13)	
		Confidence (F14)	5-pt Likert
		P&P Relevance (F15)	5-pt Likert
		P&P Enjoyment (F16)	5-pt Likert
		Social Distance (socdis)	5-pt Likert
		Support (perceived support for others)	5-pt Likert
		Teaching (Attitude toward teaching)	5-pt Likert
		Openness in classroom	5-pt Likert

Stages of Adoption of Technology

Keyes teachers responded to statements on the Stages of Adoption of Technology questionnaire, which placed each in one of six perceived levels of adoption (see Appendix C). The questionnaire was given in August 1996 (prior to training) and again in May 1997 (after treatment). Twelve of 22 total teachers moved up at least one category. Nine teachers moved up one category, 3 moved up two categories whereas 3 teachers moved down (1 teacher moved down 2 stages, and 2 teachers moved down 1 stage). General trends in the changes from August, prior to training, and in May, following the ongoing training, are depicted in Figures 4 and 5.

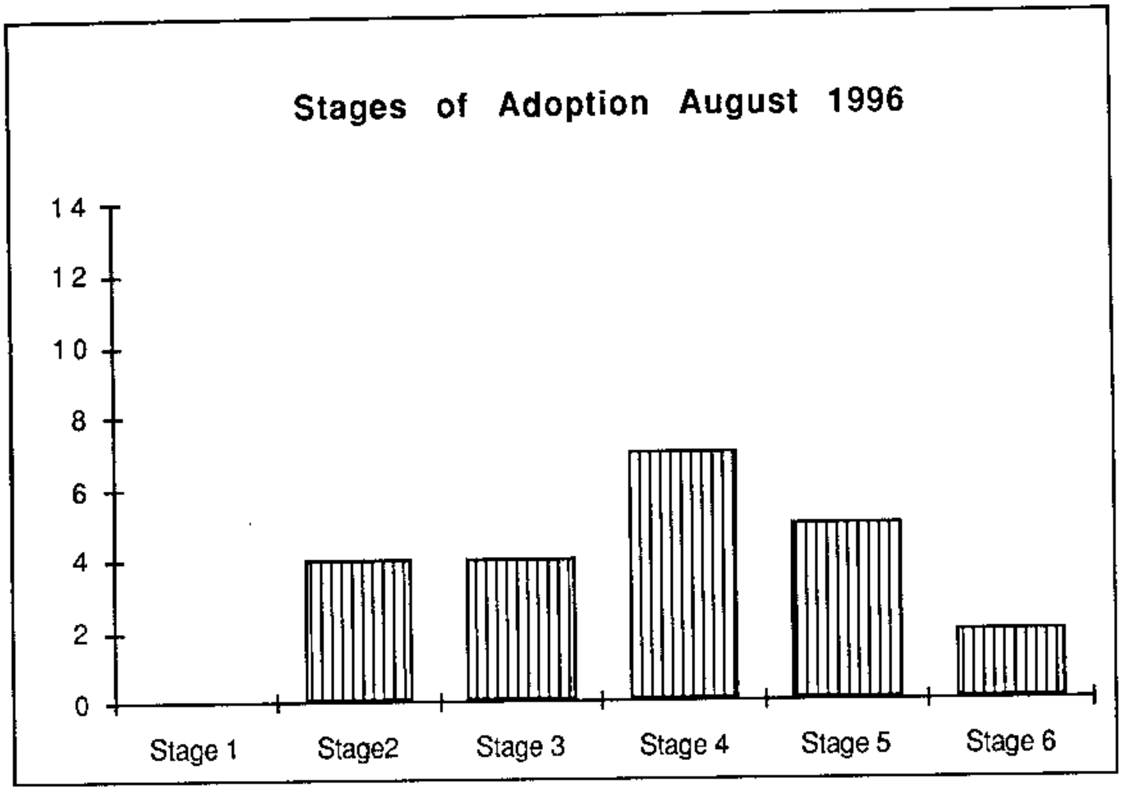

Figure 4. Keyes stages of adoption August 1996.

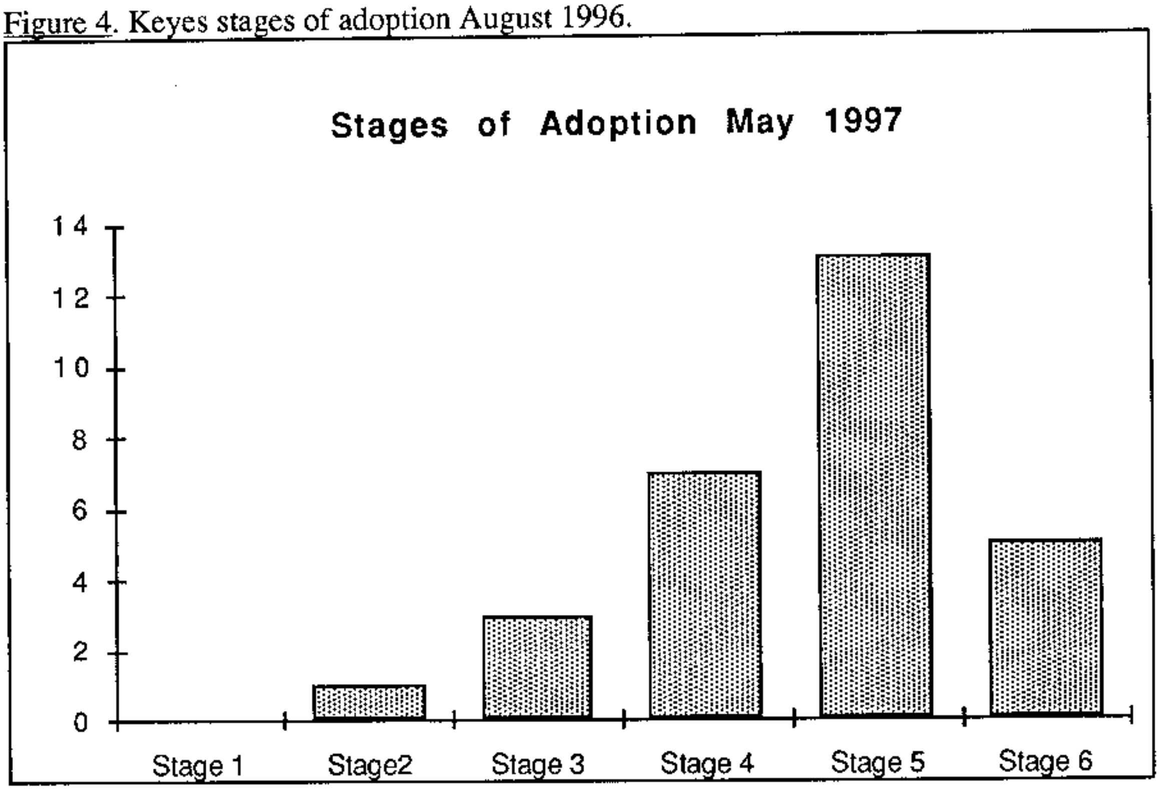

Figure 5. Keyes stages of adoption May 1997.

The mean scores, standard deviations, and ns for the 22 factors for Keyes in August, January, and May are shown in Table 7 for Keyes. The same information is shown in Tables 8 and 9 for Gilbert and Brown, respectively, for January and May.

Table 7

Keyes Teacher Subscale Mean Scores, August 1996, January 1997 , May 1997

Teacher subscale	Aug96 M	SD	n	Jan 97 M	SD	n	May97 M	SD	n
TchI(Computer Importance)	3.26	.54	19	3.34	.49	21	3.19	.43	29
TchJ(Computer Enjoyment)	3.19	.42	21	3.41	.40	20	3.27	.37	30
TchAnx (Anxiety)	3.02	.53	21	3.14	.48	19	3.22	.44	29
CASA (Anxiety)	3.77	.67	23	3.95	.57	22	4.12	.51	28
CASC (Confidence)	3.70	.39	22	3.62	.46	22	3.69	.43	29
CASL (Liking)	3.71	.45	23	3.68	.48	22	3.73	.56	30
CASU (Usefulness)	4.17	.48	22	4.15	.45	22	4.16	.54	30
F1 (Enthusiasm)	4.04	.40	22	4.04	.38	21	4.06	.44	29
F2 (Anxiety)	3.72	.82	23	4.02	.60	20	4.03	.56	29
F3 (Acceptance)	4.35	.53	20	4.31	.47	21	4.38	.49	29
F4 (Email)	3.62	.64	23	3.52	.72	22	3.52	.68	30
F5 (NI on society)	3.83	.56	22	3.85	.47	21	3.75	.54	29
F6 (Class productivity)	4.13	.45	23	4.11	.43	21	4.17	.52	29
F7 (Kay's Semantic)	5.41	.90	22	5.71	.76	21	5.88	.71	29
F8 (Vocation)	3.90	.40	21	4.03	.49	18	4.03	.57	29
F9 (Prestige)	3.84	.44	20	3.74	.57	20	3.69	.69	29
F10 (Teacher productivity)	4.10	.45	23	4.03	.44	19	4.12	.55	29
F11 (Aversion)	4.08	.48	23	4.11	.54	20	4.11	.49	30
F13 (K&M Importance)	3.44	.44	19	3.47	.46	21	3.33	.41	29
F14 (Confidence)	3.60	.45	21	3.40	.58	22	3.49	.56	30
F15 (P&P Relevance)	4.37	.41	22	4.37	.44	21	4.42	.45	28
F16 (P&P Enjoyment)	2.96	.42	21	2.90	.57	22	2.93	.55	30
Social Distance (socdis)	4.35	.54	22				4.41	.47	30
Support	3.85	.62	23				3.96	.63	30
Teaching (Att toward)	4.10	.45	23				4.23	.48	30
Openness in classroom	4.26	.53	23				4.42	.44	30

Table 8

Gilbert Teacher Subscale Mean Scores, January 1997 and May 1997

	Jan 97 M	SD	n	May97 M	SD	n
TchI (Computer Importance)	3.31	.40	20	3.43	.38	17
TchJ (Computer Enjoyment)	3.23	.40	20	3.27	.36	17
TchAnx (Anxiety)	3.01	.44	18	3.09	.39	16
CASA (Anxiety)	3.80	.52	19	3.92	.44	16
CASC (Confidence)	3.49	.39	19	3.64	.40	16
CASL (Liking)	3.61	.63	19	3.82	.57	16
CASU (Usefulness)	4.13	.43	19	4.25	.41	17
F1 (Enthusiasm)	3.82	.55	19	4.01	.49	15
F2 (Anxiety)	3.56	.72	17	3.75	.52	16
F3 (Acceptance)	4.21	.54	19	4.37	.42	15
F4 (Email)	3.40	.50	20	3.99	.71	14
F5 (NI on society)	3.51	.59	20	3.53	.67	15
F6 (Class productivity)	4.07	.50	18	4.11	.45	16
F7 (Kay's Semantic)	5.58	.92	19	5.31	1.01	16
F8 (Vocation)	3.88	.43	17	4.07	.54	16
F9 (Prestige)	3.64	.45	20	3.83	.53	16
F10 (Teacher productivity)	4.00	.54	18	4.04	.50	15
F11 (Aversion)	3.92	.41	19	3.85	.55	16
F13 (K&M Importance)	3.37	.41	20	3.50	.35	17
F14 (Confidence)	3.37	.64	19	3.60	.57	16
F15 (P&P Relevance)	4.31	.48	18	4.29	.43	16
F16 (P&P Enjoyment)	2.98	.51	19	3.14	.65	17

Table 9

Brown Teacher Subscale Mean Scores, January 1997 and May 1997

Teacher subscales	Jan 97 M	SD	n	May 97 M	SD	n
TchI (Computer Importance)	3.18	.47	16	3.16	.35	16
TchJ (Computer Enjoyment)	3.17	.37	16	3.33	.42	17
TchAnx (Anxiety)	2.87	.53	17	3.13	.44	17
CASA (Anxiety)	3.66	.50	18	3.95	.59	19
CASC (Confidence)	3.51	.42	17	3.59	.40	19
CASL (Liking)	3.41	.54	17	3.67	.53	19
CASU (Usefulness)	4.05	.30	18	4.02	.33	18
F1 (Enthusiasm)	3.84	.44	17	3.91	.44	19
F2 (Anxiety)	3.57	.59	18	3.95	.64	18
F3 (Acceptance)	4.38	.40	14	4.35	.44	18
F4 (Email)	3.44	.68	18	3.68	.75	19
F5 (NI on society)	3.66	.47	18	3.68	.56	19
F6 (Class productivity)	3.93	.48	18	4.07	.44	19
F7 (Kay's Semantic)	5.27	1.10	17	5.51	1.07	18
F8 (Vocation)	3.87	.26	15	3.75	.48	16
F9 (Prestige)	3.58	.45	18	3.52	.49	17
F10 (Teacher productivity)	3.99	.47	18	4.06	.45	19
F11 (Aversion)	3.95	.37	18	4.06	.44	18
F13 (K&M Importance)	3.29	.38	17	3.34	.31	16
F14 (Confidence)	3.21	.64	18	3.35	.67	19
F15 (P&P Relevance)	4.36	.30	18	4.43	.33	19
F16 (P&P Enjoyment)	2.73	.49	18	2.80	.53	19

Treatment and Comparison Groups

Keyes was the only one of the three schools to receive the needs-based technology integration education. Gilbert and Brown did not receive the treatment. In order to determine whether it was reasonable to combine Gilbert and Brown as a single comparison group, class means for student attitudes were calculated for each classroom and assigned to their teacher as an indicator of a class. A classroom-by-classroom MANOVA was carried out for all three schools using January 1997 data (see Table 10), as well as data from Gilbert versus Brown (see Table 11). No significant ($p<.05$) differences were found for the overall multivariate Fs or with univariate Fs for any of the individual technology-related subscales. In addition, no significant diferences (p<.05) were found when the same procedure was applied to Gilbert versus Brown Elementary Schools. Therefore, for subsequent analyses, subjects at the two schools--Gilbert and Brown--were combined into a single comparison group.

Table 10

Multivariate Test of Keyes, Gilbert, and Brown on 7 Student Indices

Subscale	SS	df	ms	F	p
I (Computer Importance)	.033	2	.017	1.10	.340
Error	.864	57	.015		
J (Computer Enjoyment)	012	2	.006	.72	.491
Error	.496	57	.009		
M (Motivation)	.206	2	.103	4.58	.014
Error	1.284	57	.022		
S (Study Habits)	.076	2	.038	2.07	.136
Error	1.047	57	.018		
E (Empathy)	.092	2	.046	3.52	.036
Error	.746	57	.013		
C (Creativity)	.039	2	.019	.82	.445
Error	1.348	57	.024		
SC (Attitudes toward School)	.027	2	.014	.24	.786
Error	3.213	57	.056		

Wilks's lambda = .042. F = 1.54. df = 14, 399. p =.094. n = 60.

Table 11

MANOVA of Gilbert and Brown on 7 Student Indices

Subscale	SS	ms	F	p
I (Computer Importance)	.019	.019	1.379	.248
Error	.489	.014		
J (Computer Enjoyment)	.012	.012	1.508	.227
Error	.280	.008		
M (Motivation)	.045	.045	2.305	.138
Error	.702	.020		
S (Study Habits)	.012	.012	.584	.450
Error	.761	.021		
E (Empathy)	.016	.016	1.188	.283
Error	.480	.013		
C (Creativity)	.006	.006	.318	.576
Error	.713	.020		
SC (Attitudes toward School)	.027	.027	.476	.495
Error	2.010	.056		

Wilks's lambda = .801. F = .904. df = 7,252. p = .50. n = 37

Description of Paired Sample

A paired t-test was carried out for Keyes and the combined Gilbert/Brown sample in order to contrast treatment versus comparison groups. The trend for the Keyes teachers was to change in a more positive direction in their attitudinal measures over time. From August to January, 14 of the 22 factors changed in a positive direction. The 4 that changed significantly ($p<.05$) were Tchi (Computer Importance), Tchj (Computer Enjoyment), F8 (Vocation), and F13 (K&M Importance).

From January to May, 15 of the 22 factors for the Keyes teachers changed in a positive direction. Three of those were significant at the $p<.05$ level CASA -- (Loyd & Gressard's Anxiety), F3 (Acceptance), and F8 (Vocation) (see Table 12). Overall, from August to May, there were 14 of 22 factors changed in a more positive direction. Four of those were significant at the $p<.05$ level (CASA (Loyd & Gressard's Anxiety), F2 (Anxiety), F7 (Kay's Semantic), and F8 (Vocation).

Over the entire time period from August to May, all 22 factors changed in a more positive direction for the Keyes Elementary School teachers (either Aug. to Jan. or Jan. to May).

The overall trends were similar to Keyes for Gilbert/Brown on many factors, such as Anxiety (Table 13). However, they were different with respect to the Email (F4) measure. Gilbert teachers had access to Email in their classrooms and received training in its use, whereas Keyes and Brown teachers did not.

