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The goal for this study was to develop a valid and reliable instrument to assess public middle school teachers' attitudes toward computers in the Republic of China (ROC). Interviews with teachers, a survey of teachers' beliefs and feelings about computers, the Delphi technique, a pilot study, an item analysis, correlation analysis, known-group difference testing, and factor analysis were used in the instrument validation procedure. A final 28-item computer attitudes instrument, along with a demographic questionnaire, was used to assess 512 ROC public middle school teachers. The instrument was used to determine if teachers' computer attitudes were different as a result of selected factors such as gender, age, and computer experience and other factors

that related to computer utilization. Discussions of current computer use and training for ROC middle school teachers were also included.

The results of data analyses indicated that: 1) the instrument had two factors which were labeled as "teachers' positiveness toward computers" and "teachers' negativeness toward computers", 2) the Hoyt-Stunkard's coefficient of reliability was +.904 for Factor 1, +.911 for Factor 2, and +.943 for the entire instrument, 3) gender differences were found in "teachers' positiveness toward computers" but not for "teachers' negativeness toward computers", with male teachers having higher positive attitudes toward computers, 4) middle school teachers' computer attitudes were found to be significantly different among different age groups and groups with different lengths of computer experience.

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TABLE OF CONTENTS

Table of Contents - Continued

Table of Contents - Continued

LIST OF TABLES

List of Tables - Continued

List of Tables - Continued

LIST OF APPENDICES FIGURES

List of Appendices Figures - Continued

List of Appendices Figures - Continued

Attitudes Toward Computers of ROC Public Middle School Teachers

CHAPTER 1

INTRODUCTION

I. Background of the Study

Ever since the computer was invented it has moved humankind from the age of industrial revolution to an age of information, an era during which the computer has become an integral part of our lives (Naisbitt, 1982; Shane, 1987). In the past the computer was a giant and costly machine and was only used by a few. With the development of microchip technology, the size and price of the computer has been reduced greatly, and the power of the computer has increased dramatically. Today, the computer is a powerful tool that can be used in a variety of areas such as banking and business, manufacturing, government, and education, as well as personal use. As the impact of computer technology increases, computer education becomes a concern of all citizens in our society (Flake et al., 1990; Peelle, 1983; Uhlig, 1982) consequently, teacher education programs require students to take courses in computer education. In addition, in-service teachers are returning to college for computer education courses.

The presence of the computer as a new instructional technology tends to dominate instructional activities in the classroom. Bork (1987) predicted that, in the future, the computer will be the major delivery device and, in many cases, the only delivery device, for instruction activities. However, Bork laments that, in spite of the increased presence of the computer in education, computer use is still only a very small fraction of the total instruction system presented to students. He considers the teachers' lack of knowledge of how to use computers as an important factor contributing to the problem. Becker (1991), in his survey on the computer use in United States schools, concluded that American schools steadily increased their stock of microcomputers during the later half of 1980s, but they made only modest changes in their pattern of hardware and software use between 1985 and 1989. Although there are twice the number of computer using teachers as there were five years ago, computer-centered classrooms where students use computers for a large fraction of the time they spend on any type of learning activity are still rare.

There has been great concern about the affective factors that influence the computer implementation in the school's computer education. Lawton and Gerschner (1982) stated that when computer-based programs are introduced into curricula, teacher attitudes toward computers are a key factor in their success. When teachers have negative attitudes toward computers, the result has sometimes been "covert and in some cases overt sabotage" to the computer aided learning process (Clement, 1981). Cory (1983) suggested in his 4-stage model of development for implementation of computers for instruction in school system that attitude is one of the important factors that characterize the implementation. He stated that:

> At stage 1 (Stage of getting on the bandwagon) ambivalence is the general attitude. Combined feelings of fear, mistrust of what computers will do to the role of the teacher, uncertainty about what computers can do, curiosity, and attractions generate this ambivalence. The attitude that computers are just for games and fun also exists, and the attitude that they are transient in education is popular. At stage 2 (Stage of confusion) attitudes at this stage are quite diverse. Teachers who have taken courses and use the computer with their students tend to be excited and enthusiastic. Seeing this enthusiasm makes others very nervous, feeling their students might be missing out, and realizing they may in fact have to learn about the computer sooner or later but feeling inadequate to succeed. Teachers begin to feel that everyone will have to know how to program a computer as they see that the teachers who are using the computers have taken courses that involve quite a bit of programming. At stage 3 (Stage of pulling it all together) some teachers see the computer as a panacea for education and go overboard in their zeal to sell it to others. As a result, there is a backlash of resistance. Many teachers at this stage are becoming interested in what computers can add to an instructional program, and they are becoming much less fearful of using the computer in their classroom. Teachers are realizing that it's not necessary to be an accomplished programmer in order to make excellent use of the computer with their students. At stage 4 (Stage of full implementation) respect for the capabilities and limitations of the computer is the prevalent attitude at this stage. There is real understanding of what the computer can and cannot do, a real understanding of its importance in the lives of the children in the school system, and an appreciation of the computer as a tool of great value for all people.

In a study conducted in 1979 (Lichtman, 1979) almost one-third of the teachers interviewed felt that computers in education were a passing fancy; yet, when the survey was conducted in 1982, it was found that 80% of the teachers surveyed believed microcomputers in education were not a fad and predicted they will continue to have a drastic impact on education. As computer literacy and computer use become more important in the educational process, the attitudes of teachers will play an important role in the successful implementation of computer-related components in the curriculum. Because educational change depends on what teachers think (Fullan, 1982), positive attitudes increase the prospects of developing positive responses from students.

Computer use in ROC (Republic of China) came relatively late compared to that of the United States and other technologically advanced countries. In order to narrow the gap with the advanced countries in computer technology and its applications, the ROC government launched its first five-year plan in 1984, followed by a twelve-year plan in computer education which began in 1989 (Ministry of Education, 1989, 1992). One of the major purposes of these plans is to provide teachers of all school levels with necessary computer literacy that may be used in their teaching to foster in the students concepts of information, and the knowledge about the use of computers.

As government-sponsored training programs in information concepts for teachers take place, the hardware implementation in schools, and education in computer-aided instruction is also under way. In the first part of the training period 369 public and private senior high schools were given 35 IBM-compatible computers. Each of the 676 junior high schools were given at least 10 microcomputers. In 1988 the Ministry of Education began purchasing microcomputer for elementary schools with the intention of placing 10 microcomputers in each of the 2486 ROC elementary schools within 4 years (Alessi and Shih, 1989). The training programs for Computer-Aided Instruction began in 1985, first for vocational school teachers, later for elementary school teachers. In 1986 middle school teachers were included in the program (Wu, 1991).

Compared to the colleges, high schools, and vocational schools, the computer use in middle schools in Taiwan has not gotten much attention until recent years. One of the factors contributing to this is the nature of the country's information development plan. Middle school teachers were not including in national training programs until 1988 (Ministry of Education, 1989). Today, 85% of the middle schools in ROC have computers. However, the computer use in instruction has been very low. There are some reasons contributing to this situation: 1) lack of teachers' knowledge of using and teaching computers, 2) no formal curriculum designated for computers (Currently, computer concepts are introduced in, and are only a part of, the Art of Engineering and Applied Mathematics classes), 3) no incentive for computer teaching teachers (I.I.I. & I.E.M. Report, 1991).

Recently one study about instructional uses of computers in ROC high schools (Wei, 1992) indicated that 94% of the teachers agree that computers should be used in high school teaching. The five most stated reasons were 1) the computer is important to the students' futures, 2) computers could improve teaching effectiveness, 3) computers are cost-effective, 4) computers are good for the country's development, and 5) computers could reduce teachers' work loads. Six (6) percent of the teachers were against computer use in high schools. The six most stated reasons were 1) there are not enough teachers who can operate computers, 2) CAI is redundant, 3) there has not been enough good quality courseware, 4) there is no need for computers in teaching, and 5) not enough hardware and 6) computers have not provided help for entrance examinations. In another study by Chen (1991), done at teachers' universities and colleges reports that students' and teachers' attitudes toward computers, computer experience, general perception, and perception of knowledge and learning were different. He found that only 28.6% of the instructors were using microcomputers in their teaching activities, and 60% of the students indicated that current use was insufficient for learning and studying.