Table 12

Keyes Paired T-test August (1996), January (1997) and May (1997)

	N	Aug-96	Jan-97	2-tail prob	N	Jan-97	May-97	2-tail prob	N	Aug-96	May-97	2-tail prob
I	14	3.21	3.50	.04	21	3.34	3.29	.60	19	3.26	3.28	0.902
J	14	3.17	3.52	.00	20	3.41	3.31	.222	21	3.19	3.28	0.304
Anxiety	14	3.04	3.13	0.44	19	3.14	3.24	.187	20	3.03	3.21	0.121
CASA	18	3.83	3.97	0.14	20	3.95	4.14	.027	21	3.77	4.08	0.003
CASC	17	3.74	3.70	.65	21	3.60	3.70	.15	21	3.68	3.76	0.367
CASL	18	3.71	3.71	1.00	22	3.68	3.77	0.23	23	3.71	3.76	0.646
CASU	17	4.25	4.08	0.02	22	4.15	4.06	0.188	22	4.17	4.05	0.241
F1 (Enthusiasm)	16	4.04	3.85	.00	20	4.04	3.83	0.001	21	4.05	3.83	0.001
F2 (Anxiety)	16	3.81	3.99	0.17	19	3.98	4.05	0.232	22	3.70	3.98	0.022
F3 (Acceptance)	15	4.42	4.28	0.12	21	4.31	4.44	0.038	20	4.35	4.34	0.906
F4 (Email)	18	3.65	3.51	0.18	22	3.52	3.56	0.746	23	3.62	3.54	0.462
F5 (NI)	16	3.79	3.83	0.70	20	3.83	3.70	0.14	21	3.83	3.70	0.276
F6 (Prod-class)	17	4.08	4.17	0.22	20	4.10	4.20	0.319	22	4.14	4.17	0.75
F7 (KaySem)	17	5.68	5.84	0.46	21	5.71	5.86	0.184	21	5.42	5.91	0.023
F8 (Vocation)	13	4.00	4.18	0.06	18	4.03	4.20	0.045	21	3.90	4.08	0.111
F9 (Prestige)	14	3.82	3.79	0.76	19	3.72	3.74	0.87	19	3.84	3.84	1
F10 (Prod-tchr)	15	4.06	4.07	0.90	18	4.02	4.17	0.138	22	4.10	4.14	0.753
F11 (Aversion)	16	4.07	4.20	0.24	20	4.11	4.17	0.574	23	4.08	4.09	0.931
F13 (K&M Imp)	14	3.42	3.65	0.04	21	3.47	3.44	0.691	19	3.44	3.40	0.728
F14 (L&G Conf)	16	3.65	3.50	0.23	22	3.40	3.51	0.275	21	3.60	3.60	0.945
F15 (P&P Rel)	16	4.34	4.47	0.11	20	4.36	4.44	0.166	21	4.37	4.39	0.46
F16 (P&P Enj)	16	2.94	3.01	0.51	22	2.90	2.87	0.757	21	2.96	2.96	1

Table 13

Gilbert/Brown Paired t-test January (1997), May (1997)

Teacher subscale	n	Jan-97 M	May-97 M	2-tail prob
Tchi (Computer Importance)	27	3.26	3.33	.33
Tchj (Computer Enjoyment)	28	3.23	3.22	.75
Anxiety	25	3.02	3.08	.39
CASA (CAS Anxiety)	28	3.76	3.85	.25
CASC (CAS Confidence)	28	3.53	3.53	1.00
CASL (CAS Liking)	27	3.63	3.69	.49
CASU (CAS Usefulness)	29	4.09	3.93	.06
F1 (Enthusiasm)	27	3.87	3.67	.00
F2 (Anxiety)	26	3.60	3.74	.05
F3 (Acceptance)	25	4.34	4.35	.90
F4 (Email)	27	3.54	3.82	.02
F5 (Negative Impact)	28	3.55	3.58	.68
F6 (Productivity-classroom)	27	4.06	4.07	.83
F7 (Kay's Semantic)	27	5.47	5.32	.40
F8 (Vocation)	23	3.90	3.93	.68
F9 (Prestige)	28	3.61	3.67	.42
F10 (Productivity-teacher)	26	4.00	4.03	.65
F11 (Aversion)	27	3.87	3.89	.76
F13 (K&M Imp)	28	3.33	3.41	.23
F14 (Confidence)	28	3.40	3.40	1.00
F15 (P&P Relevance)	27	4.34	4.33	.89
	29	2.91	2.95	.65

Tests of Hypotheses

The findings and interpretations of data analysis are presented in this section. Findings are discussed in the order of the hypotheses.

Analysis of Hypothesis 1

Hypothesis 1: Needs-based technology integration education fosters positive attitudes toward information technology among elementary school classroom teachers.

All teacher subjects from the three Irving schools were combined for the initial analysis of the data regarding Hypothesis 1. They were divided into two categories – those who reported having received integration training (IT) and those who reported having received no integration training (NIT).

A one-way analysis of variance was performed using January data for Keyes and Gilbert/Brown combined and separating teachers who reported receiving integration training (IT) from those who reported receiving no integration training (NIT). Teachers who were in the IT group were significantly different (all higher) from the NIT group on 13 of 22 factors. These data are provided in Table 14.

Table 14

Keyes, Gilbert, and Brown Teachers - Integration Training Versus No Integration Training January 1997

Subscale	n	M	SD	F	df	p	SS	Tot SS	MS
CASA (IT)	26	4.09	.53	11.13	48	.00	11.01	13.62	.23
CASA (NIT)	23	3.62	.43						
CASC(IT)	26	3.70	.43	3.74	47	.06	7.31	7.91	.16
CASC(NIT)	22	3.47	.35						
CASL(IT)	26	3.82	.52	7.76	47	.01	12.15	14.20	.26
CASL(NIT)	22	3.40	.51						
F1(IT)	26	4.05	.51	3.63	46	.06	9.52	10.29	.21
F1(NIT)	21	3.80	.39						
F2(IT)	26	4.01	.64	9.00	45	.00	16.42	19.78	.37
F2(NIT)	20	3.46	.57						
F4(IT)	27	3.67	.80	5.14	49	.03	19.43	21.51	.40
F4(NIT	23	3.26	.36						
F6(IT)	26	4.18	.51	5.55	46	.02	7.94	8.92	.18
F6(NIT	21	3.89	.27						
F8(IT)	24	4.07	.49	4.27	39	.05	6.56	7.30	.17
F8(NIT)	16	3.79	.27						
F9(IT)	27	3.85	.53	8.73	47	.00	9.64	11.47	.21
F9(NIT)	21	3.46	.34						
F10(IT)	25	4.11	.52	4.49	44	.04	9.00	9.93	.21
F10(NIT)	20	3.81	.35						
F11(IT)	27	4.09	.53	5.29	46	.03	8.84	9.89	.20
F11(NIT)	20	3.79	.28						
F14(IT)	26	3.54	.65	3.30	48	.08	17.11	18.31	.36
F14(NIT)	23	3.22	.54						
F16(IT)	26	3.11	.57	7.72	48	.01	12.56	14.62	.27
F16(NIT)	23	2.70	.45						

*two-tailed significance reported, $p<.05$

A one-way analysis of variance was also performed using May 1997 data. Teachers who reported they had received integration training (IT) had significantly higher (more positive) attitudes on all of the teacher attitude subscales measured. These data are provided in Table 15.

Table 15

Keyes, Gilbert, and Brown Teachers Integration Training Versus No Integration Training May 1997

Subscale	n	M	SD	F	df	p	SS	Tot SS	MS
Tchi (IT)	26	3.40	.45	3.60	47	.06	7.40	8.00	.34
Tchi(NIT)	22	3.18	.34						
Tchj(IT)	27	3.37	.35	6.66	47	.01	5.48	6.28	.12
Tchj(NIT)	21	3.11	.34						
Tchanx(IT)	26	3.25	.42	5.65	46	.02	7.25	8.16	.16
Tchanx(NIT)	21	2.97	.37						
CASA (IT)	25	4.18	.55	8.41	46	.01	10.24	12.16	.23
CASA(NIT)	22	3.78	.38						
CASC(IT)	26	3.77	.41	8.42	47	.01	5.93	7.01	.13
CASC(NIT)	22	3.46	.29						
CASL(IT)	27	3.93	.51	8.42	48	.01	10.76	12.68	.23
CASL(NIT)	22	3.53	.44						
CASU(IT)	27	4.21	.47	14.10	49	.00	8.60	11.12	.18
CASU(NIT)	23	3.76	.36						
F1(IT)	25	3.86	.42	5.79	47	.02	5.96	6.71	.13
F1(NIT)	23	3.61	.28						
F2(IT)	25	4.05	.63	5.42	46	.02	13.94	15.61	.31
F2(NIT)	22	3.67	.46						
F3(IT)	27	4.47	.47	3.98	47	.05	9.08	9.83	.20
F3(NIT)	21	4.21	.41						
F4(IT)	25	3.92	.71	10.07	46	.00	16.66	20.40	.37
F4(NIT	22	3.36	.47						
F5(IT)	25	3.73	.47	2.80	46	.10*	9.77	10.38	.22
F5(NIT)	22	3.50	.46						
F6(IT)	25	4.24	.53	6.40	47	.01	9.04	10.30	.20
F6(NIT	23	3.91	.31						
F7(IT)	26	5.76	.82	3.86	46	.06	36.47	39.60	.81
F7(NIT)	21	5.24	.99						
F8(IT)	25	4.15	.56	5.91	46	.02	9.86	11.15	.22
F8(NIT)	22	3.82	.32						

(table continues)

Subscale	n	M	SD	F	df	p	SS	Tot SS	MS
F9(IT)	24	3.83	.68	4.08	46	.05	13.91	15.17	.31
F9(NIT)	23	3.51	.39						
F10(IT)	25	4.18	.55	4.85	46	.03	9.33	10.34	.21
F10(NIT)	22	3.89	.32						
F11(IT)	25	4.10	.56	2.50	47	.12*	11.72	12.36	.25
F11(NIT)	23	3.87	.44						
F13(IT)	26	3.51	.39	4.18	47	.05	5.66	6.17	.12
F13(NIT)	22	3.31	.30						
F14(IT)	27	3.59	.60	2.73	48	.11*	15.87	16.79	.34
F14(NIT)	22	3.31	.55						
F15(IT)	25	4.46	.46	5.56	47	.02	6.46	7.24	.14
F15(NIT)	23	4.21	.24						
F16(IT)	27	3.09	.60	5.65	49	.02	14.49	16.20	.30
F16(NIT)	23	2.72	.48						

*two-tailed significance reported, $p<.05$

Data for January versus May were also analyzed by looking at the combined Gilbert and Brown teachers. Three factors were significantly ($p<.05$) higher (more positive) in January, and seven were significantly ($p<.05$) more positive in May.

Table 16

One-way Analysis of Variance for Integration Education Versus Non-integration Education, Gilbert and Brown, January 1997

Subscale	n	M	SD	df	F ratio	Sig
CASA (IT)	16	3.97	.48	1,25	4.46	.04
CASA (NIT)	10	3.58	.47			
F2 (Anxiety) (IT)	16	3.81	.58	1,25	5.34	.03
F2 (Anxiety)(NIT)	10	3.25	.63			
F16 (IT)	16	3.10	.56	1,25	3.60	.07*
F16 (NIT)	10	2.71	.46			

$p<.05$, *two-tailed significant reported

Table 17

One-way Analysis of Variance for Integration Education Versus Non-integration Education, Gilbert and Brown, May 1997

	n	M	SD	df	F ratio	p
CASA (IT)	15	4.04	.42	1,25	4.09	.05
CASA (NIT)	11	3.69	.45			
CASU (IT)	15	4.02	.46	1,25	2.86	.10*
CASU (NIT)	11	4.12	.34			
F2 (IT)	15	3.92	.55	1,25	3.00	.10*
F2 (NIT)	11	3.55	.52			
F4 (IT)	15	4.03	.72	1,25	6.65	.02
F4 (NIT)	11	3.38	.46			
F5 (IT)	15	3.70	.49	1,25	3.09	.10
F5 (IT	11	3.35	.50			
F7 (IT)	15	5.71	.91	1,25	8.15	.01
F7 (NIT)	11	4.66	.94			

p.<.05 , *two-tailed significance reported

Regression analysis was used to determine whether Keyes teachers' attitudes were a function of the training they had received prior to the August training. Using the August 1996 data (prior to the treatment), it was found that none of the 22 factors was influenced by prior training.

The same regression analysis using May 1997 data revealed that 11 of the factors were significantly influenced by the training they reported having received. These factors were significantly ($p<.05$) influenced by training and are boldfaced in Table 18.

Table 18

Teacher Attitudes as a Function of Training, May 1997

Teacher factor	Beta	Signif
TchI = f(trng)	.43	**.04**
TchJ = f(trng)	.38	**.06**
Tchanx	.48	**.02**
CASA (CAS Anxiety)	.41	**.06**
CASC (CAS Confidence)	.31	.15
CASL (CAS Liking)	.35	.10
CASU (CAS Usefulness)	.57	**.00**
F1 (Enthusiasm)	.28	.20
F2 (Anxiety)	.30	.16
F3 (Acceptance)	.60	**.00**
F4 (Email)	.17	.44
F5 (NI on society)	.09	.69
F6 (classroom productivity)	.55	**.01**
F7 (Kay's semantic)	-.13	.57
F8 (Vocation)	.53	**.01**
F9 (Prestige)	.27	.22
F10 (teacher productivity)	.49	**.02**
F11 (Aversion)	.30	.16
F13 (K&M Importance)	.44	**.04**
F14 (L&G Confidence	.11	.62
F15 (P&P Relevance)	.56	**.01**
F16 (P&P Enjoyment)	.09	.69

n=22 Reported as two-tail significance

Treatment Group Comparisons Over Time

Only Keyes teachers received the treatment of technology integration education provided by the author. Using their August data (reported prior to the treatment), a series of one-way ANOVAs were performed between those who reported having received integration training (prior to treatment) (Group 1) (n=6) and those who reported having received no integration training (Group 2) (n=16). There were no significant (p<.05) differences between the two groups on any of the 22 attitudinal factors as measured by the TAC.

For the time period January to May, among teachers who reported integration training, 13 out of 22 factors changed significantly ($p<.05$) in a positive direction for Keyes teachers (see Table 19), whereas only 4 of the 22 factors changed in a positive direction for the Gilbert/Brown teachers (see Table 20). A binomial test was performed using 4/22 as the expected probability of success. The two groups were found to be significantly different at the alpha = .0001 level (Weast, 1969, p. 600).

Table 19

Keyes Teachers January to May on Integration Training (IT) Versus No Integration Training (NIT)

Teacher subscale	Means IT	Means NIT	Difference between IT and NIT	Difference between Jan. and May	p
I-Jan	3.43	3.24	-.19		.40
I2-May	3.49	3.07	-.42	.23	.02
J	3.41	3.40	-.01		.92
	3.44	3.12	-.32	.31	.05
Anxiety	3.19	3.10	-.09		.70
	3.41	3.03	-.38	.29	.04
CASA	4.24	3.67	-.57		.01
	4.40	3.88	-.52	-.05	.03
CASC	3.81	3.44	-.37		.05
	3.91	3.49	-.42	.05	.02
CASL	3.93	3.43	-.50		.01
	4.05	3.50	-.55	.05	.02
CASU	4.39	3.92	-.47		.01
	4.41	3.72	-.69	.22	0
F1 (Enthusiasm)	4.18	3.89	-.29		.08
	4.00	3.67	-.33	.04	.02
F2 (Anxiety)	4.27	3.71	-.56		.03
	4.23	3.78	-.45	-.11	.09
F3 (Acceptance)	4.57	4.03	-.54		0
	4.75	4.10	-.65	.11	0

(table continues)

Teacher subscale	Means IT	Means NIT	Difference between IT and NIT	Difference between Jan. and May	p
F4 (Email)	3.77	3.28	-.49		.12
	3.79	3.33	-.46	-.03	.10
F5 (NI)	3.90	3.80	-.10		.64
	3.77	3.65	-.12	.02	.51
F6 (Prod-class)	4.32	3.88	-.44		.02
	4.60	3.83	-.77	.33	0
F7 (KaySem)	5.47	5.97	.50		.14
	5.84	5.88	.04	.46	.88
F8 (Vocation)	4.24	3.71	-.53		.02
	4.45	3.79	-.66	.13	0
F9 (Prestige)	4.01	3.40	-.61		.01
	4.04	3.45	-.59	-.02	.04
F10 (Prod-tchr)	4.25	3.79	-.46		.02
	4.51	3.87	-.64	.18	0
F11 (Aversion)	4.30	3.87	-.43		.07
	4.32	3.92	-.40	-.03	.07
F13 (K&M Imp)	3.52	3.41	-.11		.60
	3.63	3.23	-.40	.29	.01
F14 (L&G Conf)	3.59	3.21	-.38		.13
	3.34	3.38	.04	-.42	.28
F15 (P&P Rel)	4.61	4.11	-.50		.01
	4.77	4.13	-.64	.14	0
F16 (P&P Enj)	3.12	2.68	-.44		.07
	3.05	2.70	-.35	-.09	.11
January	n=10	n=11			
May	n=10	n=11			

Table 20

Gilbert/Brown Teachers January (1997) and May (1997)

Teacher subscales	Means for IT	Means for NIT	Difference between IT and NIT	Difference between Jan and May	F prob
I-Jan	3.29	3.24	-.05		.80
I2-May	3.32	3.26	-.06	.01	.70
J	3.33	3.13	-.20		.19
	3.32	3.10	-.22	.02	.12
Anxiety	3.13	2.92	-.21		.29
	3.13	2.92	-.21	0	.18
CASA	3.97	3.58	-.39		.04
	4.04	3.69	-.35	-.04	.05

(table continues)

Teacher subscales	Means for IT	Means for NIT	Difference between IT and NIT	Difference between Jan and May	F prob
CASC	3.61	3.51	-.10		.49
	3.68	3.44	-.24	.14	.08
CASL	3.74	3.38	-.36		.14
	3.84	3.55	-.29	-.07	.14
CASU	4.02	4.12	.10		.55
	4.07	3.79	-.28	.38	.10
F1 (Enthusiasm)	3.96	3.72	-.24		.25
	3.76	3.55	-.21	-.03	.18
F2 (Anxiety)	3.81	3.25	-.56		.03
	3.92	3.55	-.37	-.19	.10
F3 (Acceptance)	4.23	4.38	.15		.46
	4.28	4.32	.04	.11	.83
F4 (Email)	3.60	3.24	-.36		.13
	4.03	3.38	-.65	.29	.02
F5 (NI)	3.58	3.48	-.10		.66
	3.70	3.35	-.35	.25	.09
F6 (Prod-class)	4.08	3.90	-.18		.33
	4.00	3.99	-.01	-.17	.94
F7 (KaySem)	5.74	5.21	-.53		.16
	5.71	4.66	-1.05	.52	.01
F8 (Vocation)	3.93	3.85	-.08		.66
	3.92	3.84	-.08	0	.69
F9 (Prestige)	3.74	3.50	-.24		.15
	3.69	3.55	-.14	-.10	.51
F10 (Prod-tchr)	4.01	3.84	-.17		.39
	3.97	3.90	-.07	-.10	.70
F11 (Aversion)	3.95	3.73	-.22		.14
	3.93	3.82	-.11	-.11	.59
F13 (K&M Imp)	3.38	3.31	-.07		.67
	3.43	3.38	-.05	-.02	.68
F14 (L&G Conf)	3.50	3.24	-.26		.31
	3.55	3.24	-.31	.05	.22
F15 (P&P Rel)	4.27	4.38	.11		.48
	4.26	4.28	.02	.09	.86
F16 (P&P Enj)	3.10	2.71	-.39		.07
	3.12	2.74	-.38	-.01	.11
January	n=16	n=10			
May	n=15	n=12			

Impact of Teacher Integration Education for Treatment Versus Comparison Groups

A dummy-coded multiple regression analysis was performed to determine whether teacher integration education had a differential effect on teacher attitudes for the treatment versus the comparison group. Basically, this was a test to determine whether the teacher integration education delivered by the researcher had a greater impact than the standard school district training and workshops available to all teachers in the treatment and comparison groups. Frequency of use (usenow and howoft) was also included in the regression model in order to statistically control for frequency of use. Two sets of dummy vectors were created in order to accomplish this test, using the following SPSS code:

```
if (id lt 200) dummy =1.  [Keyes teacher]
if (id ge 200) dummy =0.  [Gilbert or Brown teacher]
compute ktrng2 = dummy * trng2.
compute kusenow = dummy * usenow.
compute khowoft = dummy * howoft2.
compute kcompuse = dummy * compuse2.
compute idummy = 1-dummy.
compute gbtrng2 = idummy * trng2.
compute gbusenow = idummy * usenow.
compute gbhowoft = idummy * howoft2.
compute gbcomp = idummy * compuse2.
Regression variables = tchi2 ktrng2 gbtrng2 kusenow gbusenow khowoft
gbhowoft kcompuse gbcomp /dependent = tchi2 /method = enter.
```

As shown in Table 21, when using standardized regression coefficients (betas) to compare the impact of Keyes training and use to Gilbert/Brown's training and use, it appears that the amount of teacher computer use (usenow) is a stable predictor of the teacher's perceptions of Computer Importance (I2) for Keyes Elementary School (beta = .42, $p < .02$) and for the comparison schools of Gilbert/Brown (Beta = .45, $p < .04$). Level of teacher integration education reported for May 1997 (trng2) is not a significant predictor of teacher Computer Importance for Gilbert/Brown (beta = -.10, NS), but it is a good predictor of teacher Computer Importance for Keyes Elementary (beta = .73, p < .04). This indicates that the integration education delivered to the teachers at Keyes Elementary significantly influenced their perceptions of Computer Importance.

Table 21

Multiple Regression for Teacher Computer Importance in May 1997 as a Function of Training and Use, Incorporating Dummy-coded Treatment Versus Comparison Groups

TchI2 as a function of:	beta	Signif
GB compuse	.52	.24
Keyes compuse	.14	.84
GB usenow	.45	.04
Keyes usenow	.42	.02
GB howoft	.55	.06
Keyes howoft	.23	.47
GB trng2 (May measure)	-.10	.72
Keyes trng2 (May)	.73	.04

$n = 50$. F (8,31 df) = 3.43. Signif F = .0061.

Acceptance of Hypothesis 1

Data gathered in this study indicate that (a) teachers at the treatment and comparison sites who reported having received computer integration education tended to exhibit more positve attitudes toward information technology than their non-integration counterparts ; (b) teachers at the treatment site changed to a greater extent in the direction of more positive attitudes than did their comparison group peers; and (c) the integration education delivered at the treatment site had a significant impact on perceived computer importance (after controlling for frequency of use) while the impact of training at the comparison sight was negligible. These findings, taken as a whole, led to the acceptance of the hypothesis that needs-based technology integration education fosters positive attitudes toward information technology among elementary school classroom teachers.

Analysis of Hypothesis 2

Hypothesis 2: Teacher instruction in needs-based technology integration combined with significant classroom utilization fosters positive student attitudes toward information technology.

Trends in classrooom utilization of computers. A background question in May asked the teachers how many hours per week they currently used computers and how many hours they had used computers at the beginning of the school year.

For Keyes teachers, 18 reported an increase in use, whereas 1 reported a decrease in use. Out of the 10 Gilbert teachers with complete data, 9 reported an increase in computer use whereas 1 reported a decrease. Out of the 12 Brown teachers with complete data, 4 reported an increase in computer use, 1 reported a decrease and 7 reported no change. Combining Gilbert and Brown subjects, the number of teachers who increased for the comparison time period was 13/22 as compared to 18 out of 19 teachers for Keyes who reported an increase in use.

Table 22

Computer Use Now (May 97) Versus Use Then (August 1996) as Reported in May

Number of hours	Keyes Usethen	Keyes Usenow	Gilbert Usethen	Gilbert Usenow	Brown Usethen	Brown Usenow
0	6	0	0	0	0	0
1	5	3	3	0	4	2
2	8	6	3	0	7	8
3	2	4	1	2	2	3
4	0	1	2	4	0	1
5	7	6	1	3	4	2
6	0	2	0	2	0	0
7	0	0	0	1	0	1
8	0	3	0	0	0	0
10	2	2	1	2	0	1
15	0	2	0	0	0	0
20	0	0	0	1	0	0
30	0	1	0	0	0	0
	n=30		n=17		n=19	

Operational definition of significant classroom utilization. Frequency distributions were calculated to help determine what amount of use would be classified as significant, for the purpose of categorizing teachers to be included in the analysis. Looking across all classroom teachers from the three schools, it was found that roughly 50% were at 4 hours or below, and roughly 50% were at 5 hours or above in the amount of use per week. Therefore, teachers who used computers 5 hours or more per week were classified as significant users, and those reporting 4 or fewer were classified as not having significant use.

Operational definition of technology integration education. The same determination of technology integration education for teachers from Hypothesis 1 was used in Hypothesis 2. The groupings were teachers who reported IT (Group 1) and those who reported NIT (Group 2).

Treatment and comparison of student differences due to technology integration education. One-way analysis of variance procedures were carried out on seven student subscales, using data from the treatment group (Keyes Elementary) alone. As shown in Table 23, Keyes students by teacher integration training (Group 1) versus no integration training (Group 2) on the January and May student data showed only significant differences on Creativity in January and no other significant differences on any of the other seven subscales in January or May.

Table 23

Analysis of Variance for Keyes Integration Training Versus No Integration Training January and May 1997

Subscale	January IT M (SD)	January NIT M (SD)	p	May IT M (SD)	May NIT M (SD)	p
I (Computer Importance)	2.71 (.34)	2.75 (.28)	.16	2.64 (.37)	2.67 (.35)	.51
J (Computer Enjoyment)	2.83 (.29)	2.86 (.25)	.24	2.84 (.26)	2.84 (.28)	.91
M (Motivation)	2.48 (.39)	2.51 (.41)	.49	2.46 (.42)	2.44 (.41)	.60
S (Study Habits)	2.60 (.33)	2.61 (.35)	.76	2.57 (.35)	2.56 (.38)	.77
E (Empathy)	2.56 (.41)	2.58 (.39)	.60	2.63 (.41)	2.60 (.39)	.35
C (Creativity)	2.54 (.39)	2.63 (.38)	.02	2.56 (.37)	2.58 (.41)	.61
SC (Attitudes toward School)	2.31 (.56)	2.28 (.56)	.53	2.27 (.53)	2.26 (.61)	.84
	n=212	n=186		n=198	n=202	

One-way analysis of variance was also performed on the seven student subscales using data from the comparison group Gilbert/Brown alone. As shown in Table 24, students by teacher integration (group 1) versus non-integration training (Group 2) showed significant differences (.0911) for I (Computer Importance) in the May 1997 data. Group 1 (IT) was higher than Group 2 (NIT). Using January student data, Empathy was significantly (.0147) higher for Group 1.

Table 24

Analysis of Variance for Gilbert/Brown Teachers Integration Training Versus No Integration Training, January and May 1997

Subscale	Jan. IT M (SD)	Jan. NIT M (SD)	p	May IT M (SD)	May NIT M (SD)	p
I (Computer Importance)	2.70 (.33)	2.71 (.28)	.62	2.65 (.33)	2.60 (.32)	.09
J (Computer Enjoyment)	2.86 (.24)	2.87 (.21)	.52	2.79 (.31)	2.81 (.30)	.49
M (Motivation)	2.40 (.40)	2.35 (.42)	.21	2.44 (.41)	2.44 (.40)	.99
S (Study Habits)	2.56 (.35)	2.57 (.33)	.92	2.55 (.35)	2.58 (.33)	.37
E (Empathy)	2.69 (.31)	2.61 (.35)	.01	2.64 (.39)	2.64 (.35)	.88
C (Creativity)	2.55 (.36)	2.55 (.30)	.89	2.57 (.33)	2.58 (.32)	.63
SC (Attitudes toward School)	2.37 (.52)	2.28 (.60)	.11	2.32 (.57)	2.37 (.61)	.33
	n=245	n=190		n=258	n=210	

Treatment and comparison of student differences due to teacher use. Using one-way analysis of variance procedures on the seven student subscales, Keyes students by teacher use showed no significant differences in the January data, but Computer Importance was significant (.0147) using the May 1997 student data. Students of the teachers who were in the significant use category (Group 1) were higher in Computer Importance than the students of the teachers who reported less use, as shown in Table 25. Gilbert/Brown students by teacher use showed no significant differences in January student data, but Computer Importance was significant (p =.0149) in the May 1997 data as shown in Table 25.

Table 25

One-way Analysis of Variance for Significance by Teacher Use at Keyes January and May 1997

Subscale	Jan. Use M (SD)	Jan. NS Use M (SD)	p	May Use M (SD)	May NS Use M (SD)	p
I (Computer Importance)	2.74 (.30)	2.73 (.33)	.77	2.70 (.33)	2.61 (.38)	.01
J (Computer Enjoyment)	2.83 (.26)	2.85 (.28)	.60	2.84 (.26)	2.84 (.28)	.74
M (Motivation)	2.52 (.39)	2.47 (.41)	.19	2.43 (.42)	2.48 (.41)	.29
S (Study Habits)	2.63 (.33)	2.59 (.36)	.31	2.54 (.37)	2.59 (.36)	.19
E (Empathy)	2.55 (.41)	2.58 (.39)	.47	2.61 (.38)	2.62 (.42)	.81
C (Creativity)	2.57 (.37)	2.59 (.40)	.70	2.56 (.36)	2.58 (.42)	.52
SC (Attitudes toward School)	2.33 (.51)	2.27 (.61)	.29	2.27 (.57)	2.26 (.58)	.84
	n=185	n=209		n=199	n=201	

Table 26

One-way Analysis of Variance for Significance by Teacher Use at Gilbert/Brown January and May 1997

Student subscale	Jan. Use M (SD)	Jan. NS Use M(SD)	p	May Use M (SD)	May NS Use M (SD)	p
I (Computer Importance)	2.71 (.33)	2.72·(.29)	.74	2.67 (.30)	2.59 (.34)	.01
J (Computer Enjoyment)	2.88 (.22)	2.87 (.22)	.75	2.83 (.25)	2.79 (.33)	.15
M (Motivation)	2.41 (.38)	2.38 (.43)	.38	2.47 (.40)	2.46 (.39)	.81
S (Study Habits)	2.57 (.34)	2.61 (.32)	.20	2.58 (.32)	2.59 (.33)	.66
E (Empathy)	2.68 (.30)	2.66 (.35)	.51	2.64 (.38)	2.65 (.37)	.77
C (Creativity)	2.58 (.30)	2.58 (.32)	.93	2.59 (.30)	2.60 (.34)	.66
SC (Attitudes toward School)	2.37 (.54)	2.35 (.57)	.72	2.33 (.55)	2.31 (.60)	.74
	n=166	n=229		n=161	n=261	

Treatment and comparison of student differences due to teacher training and use. One-way analysis of variance procedures were carried out on the Keyes, Gilbert, and Brown students by teacher integration and use (Group 1) versus those teachers without integration training or significant use (Group 2). There were no significant differences for May 1997. Mean values and p values for the one-way analysis of variance are reported in Table 27.

Table 27

One-way Analysis of Variance for Significance Due to Teacher Training and Use at 3 Schools

Subscale	May IT/Sig Use M (SD)	May NIT/No Sig Use M (SD)	p
I (Computer Importance)	2.67 (.31)	2.63 (.35)	.11
J (Computer Enjoyment)	2.84 (.24)	2.81 (.31)	.28
M (Motivation)	2.44 (.41)	2.46 (.40)	.48
S (Study Habits)	2.57 (.62)		.62
E (Empathy)	2.63 (.37)	2.62 (.39)	.74
C (Creativity)	2.57 (.32)	2.59 (.37)	.48
SC (Attitudes toward School)	2.32 (.53)	2.28 (.59)	.33
	n=244	n=589	

Regression analysis of student and teacher attitudes due to training and use. A regression analysis was used as a second approach to examining the impact of computer use and technology integration education on student attitudes. The rationale for this procedure was to take advantage of the ordered nature of computer use and integration education for added precision in measurement. Student Computer Importance (I) and Computer Enjoyment (J) were measured as a function of teacher training and classroom use in May 1997. As shown in Table 28, only the amount of teacher use (usenow and howoft) significantly ($p<.05$) influenced student I and J in a positive direction.

Table 28

Student I and J as a Function of HowOft, Trng and UseNow, May 1997 Keyes Data

Teacher and student factors	beta	Signif.
I2(student)= f(howoft + trng)		
HowOft	.27	.00
Trng	-.094	.05
Sig of F = .0000		
I2 (student) = f(usenow+trng+howoft)		
UseNow	.11	.05
Trng	-.06	.21
HowOft	.23	.00
J2 (student) = f(HowOft + Trng)		
HowOft	.17	.00
Trng	-.02	.66

Time-lag regression analysis of student and teacher attitudes. A time-lag regression analysis for student attitudes as a function of teacher training was carried out to determine if teacher integration education had a time-delayed impact on student attitudes. Removing outliers that were three standard deviations or greater from the mean, a regression analysis was run using the Keyes teachers. Student Computer Importance in May was found to be a function of reported teacher training in January (b=.14, p<.03). There appears to be a 3-month lag in student perceived importance due to teacher training.

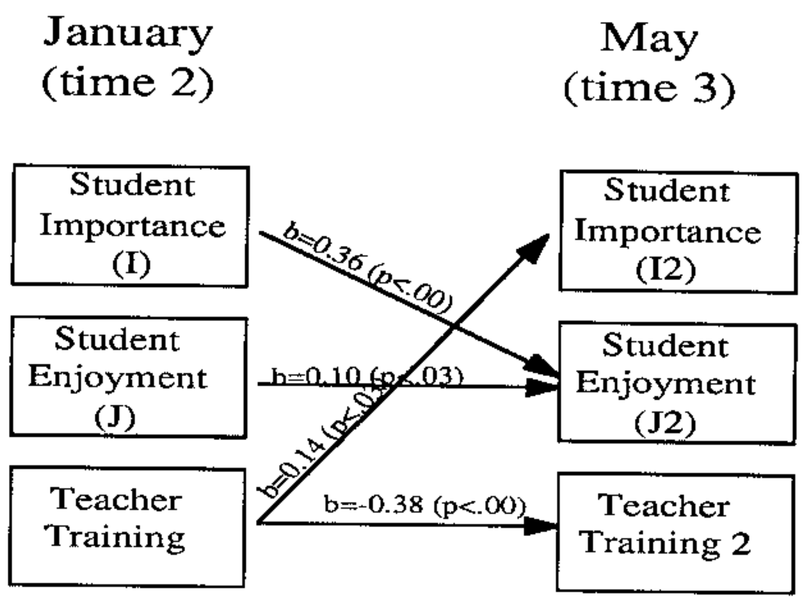

Figure 6. Time-lag regression for student importance and enjoyment in May 1997 as a function of student importance and enjoyment and teacher training in January 1997.

Other significant findings from the time-lag regression include:

1. Higher student attitudes on Computer Importance at time 2 appear to positively influence perceived student Computer Enjoyment at time 3 (b=.36, p<.00).

2. Higher student attitudes on Computer Enjoyment at time 2 appear to positively influence perceived student Computer Importance at time 3 (b=.10, p<.03).

Conditional Acceptance of Hypothesis 2

Based on the data gathered in this study, there is ample evidence to accept the hypothesis that teacher instruction in needs-based technology integration, combined with significant classroom utilization, fosters positive student attitudes toward information technology. Both analysis of variance and regression techniques confirmed the strong impact of the extent of teacher computer use on the attitudes of their students. Although there is scant evidence in the analysis of variance and simple regression analysis results of this section that teacher integration education has a direct impact on the attitudes of the students, time-lag regression confirmed the existence of a probable causal path from the January level of teacher integration education to May Computer Importance for their students. Evidence was also found in support of indirect paths from teacher integration education to more positive attitudes toward information technology in students. This is further discussed in chapter 5.

Analysis of Hypothesis 3

Hypothesis 3: Positive teacher attitudes toward information technology foster positive attitudes in their students.

A MANOVA was done to compare the students and teachers at Keyes, Gilbert, and Brown to determine whether they were significantly different from each other in January 1997. In the data file, each teacher was paired with their students' class means for Computer Importance (I), Computer Enjoyment (J), Motivation (M), Study Habits (S), Empathy (E), Creativity (C), and Attitudes toward School (SC).

In the data comparing Keyes (Group 1) and Gilbert/Brown (Group 2), there were no overall significant Fs. In analyzing teacher Importance (Tchi) and teacher Enjoyment (Tchj) along with student I and J, (n=55), there were no overall significant differences between the two groups (Wilks's F = .270). The same finding was also true when comparing three groups – Keyes (Group 1), Gilbert (Group 2) and Brown (Group 3). (Wilks's F=.541).

When analyzing Keyes versus Gilbert/Brown student I, J, and SC with Tchi, Tchj, CASA, CASC, CASL, CASU, the F was still not significant (Wilks's F=.758). The same run with the three schools separated was also not significant (F=.82)

When analyzing Keyes versus Gilbert/Brown student I and J with teacher I (Tchi) J (Tchj) CASA, F1, F7, Anxiety the F was still not significant (Wilks's F=.315). The same run with the three schools separated was also not significant (F=.60).

It was therefore determined that the treatment group and the comparison groups were not significantly different in January 1997. The two comparison groups were then combined for most of the analyses.

Panel analysis for directional effects of student and teacher attitudes. Panel analysis was used to determine probable causal relations among student and teacher attitudes. Panel analysis is a form of time-lag regression analysis in which attitudes at one time are used to predict attitudes at a subsequent time. Due to a skew in the student data, an outlier test was run and the student outliers (>+/- 3 SD)were removed.

Teacher information technology attitudes were compared to student information technology attitudes using panel analysis. Teacher Computer Importance (Tchi2) was run as a function of student Computer Importance (I). Student I at time 3 was run as a function of Tchi at time 2. Using time-lag regression January to May, it was found that teacher Importance (Tchi) in January (time 2) is a strong predictor of student Computer Importance (I2) in May (time 3) (see Figure 7).

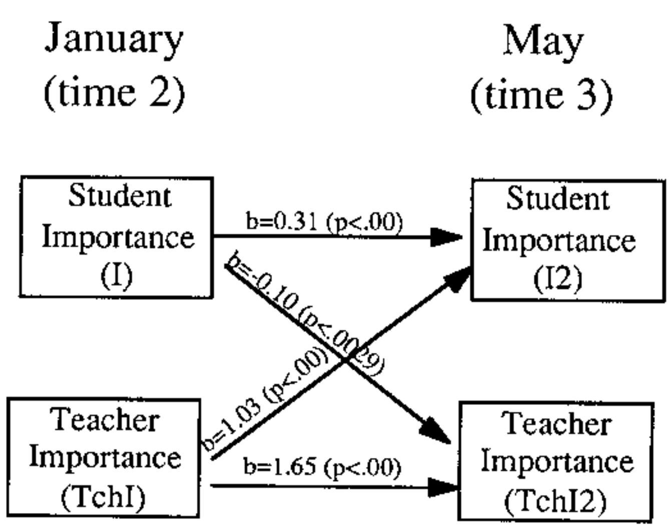

Figure 7. Panel analysis for directional effects of teacher and student Computer Importance.

1. Higher student attitudes on Computer Importance at time 2 appear to positively influence perceived student Computer Importance at time 3 (b=.31, p<.00).

2. Higher teacher attitudes toward Computer Importance appear to positively influence perceived student Computer Importance at time 3 (b=1.03, p<.00).

3. Higher teacher attitudes toward Computer Importance appear to positively influence perceived teacher Computer Importance at time 3 (b=1.65, p<.00).

Student Importance at time 3 was run as a function of teacher Enjoyment at time 2. The path from teacher Enjoyment to student Importance is very strong, with a beta of .82 (p< .00).