Each year many computer science students graduate from colleges. Because of the current education system in ROC, they are not qualified to teach in middle schools. Only those who graduate from teachers' universities and departments of education from non-teachers' universities can automatically become middle school teachers. With these limited channels, lack of good computer training programs for pre-service teachers and the better salary and perspective in computer-related jobs in government or private companies result in middle school teachers having very little knowledge about computers.

In order to reach the goal of computer literacy for all citizens, fostering the concepts of information in the young is typically important. Middle school education has long been considered as the starting point of main stream education in ROC. As a country devoting effort to improving computer education in middle schools, the acquisition of hardware and software will not guarantee the success of computer education. Today, computer training programs are largely emphasized by the government. On the other hand, lack of computer use in the instruction of middle school teachers still prevails. At this stage of development it is very important to know teachers' attitudes toward computers. Attitudes toward computers are thought to influence not only the acceptance of computers, but also future behaviors, such as using a computer as a professional tool or introducing computer applications into the classroom (Anderson 1979; Fauri, 1984; Woodrow, 1987). For this reason, the promotion and maintenance of positive attitudes toward computers, especially among ROC in-service teachers, is of paramount importance. Negative attitudes must not be allowed to limit the knowledge and creativity of potential computer users, nor should anxiety interfere with the learning process.

The literature reviews indicate that there have been only three studies about computer attitudes in ROC. One was a study about gender and background differences in computer attitudes and achievement among high school students (Tsai, 1985), the second was a study about middle school students' computer attitudes and their related factors (Wang & Wu, 1986), and the third was a study about the effects of academic achievement on the acquisition of computer literacy, and on attitudes toward computers (Wu, Wang & Liu, 1987). The three studies used the Computer Attitude Scale developed by Brenda H. Loyd and Clarice Gressard (1984a). In ROC there has been no study of middle school teachers' attitudes toward computers in the past. It is important to examine middle school teachers in this regard.

II. Significance of the study

Computer education has been considered one of the key elements in 21st century education by numerous educators.

Simonson (1987) and others stated that "Skills and [computer] knowledge were felt to be important, but because of the rapid and continuous changes projected for the future of computers a positive attitude toward computing was also considered necessary." To guarantee the success of computer education in ROC, the school teacher must be given opportunities to acquire computer skills, and perhaps most importantly, to develop and maintain positive attitudes toward computers. This would inspire their dedication to gain computer competencies which, in turn, could inspire students' motivation in learning with computers. The first step in accomplishing this goal is to construct an instrument to assess teachers' attitudes toward computers.

The literature review shows that there have been relatively few instruments constructed for assessing teachers' attitudes toward computers when compared to the instruments available for assessing students' computer attitudes. This is especially true for instruments that are constructed for assessing middle school teachers' computer attitudes. In ROC there has been no instrument of attitudes-assessment toward computers developed for use among middle school teachers. Some claim that valid and reliable instruments have been used by Western researchers to evaluate computer attitudes. For example, The Computer Attitude Scale (Loyd & Gressard, 1986), Attitudes Toward Computer (Reece & Gable, 1982), and Computer Use Questionnaire (Griswold, 1983) have been used by many researchers in the past, but they have been directed primarily at Western students or pre-service teachers. Despite this accomplishment, to borrow a Western instrument and translate it into another language without consideration of culture differences will reflect cultural bias, and result in a lack of cross-cultural validity (Brislin, 1986). Brislin stated that in using existing instruments, the researcher runs the risk of missing aspects of a phenomenon as viewed by (and seen as important by) people in other cultures. Further, they risk imposing conclusions based on concepts which exist in their own cultures but which are foreign, or at least partially incorrect, when used in another culture. Therefore, the instrument developed for this study will contribute greatly to ROC researchers and training program sponsors who are concerned with issues of the teachers' computer training and attitudes toward computers. Since it is intended that the proposed instrument will be preliminary to the assessment of computer attitudes among ROC middle school teachers, it will constitute a necessary first step for subsequent research and ultimately result in the formulation of a standardized instrument that may be used across the nation for ROC middle school teachers.

III. Statement of the Problem

The primary goal of this study is to develop and validate an instrument which can be used to assess attitudes toward computers among middle school teachers in Taiwan, ROC. The subsidiary goal is to determine if ROC teachers' attitudes toward computers show differences due to gender, age and computer experience.

IV. Objectives of the Study

1. To develop an instrument which will assess attitudes toward computers among middle school teachers in Taiwan, ROC.

2. To validate the instrument by administering it to an appropriate sample of ROC middle school teachers.

3. To conduct a factor analysis to determine if the developed questionnaire reflects the computer attitudes of ROC middle school teachers as being unidimensional (or multidimensional) in character.

4. To determine if teachers' computer attitudes are different as a result of selected factors such as gender, age, computer experience and other factors related to computer utilization.

5. The subsidiary objective is to investigate the gender, age, computer experience, computer training, current computer usage and other factors that would impact the future ROC middle school teachers' attitudes toward computers.

V. Definition of Terms

The following terms reflect the meaning of words and phrases used in the research. Other terms are considered to be self-explanatory.

1. Attitudes: Refers to "a predisposition of the individual to evaluate some symbol or object or aspect of his world in a favorable or unfavorable manner" (Katz, 1960, p.168).

2. Computer Attitude Scale: A specially constructed scale containing statements relating to computers to determine the direction and intensity of attitudes toward computers.

3. Expert: An individual who demonstrates skills, knowledge and experience in a specific area and is recognized by others for his/her expertise and knowledge.

4. Factor Analysis: A statistical method encompassing (Gunderson, 1971);

1) A large number of test scores which measure some aspects of the general trait and will represent a wide range of elements that might enter into the trait;

2) Evaluating intercorrelations among these test scores to find those which tend to measure the same element or factor; and

3) Deducing what this trait measures in common and giving it a name.

Sax (1980) defined factor analysis as "a mathematical procedure used to identify the minimum number of traits, abilities, or factors that account for test variance."

5. Likert-type Scale: A scale for measuring attitudes based on the research of Rensis Likert (1932). The individual checks one of five possible responses to each statement: strongly agree, agree, undecided, disagree, strongly disagree.

6. Middle School teacher: Sometimes junior high school teacher is used as an interchangeable term to indicate the teacher who teaches from grades 7-9 in the current education system in ROC (Republic Of China).

7. Multidimensionality: Refers to the existence of a single latent dimension underlying a set of obtained observations showing more than one dimension or factor (McIver & Carmines, 1981)

8. Reliability: Used in the study to refer to internal consistency. Although several methods are used for assessing reliability, the two which are recommended for Likert-type scales are Cronbach's alpha coefficient (Cronbach, 1951) and Hoyt-Stunkard analysis of variance (ANOVA, Hoyt & Stunkard, 1952). For this study, Cronbach's alpha coefficient, for

which a reliability coefficient of .80 or higher, would be acceptable for the instrument scale, has been selected as the initial method for determining reliability, with the option of using Hoyt-Stunkard ANOVA, should the scale prove to be multidimensional.

9. Unidimensionality: Refers to internal homogeneity, in which all items of the instrument scale are in accordance with a single dimension (or factor). A set of items forming an instrument all measure just one thing in common (Hattie, 1984).

10. Validity: Refers to whether the instrument measures what it purports to measure. Factor analysis is the technique selected for the determination of the dimensionality of the developed instrument.

The most recent revision of Standards for Educational and Psychological Tests (1985) modified slightly some terms that had been used before 1985. The following terms may be used interchangeably in this research.

Pre-1985 Standards	Post-1985 Standards
Content Validity	Content-Related Evidence of Validity
Criterion-Related Validity	Criterion-Related Evidence of Validity
Construct Validity	Construct-Related Evidence of Validity

VI. Summary

This section of the proposal has provided an overview of the proposed study. The discussion has included the statement of the problem and the objectives of the study. The importance of the study is described and the purposes for developing the instrument to measure the attitudes toward computers among middle school teachers in ROC has been identified. The definition of terms is provided to facilitate the clarity of the terms used in this study.

CHAPTER 2

REVIEW OF THE RELATED LITERATURE

This review of the literature provides an overview of attitudes toward computers. The central focus of the study is the construction of an "attitudes toward computers" inventory for ROC middle school teachers. The review of the literature in this chapter is divided into four sections. The first section presents a historical perspective and rationale for attitude measurement. The second part focuses on the studies related to teachers' attitudes toward computers. The third section examines the related studies with similar design and statistical methodology. The last section is a summary based on the review of related literature.