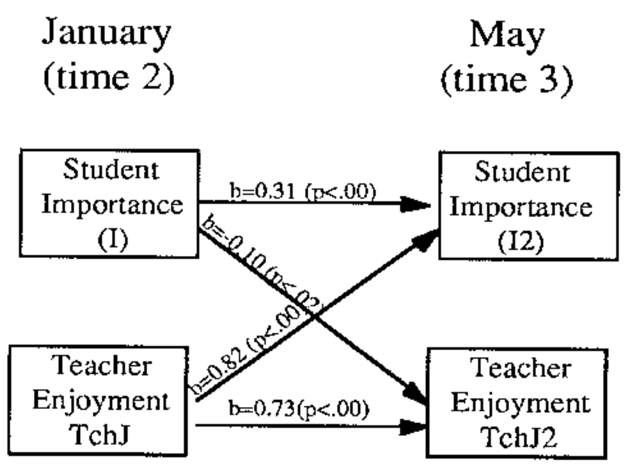

Figure 8. Panel analysis for directional effects of teacher Computer Enjoyment and student Computer Importance.

Other findings of the panel analysis include the following:

1. High student attitudes regarding Computer Importance at time 2 appear to have a weak negative impact on perceived teacher Enjoyment at time 3 (b=-.10, p<.02).

2. High student attitudes regarding Computer Importance appear to have a positive influence on perceived teacher attitudes toward Computer Importance at time 3 (b=.31, p<.00).

3. High student attitudes on Computer Enjoyment appear to have a strong positive influence on perceived student Importance at time 3 (b=.82, p<.00).

4. High teacher attitudes toward computer Enjoyment appear to have a strong positive influence on perceived teacher attitudes toward Computer Enjoyment at time 3 (b=.73, p<.00).

The paths from teacher Enjoyment to student Enjoyment and from student Enjoyment to teacher Enjoyment were not significant. However, the path was stronger in predicting from teacher Enjoyment to student Enjoyment (b= .29) rather than from student Enjoyment to teacher Enjoyment (b= -.06) (see Figure 9).

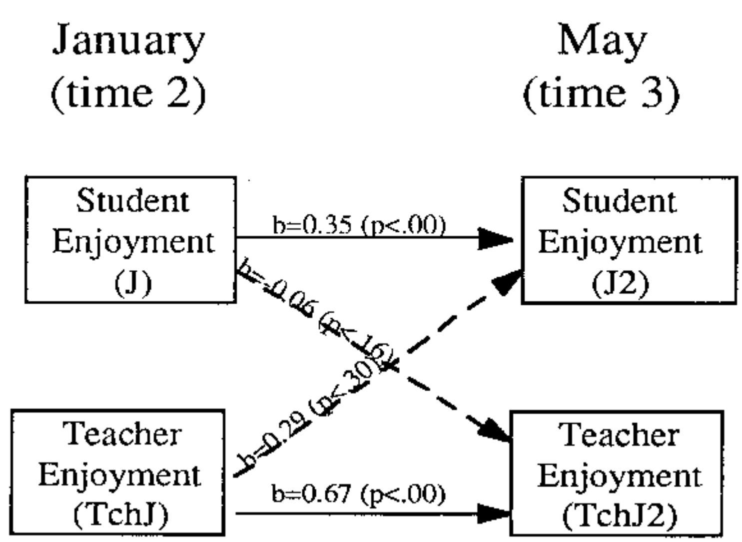

Figure 9. Panel analysis for directional effects of teacher and student Computer Enjoyment.

Major findings of the panel analysis of the teacher and student Enjoyment include the following:

1. Higher student attitudes toward Computer Enjoyment appear to have a weak negative influence on perceived teacher Enjoyment at time 3 ($\underline{b}$=-.06, $\underline{p}$<.16).

2. Higher student attitudes toward Computer Enjoyment appear to have a positive influence on perceived student Enjoyment at time 3 ($\underline{b}$=.35, $\underline{p}$<.00).

3. Higher teacher attitudes toward Computer Enjoyment appear to have a strong positive influence on perceived teacher Enjoyment at time 3 ($\underline{b}$=.67, $\underline{p}$<.00).

4. Higher teacher attitudes toward Computer Enjoyment appear to have a positive influence on perceived student attitudes at time 3 ($\underline{b}$=.29, $\underline{p}$<.30).

The path from teacher Enthusiasm (regarding computers) (F1) at time 2 (January) was a strong predictor of student Importance (I2) at time 3 (May).

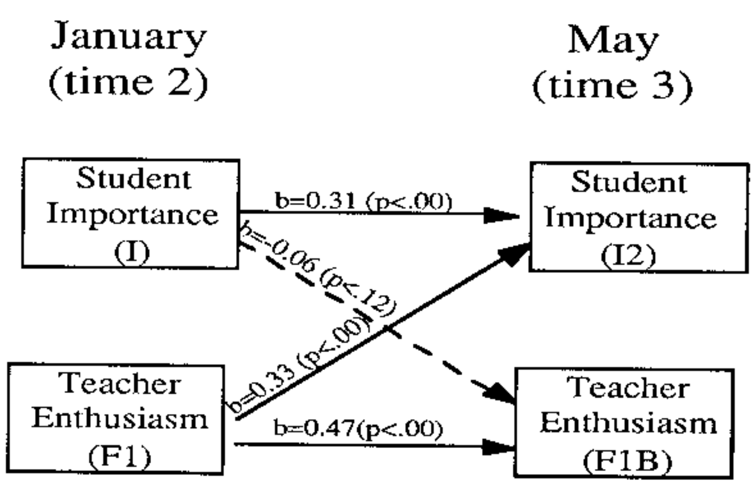

Figure 10. Panel analysis for directional effects of teacher Computer Enthusiam and student Computer Importance.

Major findings of the panel analysis for teacher Enthusiasm and student Importance include the following:

1. Higher student attitudes toward Computer Importance at time 2 appear to have a positive influence on perceived student attitudes toward Computer Importance at time 3 (b=.31, p<.00).

2. Higher student attitudes toward Computer Importance at time 2 appear to have a weak negative influence on perceived teacher Enthusiasm at time 3 (b=-.06, p<.12).

3. Higher teacher attitudes toward Enthusiasm at time 2 positively influence perceived teacher Enthusiasm at time 3 (b=.47, p<.00).

4. Higher teacher attitudes toward enthusiasm at time 2 positively influence perceived student computer importance at time 3 (b=.33, p.=.00).

For student importance (I) and teacher Computer Productivity (F10), there was a significant path from I (time 2) to F10B (time 3), but the beta (-.09) was so small that it may not be a strong causal path.

There were three measures of teacher anxiety -- CASA, F2, and TchAnx. Each of these anxiety factors was used in panel analysis to determine the relationship to student Computer Importance. All 3 factors showed the same trend. Anxiety did not significantly influence student Importance. However, in each of the 3 anxiety subscales, the path from student Computer Importance to teacher anxiety was significant with negative betas. Higher student Computer Importance has a significant negative impact on teacher anxiety.

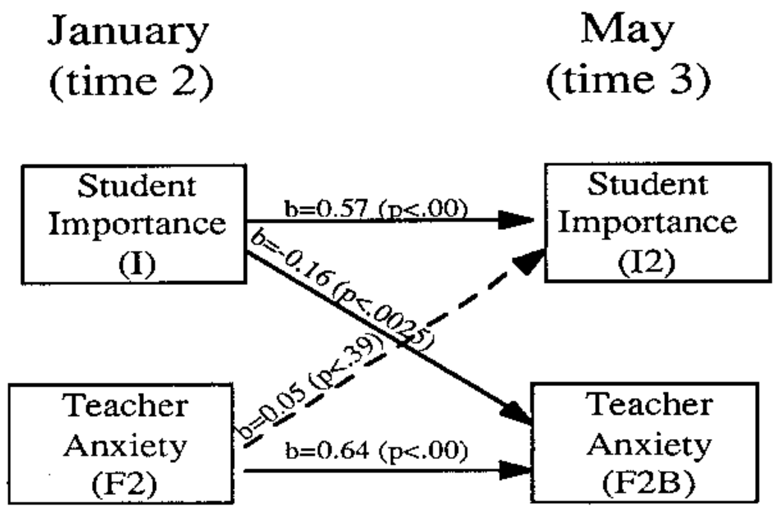

Figure 11. Panel analysis for directional effects of teacher Computer Anxiety and student Computer Importance.

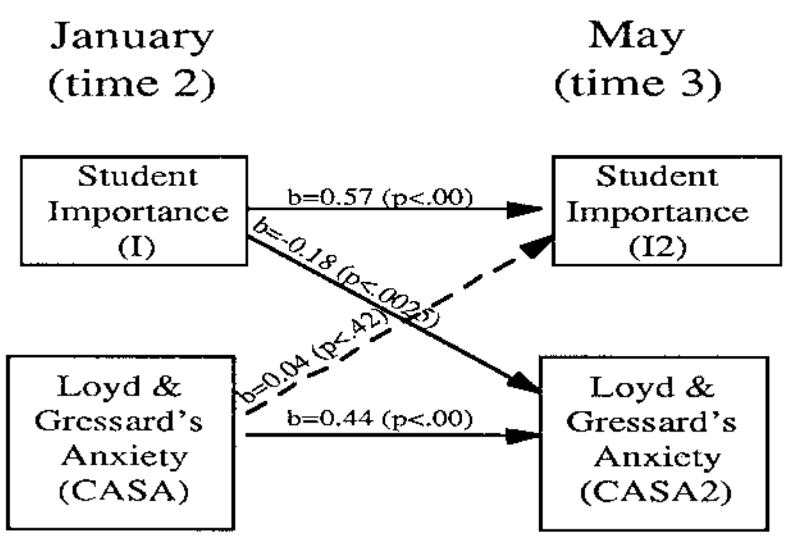

Figure 12. Panel analysis for directional effects of teachers' ratings on Loyd & Gressard's Computer Anxiety and student Computer Importance.

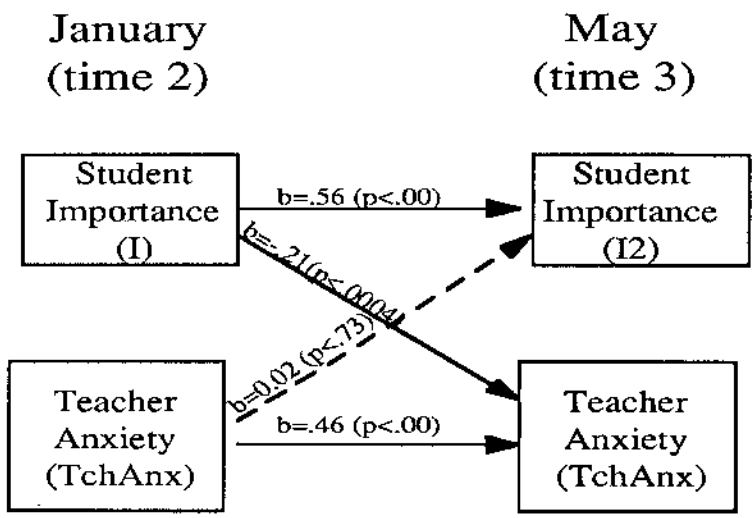

Figure 13. Panel analysis for directional effects of teacher ratings on Knezek and Miyashita's Computer Anxiety and student Computer Importance.

As is shown in Figure 14, many other paths seem to indicate the significant influence of attitudes. The following are the most meaningful of these:

1. Higher lack of teacher anxiety (Tchanx) at time 2 appears to have a negative influence on perceived student Computer Importance at time 3 (b=-.37, p<.02).

2. Higher student attitudes toward Computer Importance at time 2 appear to have a weak negative relationship toward teacher lack of anxiety at time 3 (b=-.10, p<.00).

3. Higher student attitudes toward Computer Importance appear to have a weak negative influence on teacher lack of anxiety as measured by CASA at time 3 (b=-.11, p<.00)

4. Higher student attitudes toward Computer Importance at time 2 appear to have a weak negative influence on teachers' perceived lack of anxiety as measured by F2 (b=-.09, p<.00).

5. Higher teacher Enthusiasm (F1) at time 2 appears to have a positive influence on perceived student attitudes toward Computer Importance at time 3 (b=.33, p<.00).

6. Higher student attitudes toward Computer Importance at time 2 appear to have a weak, negative influence on perceived teacher computer productivity at time 3 (b=-.08, p< .02).

7. Higher student attitudes toward Computer Importance at time 2 appear to have a weak negative influence on perceived teacher relevance of computers at time 3 (b=-.07, p<.00).

8. Higher teacher attitudes toward F7 (Kay's semantic) at time 2 appear to have a negative relationship with student Enjoyment at time 3 (b=-.27, p<.04).

Many other paths were explored but were not reported because they were not significant at the p<.05.

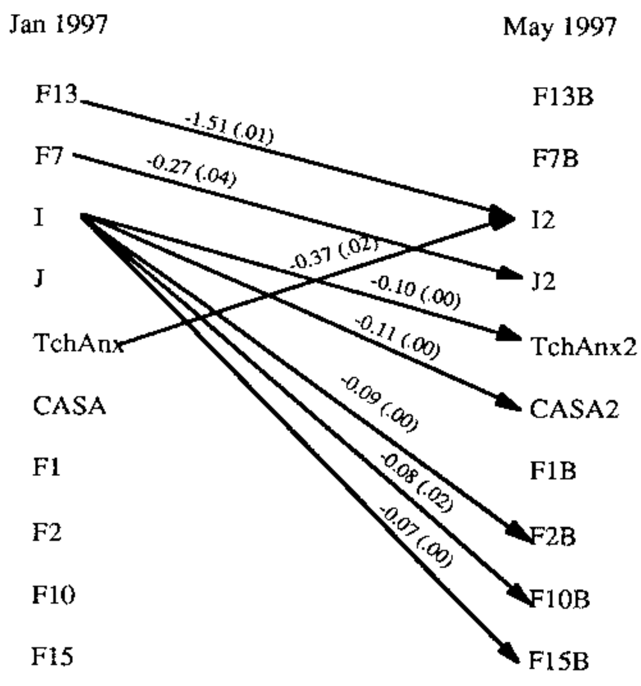

Figure 14. Time-lag regression for directional influences among 10 computer attitude measures (January to May 1997) (see Table 3 for description of subscales).

Acceptance of Hypothesis 3

A series of panel analyses using time-lag regression confirmed the following with respect to probable directional influences for teacher and student attitudes toward information technology:

1. Positive teacher perceptions of Computer Importance influence student perceptions of Computer Importance in a positive manner.

2. Positive teacher Computer Enjoyment influences student perceptions of Computer Importance in a positive manner.

3. Positive teacher Enthusiam (F1) influences student perception of Computer Importance in a positive manner.

4. Lack of teacher anxiety (TchAnx) influences student perception of Computer Importance in a negative manner.

5. Higher semantic perception of computers (F7) on the part of teachers influences student perception of Computer Importance in a negative manner.

6. No strong relationships were found in the direction of student attitudes influencing those of their teacher. However, there emerged a consistent trend of student importance negatively influencing numerous teacher dispositions related to information technology.

These findings, taken as a whole, led to the acceptance of the hypothesis that positive teacher attitudes toward information technology foster positive attitudes in their students. However, further research is needed to determine why certain Likert scales (such as teacher anxiety) are in the opposite direction of what might have been anticipated. This topic is discussed further in chapter 5.

CHAPTER 5

DISCUSSION, SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Discussion

Several findings which were not a focal point of the three major hypotheses emerged during the data analysis phase of this study. These are addressed in this section.

Relationship of Technology Integration Education to Student Attitudes

As described in chapter 4, teachers were partitioned into integration training versus non-integration training (using May data) for the purpose of assessing the impact of various aspects of technology integration education. Surprisingly, the students of the non-integration group were higher on all seven student measures than the integration group, with five of those being significant ($p<.05$). Further research is needed to determine the reason for this unexpected outcome.

Impact of High or Low Teacher Perception of Computer Importance

Using the rank sum method on the importance measures I, F13 (K&M Importance), F15 (Relevance), teachers were divided into two groups by median. Students of the low importance group (2.66, n=211) were significantly higher on Empathy than students of the high importance group (2.59, n=240) at the .076 level. A comparison of the top 27% with the bottom 27% on these same three factors revealed that there were no significant differences between groups.

Examination of I (Importance) alone revealed that there were no significant differences between low and high teacher importance groups. Looking at F13 alone, there were no significant differences between low importance and high importance groups. However, looking at F15 (relevance) alone, there were three significant differences on the student measures (I, E, SC), as shown in Table 29.

Table 29

Analysis of Variance for Seven Student Attitudinal Indices Based on Classroom Teacher Scores for Pelgrum and Plomp's Computer Relevance Scale

Student Subscales	Group 1 means	Group 2 means	F prob
I (Computer Importance)	2.69 (n=204)	2.62 (n=248)	.04
J (Computer Enjoyment)	2.85	2.84	NS
M (Motivation)	2.47	2.42	NS
S (Study Habits)	2.56	2.59	NS
E (Empathy)	2.65	2.59	.09
C (Creativity)	2.58	2.58	NS
SC (Attitudes Toward School)	2.34	2.20	.01

Apparently, if teachers perceive that the computer is relevant to their work, then their students will see the computer as important and will also tend to have higher attitudes toward school. Note that these findings do not necessarily mean that computer use by the teacher caused the better attitudes toward school. It is conceivable, for example, that a positive teacher embraces technology and independently fosters positive attitudes toward school.

Differences in Student Attitudes by Grade Level

Using January 1997 data on the YCCI, an analysis of variance was carried out comparing student attitude measures by grade level. The trend tends to be that, as grade level increases, student attitudes toward these measures go down. This is true for all seven student attitude indices. For example, as shown in Table 30, attitudes toward school decline from a mean value of 2.45 for Grade 1 to 2.04 for Grade 5. This is consistent with YCCI findings (G.A. Knezek, et al., 1994). It is further evidence of the contention by G. Knezek, Miyashita & Sakamoto (1993) that declines which may occur in attitudes toward computers (as children grow older) are not necessarily due to a "novelty effect" toward computers (Krendl & Broihier, 1992) , but rather are part of a larger decline in attitudes toward learning in school. These trends are graphically illustrated in Figure 15.

Table 30

YCCI Student Attitudes by Grade Level (1-5), January 1997,

Keyes, Gilbert, and Brown Elementary Schools

	Computer Importance		Computer Enjoyment		Mot/ Peristence		Study Habits		Empathy		Creativity		Attitudes toward School	
Grade	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
One	2.84	.25	2.87	.26	2.55	.38	2.61	.37	2.67	.32	2.66	.32	2.45	.47
Two	2.75	.29	2.90	.22	2.41	.38	2.62	.33	2.62	.37	2.60	.37	2.43	.55
Three	2.69	.33	2.85	.25	2.45	.41	2.59	.31	2.59	.35	2.57	.29	2.23	.65
Four	2.67	.31	2.83	.26	2.42	.40	2.56	.34	2.63	.36	2.53	.32	2.23	.57
Five	2.59	.35	2.78	.32	2.32	.44	2.43	.37	2.49	.44	2.41	.42	2.04	.59

$df = 4$, $p<.01$.

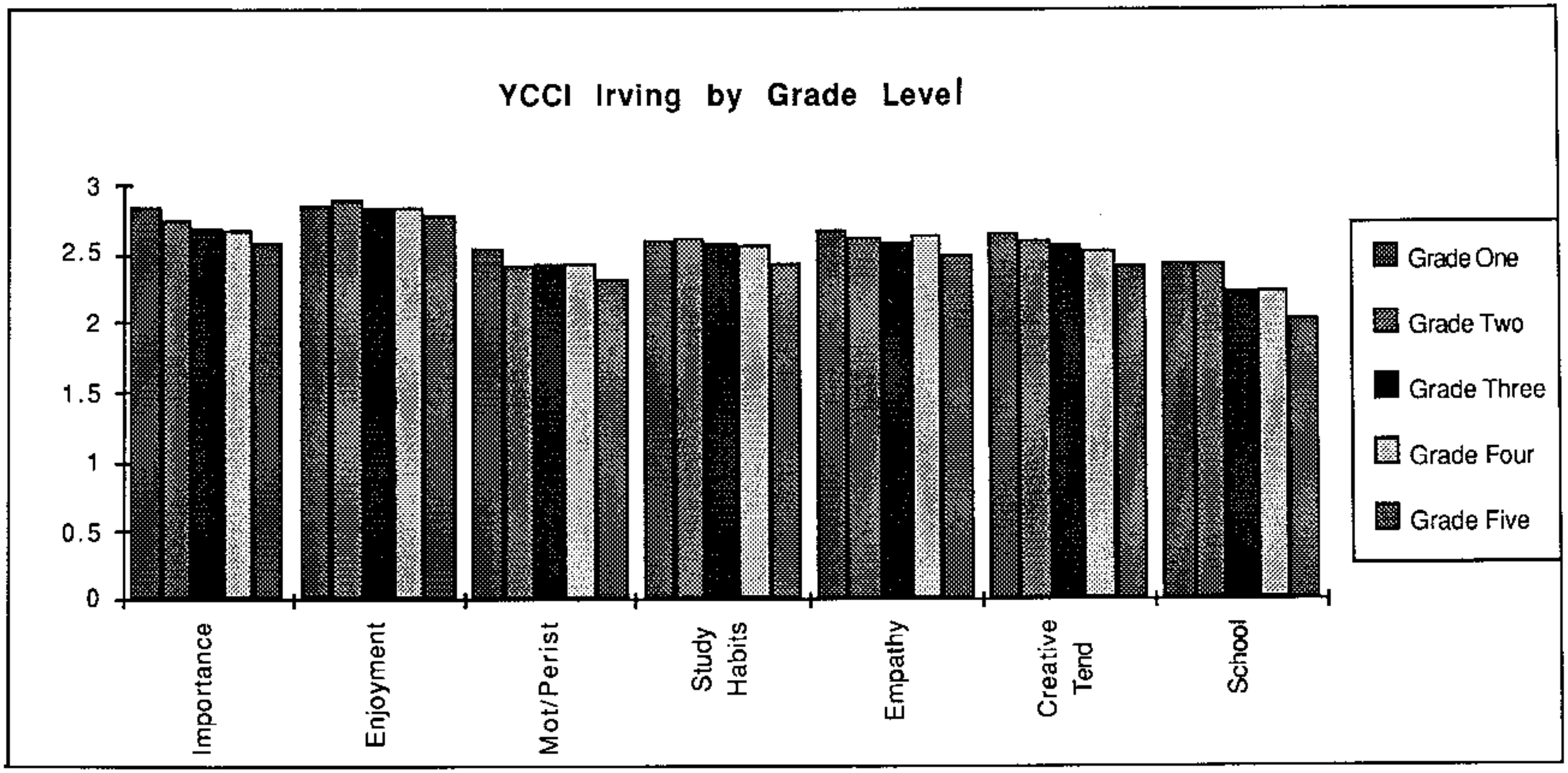

Figure 15. Student attitudes by grade level.

Differences in Students' Attitudes by Gender

Significant findings regarding gender emerged in the January 1997 data for Keyes, Gilbert, and Brown students. With students from all three sites combined, females were higher in empathy ($p<.0001$) and attitudes toward school ($p<.0001$). A post-hoc comparison (Scheffe) among the three schools confirmed ($p<.025$) that these trends held strongly for the treatment school (Keyes) and one of the comparison schools (Brown), but not for the other comparison school (Gilbert). As shown in Table 31, male/female contrasts were not significant ($p<.05$) for empathy or attitudes toward school at Gilbert Elementary.

The findings regarding empathy for Keyes and Brown Elementary Schools are consistent with those of the Young Children's Computer Inventory Project (Collis, et al., 1996), which examined the impact of computer use on children's attitudes in three nations. Gender differences regarding attitude toward school are new findings from the current study. The subscale of attitudes toward school was not included in the earlier study.

Table 31

Analysis of Variance by Gender for Seven Learning Dispositions, 3 Schools Combined and Separate

	3 Schools Combined				Keyes Elementary				Gilbert Elementary				Brown Elementary			
	M	F	f(df)	p	M	F	f(df)	p	M	F	f(df)	p	M	F	f(df)	p
I																
Mean	2.77	2.77	.03	NS												
SD	0.25	0.23	(1 x	(.86)												
n	297	367	662)													
J																
Mean	2.93	2.91	2.29	NS												
SD	0.14	0.14	(1 x	(.13)												
n	297	367	662)													
M																
Mean	2.49	2.48	.09	NS												
SD	0.38	0.36	(1 x	(.76)												
n	297	367	662)													
S																
Mean	2.63	2.61	.71	NS												
SD	0.31	0.29	(1 x	(.40)												
n	297	367	662)													
E																
Mean	2.63	2.74	31.8	.0000	2.56	2.72	18.4	.0000	2.73	2.78	2.66	.10	2.61	2.73	12.8	.0004
SD	0.29	0.24	(1 x		0.30	0.26	(1 x		0.25	0.22	(1 x		0.27	0.24	(1 x	
n	297	367	662)		110	117	225)		99	123	220)		86	126	210)	
C																
Mean	2.62	2.60	.88	NS												
SD	0.31	0.30		(.35)												
n	297	367														
SC																
Mean	2.30	2.50	29.8	.0000	2.29	2.51	12.8	.0004	2.37	2.48	2.66	.10	2.23	2.52	18.5	.0000
SD	0.49	0.46	(1 x		0.48	0.42	(1 x		0.47	0.49	(1 x		0.52	0.46	(1 x	
n	297	367	662)		110	117	225)		99	123	220)		86	126	210	

Social Distance as a Measure of Teacher Attitudes

A factor analysis was performed on the Teachers' Views of Technology and Teaching questionnaire, which was derived from two sources (Appendix B). Four factors were found, including confirmation of a clustering of three items created by Norris and Lumsden (1984), which together measure social distance. As shown in Table 32, these items are arranged in order from the computer being farther away--more social distance--to "embracing" the computer into one's home.

Table 32

Items Used in the Social Distance Factor From the Teachers' Views of Technology and Teaching

Item no.	Item	Factor loading
1	Computers are valuable tools that can be used to improve the quality of education.	.88
3	Teachers should know how to use computers in their classroom.	.92
4	If there were a computer in my classroom, it would help me to be a better teacher.	.79
5	I would like to have a computer for use in my classroom.	.68
6	Someday I will have a computer in my home.	.88

Note. Items 1,3,5 from Norris & Lumsden; Items 4 & 6 from Lichtman (1979). Factor analysis did not confirm one of Lichtman's items (Computers can teach reading).

A nonparametric correlation procedure was used to explore the relationship between social distance and selected teacher and student indices. As shown in Table 33 social distance was found to be highly correlated with student importance (I) and student empathy (E) using May 1997 student data. The social distance factor was also highly correlated with many teacher variables in May, as shown in Table 33.

Table 33

Teacher Attitude Factors Correlated with Social Distance Factor (May 1997)

Factor	Sig level	Spearman's rho
Tchi	.00	.74
Tchj	.00	.60
Tchanx	.00	.42
CASA	.00	.24
CASC	.00	.70
CASL	.00	.69
F1	.00	.75
F2	.00	.33
F7	.00	.30
F10	.00	.75
F13	.00	.74
F15	.00	.88
F16	.00	.42

n= 310

A regression analysis was carried out to determine whether social distance could serve as an indicator of teacher or student attitudes. This measurement index was included in a multiple regression analysis along with other items predicting teacher importance (Tchi), teacher enjoyment (Tchj), and student importance (I) in May. Social distance appears to be a good indicator of teacher Computer Importance (b=.75), a weaker but still significant indicator of teacher enjoyment of computers (b=.11), and a poor predictor of how important computers are perceived to be by a teacher's students.

Teachers' Views of Technology and Teaching

As described in the previous section, three additional factors were confirmed for the Teachers' Views of Technology and Teaching instrument, in addition to social distance. They were (a) Support--how much support teachers feel from parents, administrators; (b) teaching--seems to use innovative and effective teaching techniques; (c) Open--Openness to students and teaching. Items for each factor are listed in Table 34.

Table 34

Items for Support, Teaching and Open Factors From the Teachers' View of Technology and Teaching

Factor	Item no.	Item	Factor loading
Support	12	I believe teachers are appreciated at my school.	.70
	13	Teachers get adequate support from the administration.	.65
	14	Parents support teachers in this school.	.71
	15	I can get most materials I need.	.87
Teaching	7	I provide individualized instruction to many of my students.	.49
	8	Cooperative learning works well in my classroom.	.62
	11	My classes act up less than most.	.38
Open	9	I'm not afraid to let my students know I am still learning too.	.71
	10	My students feel free to come to me with their problems.	.89
	16	I enjoy using new tools for instruction.	.67

Strongly loading items for Support, Teaching, and Openness were used to construct an additional measurement index for each of these factors. That is, they were used to produce three Likert subscales.

Using a multiple regression procedure on May data, these scales were found to have a significant impact on teacher enjoyment and student importance:

Tchj2 = f(support) b=.04, p.=.01

Tchj2 = f(tching) b=.51, p.=.00

Tchj2 = f(open) b=.20, p.=.00

Student I2 = f(tching) b=.85, p=.00

Student I = f(support) b=24, p=.03.

These and other relationships are listed in Table 35.

Examining these findings as a whole, one can conclude that other teacher attitudes, and especially attitudes toward teaching, have an impact on their enjoyment of computers as well as their students' perceived importance of computers. Further research is needed to more precisely establish the direction and strength of the relationships in this area.

Table 35

Student Importance as a Function of Teacher Training and Use, January and May 1997 for Keyes Elementary

	beta (Jan)	Sig. (Jan)		beta (May97)	Sig. (May 97)
I=f(support)	.24	.03	I2=f(support)	.10	NS
I =f(usenow)	NA	NA	I2=f(usenow)	.32	.00
I =f(tching)	.75	.01	I2=f(tching)	.85	.00

Relationship of Student Attitudes to Teacher Anxiety

Using anxiety measures for teachers (TchAnx, CASA, F2) and looking at the attitudinal effects on their students, many significant findings were discovered. In addition, many surprising associations were found when examining the relationship between teacher anxiety (coded as lack of anxiety) and other teacher indices. It appears from these data that teachers who are more anxious about computers have students who have more positive attitudes toward computers. These and other relationships are shown in Table 36.

Table 36

Student Attitudes Based on Teacher Anxiety Toward Computers

Student Scales	Low Anxiety M	High Anxiety M	p
I (Computer Importance)	2.60	2.69	.01
J (Computer Enjoyment)	2.80	2.88	.00
M (Motivation)	2.42	2.46	NS
S (Study Habits)	2.52	2.58	.06
E (Empathy)	2.59	2.64	NS
C (Creativity)	2.49	2.65	.00
SC (Attitudes Toward School)	2.18	2.33	.01

The panel analyses presented in Figures 11 through 13 (see chapter 4) offer hints about the directional influences among student attitudes and teacher anxiety. They imply that classes with high ratings of Computer Importance foster high anxiety in teachers. Further research is needed to confirm or refute this implication.

Performance of Loyd and Gressard's Computer Attitude Scale (CAS)

Loyd and Gressard's CAS (1986) was selected as one of the "foundation instruments" for which all original items were included in the TAC, because it was judged to be the best among the existing instruments for measuring teachers' attitudes toward computers. Based on the data gathered in this study, the four CAS subscales have retained their reliabilities reasonably well, but other subscales are often better indicators of changes in teachers' attitudes and their relationships to the attitudes of their students. In particular, F2 appears to be a better measure of teacher anxiety than does CASA.

Performance of Young Children's Computer Inventory Questionnaire

The Young Children's' Computer Inventory (YCCI) 3-point version used in this study appears to have a 3-point ceiling that especially affects student enjoyment measures. Most of the students seemed to "top out" (have high attitudes in student enjoyment) so that there was little variance, thus making it difficult to effectively utilize this subscale in many of the analyses. Because first graders were subjects in this study, it was decided that the 3-point version was necessary due to its ease of completion. However, beyond the first-grade level, it is suggested that future researchers consider the 4-point version of the YCCI.

Other Findings Related to Research Literature

Todman and Dick (1993) reported on studies that presented teachers' attitudes toward computers as an important factor affecting children's experiences with computers at school. In their review of the literature, they identified a study by Smith (1987) that found a strong negative relationship between attitudes of children and their teachers. They interpreted these findings as meaning that teachers' self-confidence with computers decreased as their students' confidence increased, due to increased use on the part of the students. These findings could equally well be interpreted in the other direction; that is, as teachers are more confident, their students are more intimidated.

In this study a similar finding was seen regarding Computer Anxiety. When comparing the non-integration training group to the integration group, students of the teachers who did not have integration training were higher in their attitudes toward the seven student subscales, and five of these were significantly higher ($p<.05$). It appears from these data that teachers who are higher in anxiety toward computers have students who have more positive attitudes toward measured subscales when compared with teachers who report less anxiety. The reasons for these relationships are currently unknown. One hypothesis is that, perhaps, when teachers feel something is important, they exhibit more anxiety toward it, therefore passing on that sign of importance to their students. Todman and Dick (1993) hypothesized that it appears that the attitudes children bring with them to school related to their lack of experience with computers at home may influence the attitudes of their teachers. The panel analyses presented in Figures 11 -13 support a variation of the contention by Smith (1987): teachers' anxieties about computers increase because of increased perception of importance and implied increase in use by students.

Todman and Dick (1993) found clear evidence that boys were more favorably disposed toward computers than girls at the primary level but that the gap was not widening throughout the primary years. This study found few gender differences on the computer subscales at the primary level.

In addition, Todman and Dick (1993) found in their study that a negative correlation was associated with the deprivation of a school as measured by the number of students on the free and reduced meal program. They reported that, the higher the level of deprivation associated with a school, the more negative the attitudes of both teachers and pupils. This did not appear to be the case in the Irving schools, where 76.8% of the treatment school students were on free/reduced lunch whereas the comparison school with generally lower student attitudes had only 44% on free or reduced lunches. However, systematic analysis of this issue would require data from a much larger number of schools. Further examination of this question is beyond the scope of this study.

Previous researchers (G. Knezek et al., 1993; Todman & Dick, 1993) have reported finding a general tendency for children's attitudes regarding computers to progressively decline throughout their primary school years. This study found a similar trend. However, it is not only attitudes toward computers that decline but, rather, all of the measured attitudes toward school. In fact, in this study the Computer Importance and enjoyment subscales declined at a slower rate than other indices measured. Additional research is needed to determine if there is a tendency for computer attitudes to decline, independent of the overall decline in attitudes toward school.

As reported in Chin and Hortin (1993/1994) a study by Stuckman and Knapke found that the teachers who experienced success with computers readily sought additional training to enhance their competencies. This and other studies have shown that, the more teachers use technology, the more they feel confident and comfortable in using technology for teaching.

Stuckman and Knapke also reported on other studies that have shown computer training leading to more positive attitudes toward computers. They went on to conclude that teachers' attitudes toward technology can be changed through proper staff development. They also concluded that the best inservice training programs are planned and carried out with teacher participation (i.e., needs assessment) from the beginning. Findings of the current study lend additional support to the conclusions reached by Stuckman and Knapke.

Violato et al. (1989) determined that teachers' attitudes are critical determinants of their success in feeling comfortable in the use and teaching of computers. They also concluded that these attitudes are crucial as possible determinants of students' interest and success in computer use. The current study supports this concept.

Chen (1986) posited that attitude toward computers is a function of experience with them. In Green, Kluever, Lam, Staples and Hoffman (1993) Green et al. (1986) summarized that effects of computer training for teachers generally seem to have a positive effect on some, if not all, aspects of attitudes toward computers. Green et al. (1986) reported a decrease in anxiety as familiarity with technology increased. The findings of this study are consistent with those reported by this group of researchers.

Norris and Lumsden (1984) found that educators agreed that teachers should know how to use computers in the classroom. However, they seemed to be positive toward computers as long as the function of computers is removed from their experiential level. In other words, they think they are useful for education in general but are not necessarily accepted into their own classroom for use (social distance questions). The findings of this study support this contention and further demonstrate that social distance has potential as a new indicator of teacher attitudes toward information technology.

Long ago, Loyd and Gressard suggested that computer anxiety is a function of the lack of use of computers and that with increased experience anxiety should decrease (as cited in McInerney et al. (1994). The findings of this study support that contention.

Issa and Lorentz (1990) also found that exposure to computers can cause a significant decrease in anxiety. They further recommended that attempts toward integration should not be made on a short-term basis. According to these authors, educators should be given adequate time to overcome their negative attitudinal perceptions and anxiety toward the computer. The procedures and findings of this study are consistent with the recommendations of Issa and Lorentz.

In the Lawton and Gerschner (1982) review of the literature, the authors reported that staff development is a key to success in using computers with teachers. Other researchers reported that the training should be relevant and match the users' (teachers) needs and interests. Initial selection of teacher education content for this study was conducted in a manner consistent with the recommendations of these authors.

In their study, Wilder, Mackie, and Cooper (1985) found a decreased liking of computers by students (with increased age) in K-12 students in the United States. Krendl and Broihier (1992) confirmed the findings for students in 4th through 10th grades (1992). However, G. Knezek et al. (1993) did not find technology attitude declines to be as strong as the trends for other learning-related dispositions. In this study, computer attitudes did decline by grade level (Grades 1-5), but not as severely as other attitude measurements toward school.

Marcinkiewicz and Welliver (1993) studied the levels of computer use of teachers and the process of the adoption of innovation. They concluded that teachers differ before they begin to use computers and they differ once they have begun to use them. Teachers differ in the amount of time it takes to adopt computers as well as how they use them once they are adopted. The authors suggested identifying the level of teachers' computer use as well as how or whether they progress in computer use. With this and additional information, educators can recommend the type of professional development for the teachers. For this study, technology integration education was carried out in a manner consistent with these recommendations.