I. Literature Related to Attitudes: Historical Point of View

1. Attitude Studies and Definitions

As Cordon Allport pointed out some 60 years ago,

> " ... attitudes is probably the most distinctive and indispensable concept in the contemporary American social psychology. No other term appears more frequently in experimental and theoretical literature" (Allport, 1935).

Allport's words are as true today as they were in 1935. The number of attitudinal studies has been growing especially in the past two decades as new technology allows a more sophisticated approach to research analysis.

After the turn of the century, the study of attitudes was pursued in many disparate fields with little communication or agreement regarding its properties and boundaries. Researchers in the fields of psychology and sociology investigated attitude as a set, prejudice, and suggestion (Ostrom, 1968). It was not until Allport's classic chapter in The Murchison Handbook that attitude was clearly distinguished from other psychological concepts and then established as a study in social psychology. Before World War II social psychologists devoted a large part of their efforts to attitude measurement. Postwar psychologists have dedicated their efforts to theoretical and empirical issues in attitude change. Blumer (1939) took the position that social psychology is the scientific study of attitudes. He believes that it is necessary to consider psychological variables in order to understand social change.

Historically, attitudes have been more easily measured than defined (Dawes, 1972). There is little consensus among the experts in the field as to a definition of attitudes. In 1928 Louis Thurstone (Thurstone, 1928) defined attitude as:

> "the sum total of a man's inclinations and feelings, prejudice and bias, preconceived notions, ideas, fears, threats, and convictions about any specified topic" (p.531).

Later (1946) he simply defined attitude as "the intensity of positive or negative affect for or against a psychological object" (p.39). Krech and Crutchfield (1948) define an attitude as " ... an enduring organization of motivational, emotional, perceptual, and cognitive processes with respect to the individual's world" (p.152). Allport (1935) stated that:

> "An attitude is a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related"(p.810).

Similarly, Campbell (1950) defined attitude, in part, as "consistency in response to social objects" (p.31). Murphy, Murphy and Newcomb (1937) stated that "Attitude is primarily a way of being 'set' toward or against certain things" (p.889). Allport's definition implies that attitudes refer to a very general "state of readiness." Murphy, Murphy, and Newcomb, however, restrict the state of readiness or "set" to reactions "toward or against" certain objects. Their phrase "toward or against" implies evaluation, pro or con. There are other definitions which focus on the affective tendency to favorably or unfavorably evaluate objects and entirely discard the notion that any overt behavior is implied. Rosenberg (1956) defined an attitude as "a relatively stable affective response to an object" (p.367).

An attitude definition proposed by Katz (1960):

> "Attitude is the predisposition of the individual to evaluate some symbol or object or aspect of his world in a favorable or unfavorable manner ... Attitudes include

> the affective, or feeling core of liking or disliking, and the cognitive or belief, elements which describe the effect of attitude, its characteristics and relations to other objects" (p.168).

More recently, Fishbein and Ajzen (1975) offered the following definition for attitude:

> "a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given subject" (p.6).

Borg and Gall (1983) integrated the definitions to include three components:

(1). affective component: the individual's feelings about the attitude object;

(2). cognitive component: the individual's beliefs or knowledge about the attitude object;

(3). behavior component: the individual's predisposition to act toward the attitude object in a certain ways.

There is really no necessity that social psychologist agree about the definition of attitudes in order to measure attitudes. The literature suggests that an operational definition must be eclectic. Researchers have been known to choose a measurement procedure for their study and operationally define the meaning of attitude. In order to understand attitudes, one must be able to measure the attitudes. Attitude measurement scales have facilitated this process.

2. Attitudes Measurement Scales

Thorndike wrote in 1913 "Whatever exists, exists in some quantity; whatever exists in quantity can be measured" (Thorndike, 1913). This indicates that attitudes can be measured. In 1928 Louis Thurstone published a revolutionary *American Journal of Psychology* article in which he described a general method for measuring attitudes. The publication led directly to scholarly revolutions, first in the area of attitude measurement and scaling, and subsequently in the empirical research and theory regarding the formation, change, and effects of social attitudes. In the following decades Thurstone, and shortly thereafter Likert (1932), Guttman (1944), Osgood (1957), and Coombs (1964), designed different techniques to measure the attitudes.