The Concerns-Based Adoption Model (CBAM) (Hall, Wallace & Dossett, 1973) includes a stages-of-concern questionnaire that allows for identification of seven different stages of concern. Persichitte and Bauer (1996) conducted a study of computer-based technology diffusion in the school environment. It was reported that levels within each stage of concern vary as individuals move through the change process (innovation adoption). Persichitte and Bauer strongly recommended, based on their study in this area, that a strong needs assessment as well as teachers' ability to access technology once training is complete are critical factors in the success of the adoption of technology in the classroom.

In the current study, teachers in the treatment group advanced, on the average, one stage toward full technology integration on a six-stage scale for a diffusion-innovation model. The campus made extensive efforts to enhance the computer resources available to teachers while the process was underway. All signs at the end of the period of study are positive with respect to eventual success for the treatment school in fully integrated adoption of technology in the classroom. Follow-up studies would be required to determine if the process is, one day, complete.

Summary of Findings

This study analyzed the effect of technology integration education on teachers' and students' attitudes toward information technology. Two instruments measuring similar attributes were used to assess teachers' and students' attitudes. Differences in pre- and post-test scores were used to determine changes that may have occurred during the course of the study. Approximately sixty teachers in an elementary school in Texas received needs-based instruction in the integration of computers in the classroom. Two similar schools in the same school district were used as the comparison groups. It was hypothesized that properly instructing teachers to use information technology in the classroom would positively affect not only their attitudes toward information technology, but also the attitudes of their students.

Three hypotheses were explored in this study. They were: (1) Needs-based technology integration education fosters positive attitudes toward information technology among elementary school classroom teachers; (2) Teacher education in needs-based technology integration combined with significant classroom utilization fosters positive student attitudes toward information technology; and (3) Positive teacher attitudes toward information technology foster positive attitudes in their students.

Subjects participating in this study consisted of elementary classroom teachers (grades 1-5) and their students in three public elementary schools in the north Texas area. The treatment group received needs-based integration education at their school throughout the school year. The education consisted of two days of intensive training at the beginning of the school year with follow-up training throughout the school year.

Analysis of the data gathered in this study indicated that: a) teachers at the treatment and comparison sites who reported having received computer integration education tended to exhibit more positive attitudes toward information technology than their non-integration counterparts; b) teachers at the treatment site changed to a greater extent in the direction of more positive attitudes than did their comparison group peers; and c) the integration education delivered at the treatment site had a significant impact on perceived Computer Importance (after controlling for frequency of use) while the impact of training at the comparison sight was negligible. These findings, taken as a whole, led to the acceptance of the hypothesis that needs-based technology integration education fosters positive attitudes toward information technology among elementary school classroom teachers.

With respect to the hypothesis that significant classroom utilization fosters positive student attitudes toward information technology, both analysis of variance and regression techniques confirmed the strong impact of the extent of teacher computer use on the attitudes of their students. Time-lag regression confirmed the existence of a probable causal path from January level of teacher integration education to May Computer Importance for their students. Evidence was also found in support of indirect paths from teacher integration education to more positive attitudes toward information technology in students.

A series of panel analyses using time-lag regression confirmed the following with respect to probable directional influences for teacher and student attitudes toward information technology: (a) Positive teacher perceptions of Computer Importance influence student perceptions of Computer Importance in a positive manner; (b) Positive teacher Computer Enjoyment influences student perceptions of Computer Importance in a positive manner; (c) Positive teacher enthusiasm (F1) influences student perception of Computer Importance in a positive manner; (d) Lack of teacher anxiety (TchAnx) influences student perception of Computer Importance in a negative manner; and (e) Higher semantic perception of computers (F7) on the part of teachers influences student perception of Computer Importance in a negative manner.

These findings, taken as a whole, led to the acceptance of the hypothesis that positive teacher attitudes toward information technology foster positive attitudes in their students. However, further research is needed to determine why certain Likert scales (such as teacher anxiety) are in the opposite direction of what might have been anticipated.

Conclusions

Dissemination of Information

According to Belkin and Robertson (1976), the purpose of information science is to facilitate the communication of information between human beings. In this study the communication of information was in the form of integration education. It appears from the measurable changes that occurred that information was transferred successfully to a significant number of teachers and students. Attitudes changed in a more positive direction and teachers increased the amount of classroom use during the school year. In addition, the teachers' skill level improved in several areas that were included in the educational development sessions. For example, knowing how to make Kid Pix slide shows to use in the classroom showed a significant change ($p<.00$) in skill level from August (M=1.35, SD = .57, n=23) to May (M=2.17, SD=.78, n=23), on a scale of 1 = low competence, 2 = medium, and 3 = high competence[1].

Diffusion of Innovations

According to Rogers (1983), adoption of technological innovations is dependent on a critical mass, degree of use and re-invention. In this study the critical mass moved toward adoption as shown in the Stages of Adoption questionnaire (see Figures 4 and 5). The degree of use also increased from pre to post at the treatment site, from an average of 2.7

[1] Of the 17 skills measured, 13 were selected to analyze because they were introduced in the staff development sessions delivered at Keyes Elementary. Of those 13 skills, 10 were significantly higher at the posttest than the pretest. Two of the non-significant skills were only mentioned and not thoroughly covered. When looking at all 17 skills, 12 were significant. All 17 of the skills moved toward more competence.

hours per week in August 1996 to 5.5 hours per week in May 1997. Data were not collected to determine whether the teachers moved toward re-invention during this study.

Rubinyi (1989) reported the importance of a well thought-out training program and the availability of follow-up support are crucial for successful adoption. In this study, most of the teachers moved up stages of adoption during the on-going, on-site technology integration education. The average increase was 1 stage from August 1996 to May 1997.

Changes in Teacher Attitudes

Teachers responded to needs-based technology integration education with a positive change in their attitudes toward information technology. Some attitudes appear to change more quickly than others, as might be expected. For example, anxiety levels dropped quickly in the treatment group, within the first three months. Computer Importance and Computer Enjoyment were also among those attitudes changing quickly in a positive direction from August to January at the treatment site. It appears to take longer to change attributes regarding other attitudes toward computers, such as confidence and acceptance which appeared to require an entire school year (August to May) to show measurable changes. This trend is consistent with earlier findings regarding measures using the same instrument (Knezek & Christensen, 1996). In order for change to occur, there is an underlying assumption that the school administrators are supportive of technology integration as they were at all three sites in this study.

Changes in Student Attitudes

Students' attitudes were effected by teacher attitudes toward information technology in this study. Some of the linkages are direct, while other student attributes appear to be indirectly impacted by teachers' attitudes. For example there is a strong positive path from teacher training to teacher use, and from teacher use to student importance. While some effects are not directly measured, there is little doubt that the way teachers view technology effects the attitudes of their students.

There were also instances in which it appeared that student attitudes effected their teacher's attitudes. For example in the area of anxiety. Higher Computer Importance on the part of the students in January apparently fostered higher levels of teacher anxiety in May. This finding deserves to be studied in more detail with a larger sample of teachers and students.

Effect of Technology Integration Education on the Attitudes of Teachers and their Students

Technology integration education appears to be strongly related to teachers' attitudes toward computers. The direct effect on their students is weaker although present. The amount of teacher classroom use appears to have a more immediate impact on student attitudes. It can be conjectured that technology integration education increases teacher use which increases student attitudes toward computers. This thesis is supported as part of the current study, but probably warrants further study on its own.

Recommendations

Recommendations for Technology Educators

From this and other studies, it is apparent that assessing and reducing teacher anxiety is a critical factor in teachers' acceptance and use of technology. From this study, it appears that the most beneficial technology integration education occurs locally and frequently. On-site education is beneficial especially for those new to technology. It has been common in the past that teachers go to a training session only to return to their schools without the software that was taught and with a computer system that does not accommodate them in the same manner.

If it is not possible to include on-site education, a second approach might be to instruct clusters of teachers from a particular school in training based on their needs. This would at least give them a cadre to confer with when they were having difficulties.

A needs assessment that addresses what teachers know (their skill level), what they want to know and what they need to know is one of the most important planning strategies for preparing teachers to use technology in the classroom. Assessing their needs would allow instruction to be provided on a more individual basis. Often teachers are not consulted before training is provided.

It is also important to include intensive, up-front sessions as well as follow-up sessions in a technology integration education model. Teachers need time to apply what they have learned followed by new challenges or support in order to move them toward integration of technology into the classroom.

Recommendations for Technology Integration Education in Texas

Beginning in the 1998-99 school year in Texas, K-12 classroom teachers will be responsible for teaching the new Technology Applications Texas Essential Knowledge and Skills (TEKS). This mandate will require all classroom teachers to feel comfortable with using computers and become skilled at teaching with computers in the classroom.

Many teachers still feel anxious and apprehensive about using computers. Those seeking to train these teachers in the use of computers in the classroom may benefit from first assessing the teachers attitudes and needs. The first step for many teachers will most likely be to reduce the level of anxiety and make them feel comfortable and successful in the use of computers.

Recommendations for Future Studies

Based on the discussion above, it is recommended that future studies employ better measures for training, examine gender issues for students, study the relationship between school computer use by students and teacher anxiety; and seek more robust measures of Computer Enjoyment.

Better measures for training include defining integration education for the respondents as well as offering choices that provide a wider range of possible values for the analysis. The latter might eliminate one problem encountered in this study, which was that the data in this was skewed in a negative direction. Also in this study, respondents were allowed to select more than one choice of the type of training they had received, but there was no quantifiable measure of how much or how long ago they had received each type. Gathering this additional data might be useful in future studies.

The area of teacher anxiety and perceived student Computer Importance deserves additional longitudinal research. In this study it might have been accepted that higher teacher anxiety fosters higher positive student perceptions of Computer Importance, if data had been gathered on a one-shot basis. However, using time-lag regression, it was found that the impact appears to be in the opposite direction -- positive student attitudes toward Computer Importance influence teachers' computer anxiety. This "backwards" relationship appears to operate in a time-delayed feedback loop within the training-teaching-learning triangle. That is, training appears to foster meaningful use by teachers in the classroom, which in turn fosters student joy and later a perception of importance of computers. In addition to that, however, it also appears that greater positive perception of Computer Importance among the students in a classroom also fosters higher Computer Anxiety in their teachers. This implies that teachers need to have some mechanism at their disposal (on-going education, for example) that continues to reduce their anxiety more rapidly than the advancing skill level of their students tends to put pressure on their teachers, thus causing their anxiety level to increase. This is consistent with a common belief among practicing teachers that they must stay at least one step ahead of their students in whatever they wish to feel comfortable in teaching.

APPENDIX A

COMPUTER INSERVICE NEEDS ASSESSMENT

Technology Inservice Needs Assessment *
1996-97

Name:__________________________ Grade(s) Taught:______.

School:______________________ Date:__________

A. Please classify yourself into one of the following categories:

Category 1: What is a computer?
What is a mouse?
Where are the computers located?

Category 2: I know how to turn on the computer and start the programs.

Category 3: I know all the above plus I know how to: Save to disk and hard drive; retrieve work from disk and hard drive. I know the basics of Microsoft Works, ClarisWorks or some similar application package.

Category 4: I know all the above plus I know how to: Create folders and organize work, backup my work to a disk, import and manipulate graphics, check spelling, change the format of a document (font, font size, boldface, underline, center, etc.)

Category 5: I know all the above plus I know how to : Import data from other programs (ie: MS Works into ClarisWorks), use the scanner, use the modem, create and use data bases and spreadsheet using Claris or MicrosoftWorks.

Category 6: I know all the above plus I know how to: Access World Wide Web resources; download graphic images; upload documents for others to read.

Category 7: I feel comfortable teaching others how to do everything in categories 1-6.

I best fit into Category _____.

Please continue on the other side.

* Based on Dorothea Walker Elementary School Staff Computer Needs Assessment 1993-94, by Kevin Davies

B. I have Internet access: (Please check all that apply).

____ at home

____ at work

____ at my school

____ in my classroom

____ other location (Please specify ________________.)

My <u>immediate</u> technology training needs are:

I would like to learn the following during this inservice:

I plan to use what I learn to:

Additional comments:

* Based on Dorothea Walker Elementary School Staff Computer Needs Assessment 1993-94, by Kevin Davies

APPENDIX B

TEACHERS' VIEWS OF TECHNOLOGY AND TEACHING

Name: ____________________ **Date:** __________

Teachers' Views Of Technology And Teaching

Instructions: Circle one number for each item to indicate how you feel.

SD = Strongly Disagree
D = Disagree
U = Undecided
A = Agree
SA = Strongly Agree

	SD	D	U	A	SA
1. Computers are valuable tools that can be used to improve the quality of education.	1	2	3	4	5
2. Computers can teach reading.	1	2	3	4	5
3. Teachers should know how to use computers in their classrooms.	1	2	3	4	5
4. If there was a computer in my classroom, it would help me to be a better teacher.	1	2	3	4	5
5. I would like to have a computer for use in my classroom.	1	2	3	4	5
6. Someday I will have a computer in my home.	1	2	3	4	5
7. I provide individualized instruction to many of my of my students.	1	2	3	4	5
8. Cooperative learning works well in my classroom	1	2	3	4	5
9. I'm not afraid to let my students know I am still learning, too.	1	2	3	4	5
10. My students feel free to come to me with thier problems.	1	2	3	4	5
11. My classes act up less than most.	1	2	3	4	5
12. I believe teachers are appreciated at my school.	1	2	3	4	5
13. Teachers get adequate support from the administration	1	2	3	4	5
14. Parents support teachers in this school.	1	2	3	4	5
15. I can get most materials that I need.	1	2	3	4	5
16. I enjoy using new tools for instruction.	1	2	3	4	5

Adapted from Poirot, J. et al. (1991). Educators' ILS Assessment & Evaluation Kit. Denton, TX: TCET.

APPENDIX C

STAGES OF ADOPTION OF TECHNOLOGY

Name: ______________________________ Date: _____________

Stages of Adoption of Technology

Instructions: Please read the descriptions of each of the six stages related to adoption of technology. Choose the stage that best describes where you are in the adoption of technology.

Stage 1: Awareness

I am aware that technology exists but have not used it - perhaps I'm even avoiding it.

Stage 2: Learning the process

I am currently trying to learn the basics. I am often frustrated using computers. I lack confidence when using computers.

Stage 3: Understanding and application of the process

I am beginning to Understand the process of using technology and can think of specific tasks in which it might be useful.

Stage 4: Familiarity and confidence

I am gaining a sense of confidence in using the computer for specific tasks. I am starting to feel comfortable using the computer.

Stage 5: Adaptation to other contexts

I think about the computer as a tool to help me and am no longer concerned about it as technology. I can use it in many applications and as an instructional aid.

Stage 6: Creative application to new contexts

I can apply what I know about technology in the classroom. I am able to use it as an instructional tool and integrate it into the curriculum.

APPENDIX D

TEACHER'S ATTITUDES TOWARD COMPUTERS QUESTIONNAIRE (TAC)

Name: ______________________________

Survey of Teachers' Attitudes Toward Computers

To the Educator:

This questionnaire is comprised of several attitudinal surveys that have been used with teachers in the past. It is part of a study to determine the relationship between technology integration education and teacher's attitudes toward information technology. Please complete all items even if you feel that some are redundant. This may require 20-30 minutes of your time. Usually it is best to respond with your first impression, without giving a question much thought. Your answers will remain confidential. You may withdraw at any time without penalty, prejudice, or loss of benefits. This questionnaire poses no risks to subjects.

Thank you for your cooperation!

Rhonda Christensen
University of North Texas

______________________________ ______________

(Educator's Signature) (Date)

University of North Texas P.O. Box 13857, Denton, TX 76203 Phone: (817) 565-2057

This project has been reviewed and approved by the UNT Committee for the Protection of Human Subjects (817) 565-3940.

Background Information

1. How long have you been teaching?

_____ 0-1 years _____ 2-5 years _____ 6-10 years

_____ 11-15 years _____ 15+ years

2. How would you rate your experience with computers? (Check all that apply)

_____ I have never used a computer and I don't plan to anytime soon.

_____ I have never used a computer but I would like to learn.

_____ I use applications like word processing, spreadsheets, etc.

_____ I use computers for instruction in the classroom.
How often?

_____ Daily

_____ Weekly

_____ Occasionally

3. Currently I use the computer approximately ______ hours per week in the classroom.

4. At the beginning of this school year, I used the computer approximately _____ hours per week in the classroom.

5. If you do use computers, what type of training have you received? (Rank order all that apply).

_____ No training

_____ Basic Computer Literacy (on/off operations, how to run programs)

_____ Computer applications (word processing, spreadsheets)

_____ Computer integration (how to use in classroom curriculum)

6. Where did you receive your training? (Rank order all that apply).

_____ Self-taught

_____ School district

_____ College or university

_____ Other- please specify ______________________________

Do you have a computer at home? ___ Yes ___ No Gender: ___ M ___ F

Age: ___ 18-25 ___ 26-30 ___ 31-35 ___ 36-40 ___ 41-45 ___ 46+

Instructions: Please read each statement and then circle the number which best shows how you feel.

SD = Strongly Disagree D = Disagree A = Agree SA = Strongly Agree

from Computer Attitude Questionnaire, Knezek & Miyashita, 1994		SD	D	A	SA
(1)	I enjoy doing things on a computer.	1	2	3	4
(2)	I am tired of using a computer.	1	2	3	4
(3)	I will be able to get a good job if I learn how to use a computer.	1	2	3	4
(4)	I concentrate on a computer when I use one.	1	2	3	4
(5)	I enjoy computer games very much.	1	2	3	4
(6)	I would work harder if I could use computers more often.	1	2	3	4
(7)	I think that it takes a long time to finish when I use a computer.	1	2	3	4
(8)	I know that computers give me opportunities to learn many new things.	1	2	3	4
(9)	I can learn many things when I use a computer.	1	2	3	4
(10)	I enjoy lessons on the computer.	1	2	3	4
(11)	I believe that the more often teachers use computers, the more I will enjoy school.	1	2	3	4
(12)	I believe that it is very important for me to learn how to use a computer.	1	2	3	4
(13)	I think that computers are very easy to use.	1	2	3	4
(14)	I would like to study with a teacher rather than using a computer.	1	2	3	4
(15)	I feel comfortable working with a computer.	1	2	3	4
(16)	I get a sinking feeling when I think of trying to use a computer.	1	2	3	4
(17)	Working with a computer makes me nervous.	1	2	3	4
(18)	Using a computer is very frustrating.	1	2	3	4
(19)	I will do as little work with computers as possible.	1	2	3	4
(20)	Computers are difficult to use.	1	2	3	4
(21)	Computers do not scare me at all.	1	2	3	4
(22)	I can learn more from books than from a computer.	1	2	3	4

Instructions: Mark one space between each adjective pair.

from The Computer Attitude Measure (CAM), Kay, 1993

Part 2

Computers are:

1.	Unlikable	_____ _____ _____ _____ _____ _____ _____	Likable	(41)
2.	Unhappy	_____ _____ _____ _____ _____ _____ _____	Happy	(42)
3.	Bad	_____ _____ _____ _____ _____ _____ _____	Good	(43)
4.	Unpleasant	_____ _____ _____ _____ _____ _____ _____	Pleasant	(44)
5.	Tense	_____ _____ _____ _____ _____ _____ _____	Calm	(45)
6.	Uncomfortable	_____ _____ _____ _____ _____ _____ _____	Comfortable	(46)
7.	Artificial	_____ _____ _____ _____ _____ _____ _____	Natural	(47)
8.	Empty	_____ _____ _____ _____ _____ _____ _____	Full	(48)
9.	Dull	_____ _____ _____ _____ _____ _____ _____	Exciting	(49)
10.	Suffocating	_____ _____ _____ _____ _____ _____ _____	Fresh	(50)

Part 3

Instructions: Please read each statement and circle the number that best describes how you feel about that statement.

1 = Strongly Disagree (SD)
2 = Disagree (D)
3 = Undecided (U)
4 = Agree (A)
5 = Strongly Agree (SA)

Computer Attitude Scale, Loyd & Gressard, 1984			**SD**	**D**	**U**	**A**	**SA**
1.	Computers do not scare me at all.	(51)	1	2	3	4	5
2.	I'm no good with computers.	(52)	1	2	3	4	5
3.	I would like working with computers.	(53)	1	2	3	4	5
4.	I will use computers many ways in my life.	(54)	1	2	3	4	5
5.	Working with a computer would make me very nervous.	(55)	1	2	3	4	5
6.	Generally I would feel OK about trying a new problem on the computer.	(56)	1	2	3	4	5
7.	The challenge of solving problems with computers does not appeal to me.	(57)	1	2	3	4	5
8.	Learning about computers is a waste of time.	(58)	1	2	3	4	5

Computer Attitude Scale, Loyd & Gressard, 1984 (Cont.)

			SD	D	U	A	SA
9.	I do not feel threatened when others talk about computers.	(59)	1	2	3	4	5
10.	I don't think I would do advanced computer work.	(60)	1	2	3	4	5
11.	I think working with computers would be enjoyable and stimulating.	(61)	1	2	3	4	5
12.	Learning about computers is worthwhile.	(62)	1	2	3	4	5
13.	I feel aggressive and hostile toward computers.	(63)	1	2	3	4	5
14.	I am sure I could do work with computers.	(64)	1	2	3	4	5
15.	Figuring out computer problems does not appeal to me.	(65)	1	2	3	4	5
16.	I'll need a firm mastery of computers for my future work.	(66)	1	2	3	4	5
17.	It wouldn't bother me at all to take computer courses.	(67)	1	2	3	4	5
18.	I'm not the type to do well with computers.	(68)	1	2	3	4	5
19.	When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer.	(69)	1	2	3	4	5
20.	I expect to have little use for computers in my daily life.	(70)	1	2	3	4	5
21.	Computers make me feel uncomfortable.	(71)	1	2	3	4	5
22.	I am sure I could learn a computer language.	(72)	1	2	3	4	5
23.	I don't understand how some people can spend so much time working with computers and seem to enjoy it.	(73)	1	2	3	4	5
24.	I can't think of any way that I will use computers in my career.	(74)	1	2	3	4	5
25.	I would feel at ease in a computer class.	(75)	1	2	3	4	5
26.	I think using a computer would be very hard for me.	(76)	1	2	3	4	5
27.	Once I start to work with the computer, I would find it hard to stop.	(77)	1	2	3	4	5
28.	Knowing how to work with computers will increase my job possibilities.	(78)	1	2	3	4	5
29.	I get a sinking feeling when I think of trying to use a computer.	(79)	1	2	3	4	5
30.	I could get good grades in computer courses.	(80)	1	2	3	4	5
31.	I will do as little work with computers as possible.	(81)	1	2	3	4	5
32.	Anything that a computer can be used for, I can do just as well some other way.	(82)	1	2	3	4	5
33.	I would feel comfortable working with a computer.	(83)	1	2	3	4	5

Part 3

Part 3

Computer Attitude Scale, Loyd & Gressard, 1984 (Cont.)			SD	D	U	A	SA
34.	I do not think I could handle a computer course.	(84)	1	2	3	4	5
35.	If a problem is left unsolved in a computer class, I would continue to think about it afterward.	(85)	1	2	3	4	5
36.	It is important to me to do well in computer classes.	(86)	1	2	3	4	5
37.	Computers make me feel uneasy and confused.	(87)	1	2	3	4	5
38.	I have a lot of self-confidence when it comes to working with computers.	(88)	1	2	3	4	5
39.	I do not enjoy talking with others about computers.	(89)	1	2	3	4	5
40.	Working with computers will not be important to me in my life's work.	(90)	1	2	3	4	5

Part 4

from Pelgrum & Plomp, 1989

1.	Computers can help me to learn things more easily.	(91)	1	2	3	4	5
2.	With computers it is possible to do practical things.	(92)	1	2	3	4	5
3.	Knowing how to use computers will help me do well in my career.	(93)	1	2	3	4	5
4.	Knowing how to use computers is a worthwhile skill.	(94)	1	2	3	4	5
5.	All students should have an opportunity learn about computers at school.	(95)	1	2	3	4	5
6.	It is important for students to learn about computers in order to be informed citizens.	(96)	1	2	3	4	5
7.	Having computer skills helps you get better jobs.	(97)	1	2	3	4	5
8.	I like to talk to others about computers.	(98)	1	2	3	4	5
9.	Computers can be exciting.	(99)	1	2	3	4	5
10.	I like reading about computers.	(100)	1	2	3	4	5
11.	A job using computers would be very interesting.	(101)	1	2	3	4	5
12.	Computer lessons are a favorite subject for me.	(102)	1	2	3	4	5
13.	I want to learn a lot about computers.	(103)	1	2	3	4	5
14.	I like to scan computer journals.	(104)	1	2	3	4	5
15.	When I pass a computer shop, usually I stop for a while.	(105)	1	2	3	4	5
16.	Computers interest me little.	(106)	1	2	3	4	5

SD = Strongly Disagree D = Disagree A = Agree SA = Strongly Agree

Measurement of Computer Attitudes, Comparison by Gardner, Discenza & Dukes, 1993

from BELCAT (Blomberg, Erickson, Lowery Computer Attitude Task), Erickson, 1987

			SD	D	U	A	SA
1.	Knowing about computers will help me earn a living.	(109)	1	2	3	4	5
2.	I get a sinking feeling when I think of trying to do something hard with a computer.	(110)	1	2	3	4	5
3.	A computer test would scare me.	(112)	1	2	3	4	5
4.	I'll need computers for my future work.	(113)	1	2	3	4	5
5.	I'm really going to need computer skills after I finish school.	(115)	1	2	3	4	5
6.	I'd be proud to be the outstanding student in a computer class.	(116)	1	2	3	4	5
7.	I'd like people to think I was smart with computers.	(121)	1	2	3	4	5
8.	I see the computer as something I will rarely use in my daily life as an adult.	(123)	1	2	3	4	5
9.	It would make me happy if people thought I was really good with computers.	(128)	1	2	3	4	5
10.	I don't like people to think I'm smart with computers.	(129)	1	2	3	4	5

from ATC (Attitudes Toward Computers), Raub, 1981

11.	Computers have the potential to control our lives.	(134)	1	2	3	4	5
12.	Our country relies too much on computers.	(135)	1	2	3	4	5
13.	I will use a computer in my future occupation.	(137)	1	2	3	4	5
14.	Computers dehumanize society by treating everyone as a number.	(138)	1	2	3	4	5
15.	Computers will create more jobs than they eliminate	(140)	1	2	3	4	5
16.	I feel apprehensive about using a computer terminal.	(141)	1	2	3	4	5
17.	Computers are changing the world too rapidly.	(142)	1	2	3	4	5
18.	Computers isolate people by inhibiting normal social interactions among users.	(144)	1	2	3	4	5
19.	I hesitate to use a computer for fear of making mistakes I cannot correct.	(145)	1	2	3	4	5

Part 5

from CAIN, Maurer, 1983

			SD	D	U	A	SA
20.	Having a computer available to me would improve my productivity.	(146)	1	2	3	4	5
21.	If I had to use a computer for some reason, it would probably save me some time and work.	(147)	1	2	3	4	5
22.	If I used a computer, I could get a better picture of the facts and figures.	(148)	1	2	3	4	5
23.	Having a computer available to me would improve my general satisfaction.	(149)	1	2	3	4	5
24.	If I had a computer at my disposal, I would try to get rid of it.	(150)	1	2	3	4	5
25.	Computers are probably going to be an important part of my life.	(151)	1	2	3	4	5
26.	I sometimes get nervous just thinking about computers.	(153)	1	2	3	4	5
27.	I will probably never learn to use a computer.	(154)	1	2	3	4	5
28.	I sometimes feel intimidated when I have to use a computer.	(157)	1	2	3	4	5

Part 6

Comparison of Four Computer Attitude Scales, Woodrow, 1991

from Computer Use Questionnaire, Griswold, 1983

1.	Computers will improve education.	(162)	1	2	3	4	5
2.	If there was a computer in my classroom it would help me to be a better teacher.	(163)	1	2	3	4	5
3.	Someday I will have a computer in my home.	(164)	1	2	3	4	5
4.	Computers can teach mathematics.	(165)	1	2	3	4	5
5.	Computers are beyond the understanding of the typical person.	(166)	1	2	3	4	5
6.	Computers could enhance remedial instruction.	(168)	1	2	3	4	5
7.	Computers will relieve teachers of routine duties.	(169)	1	2	3	4	5
8.	Computers can be used successfully with courses which demand creative activities.	(170)	1	2	3	4	5

from The Computer Survey Scale, Stevens, 1982

9.	High school students should understand the role computers play in society.	(172)	1	2	3	4	5
10.	High school students should have some understanding about computers.	(173)	1	2	3	4	5
11.	Computers can be a useful instructional aid in almost all subject areas.	(175)	1	2	3	4	5

			SD	D	U	A	SA
12.	Use of computers in education almost always reduces the personal treatment of students.	(176)	1	2	3	4	5
13.	I feel at ease when I am around computers.	(177)	1	2	3	4	5
14.	Teacher training should include instructional applications of computers.	(179)	1	2	3	4	5

from Attitude Toward Computer Scale, Francis, 1993

			SD	D	U	A	SA
15.	Learning about computers is boring to me.	(180)	1	2	3	4	5
16.	I like learning on a computer.	(181)	1	2	3	4	5
17.	Working with a computer would make me very nervous.	(182)	1	2	3	4	5
18.	The challenge of solving problems with computers does not appeal to me.	(185)	1	2	3	4	5
19.	I think working with computers would be enjoyable and stimulating.	(186)	1	2	3	4	5
20.	Learning about computers is interesting.	(187)	1	2	3	4	5
21.	Computers are boring.	(189)	1	2	3	4	5
22.	Computers are not exciting.	(191)	1	2	3	4	5
23.	Studying about computers is a waste of time.	(192)	1	2	3	4	5
24.	It is fun to figure out how computers work.	(193)	1	2	3	4	5
25.	I enjoy learning how computers are used in our daily lives.	(195)	1	2	3	4	5

from CAM (Computer Attitude Measure), Kay, 1993

			SD	D	U	A	SA
26.	Computers would motivate students.	(196)	1	2	3	4	5
27.	Computers would significantly improve the overall quality of my students' education.	(197)	1	2	3	4	5
28.	Computers would help students improve their writing.	(198)	1	2	3	4	5
29.	Computers would stimulate creativity in students.	(199)	1	2	3	4	5
30.	Computers would help students work with one another.	(200)	1	2	3	4	5
31.	Computers would help me organize my work.	(201)	1	2	3	4	5

			SD	D	U	A	SA
32.	Computers would increase my productivity.	(202)	1	.2	3	4	5
33.	Computers would save me time.	(203)	1	2	3	4	5
34.	Computers would help me learn.	(204)	1	2	3	4	5
35.	Computers would help me organize my finances.	(205)	1	2	3	4	5
36.	Computers improve the overall quality of life.	(207)	1	2	3	4	5
	from CARS, Chu & Spires, 1991						
1.	I look forward to using a computer on my job.	(209)	1	2	3	4	5
2.	The challenge of learning about computers is exciting.	(211)	1	2	3	4	5
3.	Learning to operate computers is like learning any new skill - the more you practice, the better you become.	(214)	1	2	3	4	5
4.	I am afraid that if I begin to use computers I will become dependent upon them and lose some of my reasoning skills.	(215)	1	2	3	4	5
5.	I am sure that with time and practice I will be as comfortable working with computers as I am working with a typewriter.	(216)	1	2	3	4	5
6.	I dislike working with machines that are smarter than I am.	(218)	1	2	3	4	5
7.	I feel apprehensive about using computers.	(219)	1	2	3	4	5
8.	If given the opportunity, I would like to learn about and use computers.	(224)	1	2	3	4	5
9.	I have avoided computers because they are unfamiliar and somewhat intimidating to me.	(225)	1	2	3	4	5
10.	I feel computers are necessary tools in both educational and work settings.	(226)	1	2	3	4	5
	from CASS, Jones & Clarke, 1994						
11.	Computers intimidate and threaten me.	(227)	1	2	3	4	5
12.	Working with a computer makes me feel tense and uncomfortable.	(230)	1	2	3	4	5
13.	Computers are difficult to understand.	(231)	1	2	3	4	5
14.	I feel important when others ask me for information about computers.	(236)	1	2	3	4	5
15.	Using the computer has increased my interaction with other students.	(237)	1	2	3	4	5

			SD	D	U	A	SA
16.	Anything that a computer can be used for, I can do just as well in another way.	(239)	1	2	3	4	5
17.	Working with computers makes me feel isolated from other people.	(241)	1	2	3	4	5
18.	Working with computers will not be important to me in my career.	(242)	1	2	3	4	5
19.	I would like to spend more time using a computer.	(243)	1	2	3	4	5
20.	If I can, I will take subjects that will teach me to use computers.	(246)	1	2	3	4	5
21.	People who work with computers sit in front of a computer screen all day.	(248)	1	2	3	4	5
22.	I would like to learn more about computers.	(249)	1	2	3	4	5
23.	Working with computers means working on your own, without contact with others.	(251)	1	2	3	4	5
24.	If I need computer skills for my career choice, I will develop them	(252)	1	2	3	4	5
25.	Working with a computer makes me feel very nervous.	(256)	1	2	3	4	5
26.	Using a computer prevents me from being creative.	(257)	1	2	3	4	5
27.	Computers are confusing.	(259)	1	2	3	4	5
28.	Computers make me feel uncomfortable.	(260)	1	2	3	4	5
29.	You have to be a "brain" to work with computers.	(261)	1	2	3	4	5
30.	Not many people can use computers.	(262)	1	2	3	4	5
31.	I get a sinking feeling when I think of trying to use a computer.	(263)	1	2	3	4	5
32.	Computers frustrate me.	(264)	1	2	3	4	5

from Attitudes Toward Computers Scale, Reece & Gable, 1982

33.	I will use a computer as soon as possible.	(266)	1	2	3	4	5
34.	I will take computer courses.	(267)	1	2	3	4	5
35.	Computers can be used to save lives.	(268)	1	2	3	4	5
36.	I enjoy computer work.	(270)	1	2	3	4	5
37.	I would never take a job where I had to work with computers.	(272)	1	2	3	4	5

Instructions: Please circle the appropriate number to indicateyour agreement or disagreement with each statement.

1 = Strongly Disagree (SD)
2 = Disagree (D)
3 = Undecided (U)
4 = Agree (A)
5 = Strongly Agree (SA)

from D'Souza, 1992		SD	D	U	A	SA
1. Electronic mail (E-mail) is an effective means of disseminating class information and assignments.	(274)	1	2	3	4	5
2. I prefer E-mail to traditional class handouts as an information disseminator.	(275)	1	2	3	4	5
3. More courses should use E-mail to disseminate class information and assignments.	(276)	1	2	3	4	5
4. E-mail provides better access to the instructor.	(277)	1	2	3	4	5
5. The use of E-mail creates more interaction:						
between students enrolled in the course	(278)	1	2	3	4	5
between student and instructor	(279)	1	2	3	4	5
6. The use of E-mail increases motivation for the course.	(280)	1	2	3	4	5
7. The use of E-mail makes the course more interesting.	(281)	1	2	3	4	5
8. The use of E-mail makes the student feel more involved.	(282)	1	2	3	4	5
9. The use of E-mail helps the student to learn more.	(283)	1	2	3	4	5
10. The use of E-mail helps provide a better learning experience.	(284)	1	2	3	4	5

(End)

Thank you!

Ver 2.21
4/97

APPENDIX E

PORT ARTHUR TECHNOLOGY TRAINING COURSE CONTENT

Instructor: Dr. Des Rice
Technology Consultant

Port Arthur ISD
Technology Training

1995-1996
Session 1

Course Content Overview for Supervisors

This overview course is designed to acquaint you with some of the features of the Macintosh. This course is intended not only to help you personally with using the Macintosh computer for your own use. The approach that will be taken will be aimed at those with minimal knowledge so that no explanations will be taken for granted.

1. Introduction to the Macintosh

1. Technology Survey
2. Mac tour
3. System 7
4. Folders/documents
5. Apple folder - aliases/ duplication
6. Formatting a disk

2. Word Processing

1. Tabs - left/right/center/decimal
2. Copy/delete/paste/size/color/ style/Fonts
3. Draw/Justification
4. Save/save as/regular/template export
5. Spelling/thesaurus
6. Headers/footers/margins
7. Importing print

3. Database

1. Setting up fields
2. Organizing screen layout columns
3. Alphabetize - by cell
4. Cell Attributes
5. Sort/Find/Replace
6. Prepare reports - center on page
7. Include Draw program for titles, etc.

4. Spreadsheet

1. Entering data
2. Formulas - sum/average/ fill down/fill right
3. Borders
4. Title Boxes - draw program
5. Highlight - select/print/sort
6. Page header/footer

APPENDIX F

YOUNG CHILDREN'S COMPUTER INVENTORY (YCCI)

Young Children's Computer Inventory

Name: ______________________ Grade Level: _______ Date: ____________
Do you use a computer at home? Yes ____ No _____

Follow along with each statement as your teacher reads it and then circle the number which best shows how you feel.

Part 1		No	Don't Know	Yes
(1)	I enjoy doing things on a computer.	1	2	3
(2)	I am tired of using a computer.	1	2	3
(3)	I will be able to get a good job if I learn how to use a computer.	1	2	3
(4)	I concentrate on a computer when I use one.	1	2	3
(5)	I enjoy computer games very much.	1	2	3
(6)	I would work harder if I could use computers more often.	1	2	3
(7)	I know that computers give me opportunities to learn many new things.	1	2	3
(8)	I can learn many things when I use a computer.	1	2	3
(9)	I enjoy lessons on the computer.	1	2	3
(10)	I believe that the more often teachers use computers, the more I will enjoy school.	1	2	3
(11)	I believe that it is very important for me to learn how to use a computer.	1	2	3

Go On

Part 2

		No	Don't Know	Yes
(1)	I study by myself without anyone forcing me to study.	1	2	3
(2)	If I do not understand something, I will not stop thinking about it.	1	2	3
(3)	When I don't understand a problem, I keep working until I find the answer.	1	2	3
(4)	I review my lessons every day.	1	2	3
(5)	I try to finish whatever I begin.	1	2	3
(6)	Sometimes, I change my way of studying.	1	2	3
(7)	I enjoy working on a difficult problem.	1	2	3
(8)	I think about many ways to solve a difficult problem.	1	2	3
(9)	I never forget to do my homework.	1	2	3
(10)	I like to work out problems which I can use in my life every day.	1	2	3
(11)	If I do not understand my teacher, I ask him/her questions.	1	2	3

Part 3

		No	Don't Know	Yes
(1)	I feel sad when I see a child crying.	1	2	3
(2)	I sometimes cry when I see a sad play or movie.	1	2	3
(3)	I get angry when I see a friend who is treated badly.	1	2	3
(4)	I feel sad when I see old people alone.	1	2	3
(5)	I worry when I see a sad friend.	1	2	3
(6)	I feel very happy when I listen to a song I like.	1	2	3
(7)	I do not like to see a child play alone, without a friend.	1	2	3
(8)	I feel sad when I see an animal hurt.	1	2	3
(9)	I feel happy when I see a friend smiling.	1	2	3
(10)	I really like school.	1	2	3
(11)	School is boring.	1	2	3
(12)	I would like to work in a school when I grow up.	1	2	3
(13)	When I grow up I would not like to work in a school.	1	2	3

Go On

Part 4

		No	Don't Know	Yes
(1)	I examine unusual things.	1	2	3
(2)	I find new things to play with or to study, without any help.	1	2	3
(3)	When I think of a new thing, I apply what I have learned before.	1	2	3
(4)	I tend to consider various ways of thinking.	1	2	3
(5)	I create many unique things.	1	2	3
(6)	I do things by myself without depending upon others.	1	2	3
(7)	I find different kinds of materials when the ones I have do not work or are not enough.	1	2	3
(8)	I examine unknown issues to try to understand them.	1	2	3
(9)	I make a plan before I start to solve a problem.	1	2	3
(10)	I invent games and play them with friends.	1	2	3
(11)	I invent new methods when one way does not work.	1	2	3
(12)	I choose my own way without imitating methods of others.	1	2	3
(13)	I tend to think about the future.	1	2	3

Go On

Part 5

(1) Which would you rather do? (circle one of each pair):

(1) read a book	or	(2) write
(1) write	or	(2) watch television
(1) watch television	or	(2) use a computer
(1) use a computer	or	(2) read a book
(1) read a book	or	(2) watch television
(1) write	or	(2) use a computer

(2) Which would be more difficult for you (circle one of each pair):

(1) read a book	or	(2) write
(1) write	or	(2) watch television
(1) watch television	or	(2) use a computer
(1) use a computer	or	(2) read a book
(1) read a book	or	(2) watch television
(1) write	or	(2) use a computer

(3) Which would you learn more from (circle one of each pair):

(1) read a book	or	(2) write
(1) write	or	(2) watch television
(1) watch television	or	(2) use a computer
(1) use a computer	or	(2) read a book
(1) read a book	or	(2) watch television
(1) write	or	(2) use a computer

(END YCCI Ver 5.14 4/97)

Stop

APPENDIX G

SKILLS CHECKLIST FOR PAUL KEYES ELEMENTARY

Skills Checklist for Paul Keyes Elementary - Irving 1996

Name:______________________ Date:____________

Please rate your competence in each of the following areas (circle one number for each):

	Low	Med	High
Organizing the Macintosh desktop			
Creating folders	1	2	3
Views and color coding	1	2	3
Saving and retrieving files	1	2	3
Get info., backup, duplication	1	2	3
Access restrictions (Foolproof)	1	2	3
Teacher Productivity			
Composing with a word processor	1	2	3
Cutting and pasting	1	2	3
Saving and printing	1	2	3
Using the Mac gradebook program	1	2	3
Using a spreadsheet program	1	2	3
Integrating a spreadsheet file into a written document	1	2	3
Awareness of TENET	1	2	3
How to use TENET Email	1	2	3
Student Software			
Accessing a CD-ROM program	1	2	3
Using utility software (banner, crossword, etc.)	1	2	3
Making slides in KidPix	1	2	3
Making a slideshow in KidPix	1	2	3

APPENDIX H

IRVING INDEPENDENT SCHOOL DISTRICT APPROVAL TO CONDUCT RESEARCH

PLANNING, EVALUATION & RESEARCH

November 1, 1996

To: George Easley, V.P. Paul Keyes

From: Whit Johnstone

Subject: Research Request

I am pleased to inform you that your request to conduct research in the district has been approved on condition that it is conducted with the approval of your principal, Mr. Voelkle, along the lines described in your written communications with my office.

Good luck with your study. Let me know if I may be of further assistance.

cc Nim Voelkle

APPENDIX I

PARENTAL CONSENT FOR ADMINISTRATION OF

STUDENT INSTRUMENT

January, 1997

Dear Parents,

We are conducting a technology survey at school. The purpose of the survey is to measure students' attitudes toward technology and how it relates to students' technology skills. If your child has permission to complete the survey, please sign and return this form. There are no risks involved in completing this survey and your child's grade will not be affected by whether or not they choose to participate.

*The students will complete the survey at school. Please do not fill out the survey at home.

My child, ______________________________, has permission to complete the survey.

Yes _______

No ________

_______________________________ (Parent's signature)

_______________________________ (Child's signature)

Date:__________________

*A copy of the survey is attached. Please send this copy back to school with the permission slip in the Thursday folder.

Thank you,
The Paul Keyes Elementary Staff

This project has been reviewed and approved by the UNT Committee for the Protection of Human Subjects (817) 565-3940.

APPENDIX J

PAUL KEYES ELEMENTARY STAFF DEVELOPMENT TIMELINE

Paul Keyes Elementary School
Irving ISD
Staff Development

Rhonda Christensen
rhondac@tenet.edu

Gerald Knezek
gknezek@tenet.edu

Texas Center for Educational Technology
University of North Texas
August 7,8, 1996
Schedule

Day One (Aug. 7, 1996)

Afternoon (1:00-3:30pm)
Introduction

- Macintosh basics (organizing the desktop)
- Creating folders
- Cutting and pasting (WP)
- Finding, saving, retrieving files

Hands-on Activity - Making a template (class newsletter, class rules, class roster)

Day Two (Aug. 8, 1996)

Morning (8:30am-11:30pm)

- Mac Gradebook

- Hands-on Activity: Making your class gradebook

- Breakout sessions
  - -CD-ROM/software previewing
  - -Microsoft Works Integration
  - -Utility software- BannerMania, PrintShop, Word puzzles

Afternoon (12:30pm-3:30pm)

- Show and Tell
- Introduction to TENET
- How to subscribe to TENET
- Introduction to KidPix and Companion
- Hands-on Activity: Making a KidPix slide show
- Wrap-up

APPENDIX K

UNIVERSITY OF NORTH TEXAS HUMAN CONSENT FORM

University of North Texas

Sponsored Projects Administration

January 21, 1997

Rhonda Christensen
4623 Ellensburg Dr.
Dallas, TX 75244

Re: Human Subjects Application No. 97-002

Dear Ms. Christensen:

As permitted by federal law and regulations governing the use of human subjects in research projects (45 CFR 46), I have conducted an expedited review of your proposed project titled "Effect of Technology Integration on the Attitudes of Teachers and Their Students." The risks inherent in this research are minimal, and the potential benefits to the subjects outweigh those risks. The submitted protocol and informed consent form are hereby approved for the use of human subjects on this project.

The UNT IRB must re-review this project prior to any modifications you make in the approved project. Please contact me if you wish to make such changes or need additional information.

If you have any questions, please contact me.

Sincerely,

Mark Elder
Chairman
Institutional Review Board

ME:lg

cc: IRB Members

APPENDIX L

TAC ITEMS BY FACTOR

Variable #	Item

Teacher Importance

3 I will be able to get a good job if I learn how to use a computer.
6 I would work harder if I could use computers more often.
8 I know that computers give me opportunities to learn many new things.
9 I can learn many things when I use a computer.
10 I enjoy lessons on the computer.
11 I believe that the more often teachers use computers, the more I will enjoy school.
12 I believe that it is very important for me to learn how to use a computer.

Teacher Enjoyment

1 I enjoy doing things on a computer.
2 I am tired of using a computer.
4 I concentrate on a computer when I use one.
5 I enjoy computer games very much.
10 I enjoy lessons on the computer.
15 I feel comfortable working with a computer.
16 I get a sinking feeling when I think of trying to use a computer.
17 Working with a computer makes me nervous.
20 Computers are difficult to use.

Teacher Anxiety

7 I think that it takes a long time to finish when I use a computer.
13 I think that computers are very easy to use.
16 I get a sinking feeling when I think of trying to use a computer.
17 Working with a computer makes me nervous.
18 Using a computer is very frustrating.
19 I will do as little work with computers as possible.
20 Computers are difficult to use.
21 Computers do not scare me at all.

CASA (Loyd & Gressard Anxiety)

51 Computers do not scare me at all.
55 Working with a computer would make me very nervous.
59 I do not feel threatened when others talk about computers.
63 I feel aggressive and hostile toward computers.
67 It wouldn't bother me at all to take computer courses.
75 I would feel at ease in a computer class.
79 I get a sinking feeling when I think of trying to use a computer.
83 I would feel comfortable working with a computer.
87 Computers make me feel uneasy and confused.

CASC (Loyd and Gressard Confidence)

52 I'm no good with computers.
56 Generally I would feel OK about trying a new problem on the computer.
60 I don't think I would do advanced computer work.
64 I am sure I could do work with computers.
68 I'm not the type to do well with computers.
72 I am sure I could learn a computer language.
75 I would feel at ease in a computer class.
80 I could get good grades in computer courses.
84 I do not think I could handle a computer course.
88 I have a lot of self-confidence when it comes to working with computers.

CASL (Loyd & Gressard Liking)

53 I would like working with computers.
57 The challenge of solving problems with computers does not appeal to me.
61 I think working with computers would be enjoyable and stimulating.
65 Figuring out computer problems does not appeal to me.
69 When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer.
73 I don't understand how some people can spend so much time working with computers and seem to enjoy it.
77 Once I start to work with the computer, I would find it hard to stop.
81 I will do as little work with computers as possible.
85 If a problem is left unsolved in a computer class, I would continue to think about it afterward.
89 I do not enjoy talking with others about computers.

CASU (Loyd & Gressard Usefulness)

54 I will use computers many ways in my life.
58 Learning about computers is a waste of time.
62 Learning about computers is worthwhile.
66 I'll need a firm mastery of computers for my future work.
70 I expect to have little use for computers in my daily life.
74 I can't think of any way that I will use computers in my career.
78 Knowing how to work with computers will increase my job possibilities.
82 Anything that a computer can be used for, I can do just as well some other way.
80 It is important to me to do well in computer classes.
90 Working with computers will not be important to me in my life's work.

Factor 1 - Enthusiasm

249 I would like to learn more about computers.
211 The challenge of learning about computers is exciting.
243 I would like to spend more time using a computer.
267 I will take computer courses.
181 I like learning on a computer.
266 I will use a computer as soon as possible.
224 If given the opportunity, I would like to learn about and use computers.
186 I think working with computers would be enjoyable and stimulating.
103 I want to learn a lot about computers.
246 If I can, I will take subjects that will teach me to use computers.
187 Learning about computers is interesting.
209 I look forward to using a computer on my job.
270 I enjoy computer work.
180 Learning about computers is boring to me.
53 I would like working with computers.

Factor 2 - Anxiety

256 Working with a computer makes me feel very nervous.
260 Computers make me feel uncomfortable.
263 I get a sinking feeling when I think of trying to use a computer.
227 Computers intimidate and threaten me.
230 Working with a computer makes me feel tense and uncomfortable.
110 I get a sinking feeling when I think of trying to do something hard with a computer.
182 Working with a computer would make me very nervous.
87 Computers make me feel uneasy and confused.
79 I get a sinking feeling when I think of trying to use a computer.
264 Computers frustrate me.
17 Working with a computer makes me nervous.
153 I sometimes get nervous just thinking about computers.
225 I have avoided computers because they are unfamiliar and somewhat intimidating to me.
145 I hesitate to use a computer for fear of making mistakes I cannot correct.
88 I have a lot of self-confidence when it comes to working with computers.

Factor 3 - Acceptance

74 I can't think of any way that I will use computers in my career.
164 Someday I will have a computer in my house.
154 I will probably never learn to use a computer.
54 I will use computers many ways in my life.

Factor 4 - E-mail

282 The use of e-mail makes the student feel more involved.
284 The use of e-mail helps provide a better learning experience.
281 The use of e-mail makes the course more interesting.
283 The use of e-mail helps the student to learn more.
280 The use of e-mail increases motivation for the course.
276 More courses should use e-mail to disseminate class information and assignments.
279 The use of e-mail creates more interaction between student and instructor.
278 The use of e-mail creates more interaction between students enrolled in the course.
277 E-mail provides better access to the instructor.
274 E-mail is an effective means of disseminating class information and assignments.
275 I prefer e-mail traditional class handouts as an information disseminator.

Factor 5 - Negative Impact on Society

142 Computers are changing the world too rapidly.
138 Computers dehumanize society by treating everyone as a number.
135 Our country relies too much on computers.
144 Computers isolate people by inhibiting normal social interactions among users.
134 Computers have the potential to control our lives.
176 Use of computers in education almost always reduces the personal treatment of students.
218 I dislike working with machines that are smarter than I am.
241 Working with computers makes me feel isolated from other people.
215 I am afraid that if I begin to use computers I will become dependent upon them and lose some of my reasoning skills.
251 Working with computers means working on your own, without contact with others.

Factor 6 - Productivity - Classroom

198 Computers would help students improve their writing.
199 Computers would stimulate creativity in students.
197 Computers would significantly improve the overall quality of my students' education.
196 Computers would motivate students.
175 Computers can be a useful instructional aid in almost all subject areas.
200 Computers would help students work with one another.
168 Computers could enhance remedial instruction.
170 Computers can be used successfully with courses which demand creative activities.
162 Computers will improve education.
163 If there were a computer in my classroom it would help me be a better teacher.
179 Teacher training should include instructional applications of computers.
165 Computers can teach mathematics.
92 With computers it is possible to do practical things.
268 Computers can be used to save lives.

Factor 7 - Kay's Semantic

44	Unpleasant	Pleasant
50	Suffocating	Fresh
49	Dull	Exciting
41	Unlikable	Likable
46	Uncomfortable	Comfortable
43	Bad	Good
42	Unhappy	Happy
45	Tense	Calm
48	Empty	Full
47	Artificial	Natural

Factor 8 - Vocation

113 I'll need computers for my future work.
109 Knowing about computers will help me earn a living.
115 I'm really going to need computer skills after I finish school.
137 I will use a computer in my future occupation.
78 Knowing how to work with computers will increase my job possibilities.
93 Knowing how to use computers will help me do well in my career.
66 I'll need a firm mastery of computers for my future work.
151 Computers are probably going to be an important part of my life.
3 I will be able to get a good job if I learn how to use a computer.
90 Working with computers will not be important to me in my life's work.
123 I see the computer as something I will rarely use in my daily life as an adult.
242 Working with computers will not be important to me in my career.
252 If I need computer skills for my career choice, I will develop them.

Factor 9 - Prestige

128 It would make me happy if people thought I was really good with computers.
121 I'd like people to think I was smart with computers.
236 I feel important when others ask me for information about computers.
116 I'd be proud to be the outstanding student in a computer class.
237 Using the computer has increased my interaction with other students.
86 It is important to me to do well in computer classes.
129 I don't like people to think I'm smart with computers.
140 Computers will create more jobs than they eliminate.

Factor 10 - Productivity

203 Computers would save me time.
202 Computers would increase my productivity.
201 Computers would help me organize my work.
205 Computers would help me organize my finances.
204 Computers would help me learn.
149 Having a computer available to me would improve my general satisfaction.
146 Having a computer available to me would improve my productivity.
147 If I had to use a computer for some reason, it would probably save me some time and work.
148 If I used a computer, I would get a better picture of the facts and figures.
207 Computers improve the overall quality of life.
91 Computers can help me to learn things more easily.
150 If I had a computer at my disposal, I would try to get rid of it.
192 Studying about computers is a waste of time.
239 Anything that a computer can be used for, I can do just as well another way.

Factor 11 - Aversion

261 You have to be a "brain" to work with computers.
262 Not many people can use computers.
272 I would never take a job where I had to work with computers.
257 Using a computer prevents me from being creative.
166 Computers are beyond the understanding of the typical person.
248 People who work with computers sit in front of a computer screen all day.

Factor 12 - Gender Bias

125 I would trust a woman just as much as a man to figure out how to operate a computer.
126 I would be just as likely to ask a woman for help on a computer as a man.
122 Women certainly are logical enough to use computers.
127 In general, boys are better than girls at using computers.
111 It's hard to believe that a woman or girl could be a computer genius.
118 Girls who enjoy using computers are a little weird.

Factor 13 - K&M Importance

9 I can learn many things when I use a computer.
8 I know that computers give me opportunities to learn many new things.
10 I enjoy lessons on the computer.
12 I believe that it is very important for me to learn how to use a computer.
11 I believe that the more often teachers use computers, the more I will enjoy school.
4 I concentrate on a computer when I use one.
6 I would work harder if I could use computers more often.
64 I am sure I could do work with computers.

Factor 14 - L&G Confidence

101 A job using computers would be very interesting.
69 When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer.
57 The challenge of solving problems with computers does not appeal to me.
60 I don't think I would do advanced computer work.
85 If a problem is left unsolved in a computer class, I would continue to think about it afterward.
72 I am sure I could learn a computer language.

Factor 15 - P&P Relevance

94 Knowing how to use computers is a worthwhile skill.
173 High school students should have some understanding about computers.
95 All students should have an opportunity to learn about computers at school.
97 Having computer skills helps you get better jobs.
172 High school students should understand the role computers play in society.
214 Learning to operate computers is like learning any new skill - the more you practice, the better you become.
62 Learning about computers is worthwhile.
226 I feel computers are necessary tools in both educational and work settings.
216 I am sure that with time and practice I will be as comfortable working with computers as I am working with a typewriter.
96 It is important for students to learn about computers in order to be informed citizens.

Factor 16 - P&P Enjoyment

100 I like reading about computers.
98 I like to talk to others about computers.
104 I like to scan computer journals.
105 When I pass a computer shop, usually I stop for a while.
193 It is fun to figure out how computers work.
102 Computer lessons area favorite subject for me.
89 I do not enjoy talking with others about computers.
65 Figuring out computer problems does not appeal to me.

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