The Likert scale, also called summated rating scale, has received the greatest attention among researchers and psychologists (Maranell, 1974; Mueller, 1986, Shrigley, 1972, 1974; Shrigley & Johnson, 1974; Trueblood & Suydam, 1974). The following reasons may contribute to its popularity as compared to other types of scales (Edwards & Kennedy, 1946; Maranell, 1974; Sax, 1980):

(1). Likert scale is simple and easy to construct.

(2). Likert scale is designed mainly for measuring attitudes.

(3). It has been very consistently used and can be examined by many existing literature as a very reliable and valid tool for measuring attitudes.

(4). It is easy to perform item analysis on Likert scale.

(5). Scales constructed by the Likert method will yield higher reliability coefficients with fewer items than scales construct by the Thurstone method.

The respondent in the Likert scale is asked to indicate the degree of agreement on a five-point scale. The Guttman scale, also called Scalogram scale, is usually applied to dichotomous data. Only two values, yes-no, agree-disagree are given to the individuals involved in the study. Thurstone scales use the judgment of a panel of judges regarding the relative favorableness of attitude statements toward the attitudinal object. The amount of effort required prevents Thurstone scales from being used by most researchers. Hovland and Sherif (1952) provide data that suggest that the personal bias of the judges can be a weakness of the Thurstone technique. In 1957 Osgood and his colleagues designed the semantic differential scale (Osgood, et al., 1957). The scale uses pairs of opposite adjectives that are highly representative of the dimension(s) to be measured to serve as "items." Respondents indicate the extent to which each adjective describes the object. It has been recommended as a self-report attitude-measurement technique (Mueller, 1986). Another contribution to measuring attitudes is from Coombs (1964). Coombs presented a new type of scale called an ordered metric. This is the unfolding technique that derives information on unidimensionality, and relative spacing is used between the attitude items.

It was in the late sixties that attitude-behavior relationships were the focus of Tittle and Hill's (1967) study. They reported the Likert scale to be superior to all others. By far the greatest majority of studies rely on Likert-type scales to measure attitudes towards a certain topic, behavior, or group.

Today, social scientists have stopped asking if attitudes can be measured and have accepted the standard measurement techniques, assumptions and all (Kiesler, Collins, and Miller, 1969). Social scientists, using various scales have measured attitudes, including the measurement of attitudes toward computers.

II. Attitudes Toward Computers: Related Literature

1. Computer Attitudes Research in the Past

A classic, and perhaps the first, study on computer attitudes was conducted in 1963 by Robert Lee, an employee of IBM, who investigated attitudes toward the "electronic thinking machine". In 1970 Lee conducted a nationwide study of public views toward computers using a sample of 3,000 people aged 18 or older (Lee, 1970). Factor analysis of his twenty-item questionnaire yielded two independent factors: Factor 1, the Beneficial Tool of Man Perspective, described a positively-toned set of beliefs that computers are beneficial in science. Factor 2, the Awesome Thinking Machine Perspective, captured the science-fiction view of the computer as an autonomous entity capable of superiority of human thought. Turnipseed and Burns (1991) used the same instrument designed by Lee (1970), but contained only one change: the word "computer" was substituted for the term "electronic brain machine" to examine 232 college students and 300 non-student adults' attitudes toward computers. The results showed that there are substantial differences in attitudes held by students and non-student adults with respect to computers and their current and future place in society. It also indicated that attitudes have shifted over the past two decades with more negative feelings being prevalent among the non-student adults, or the older persons. This study indicates a need to expand the focus of computer education from programming, mechanics of machines, and usage skills to include limitations and consideration of computer's place and role in society.

In 1976 Ahl conducted a semiformal study about public attitudes toward computers in society. Later Litchman (1979) used a slightly modified version of the same questionnaire to study educators' attitudes toward computers. Cluster analysis of the responses to Ahl's 17-item Likert questionnaire revealed four groups of responses (n=843): 1) computer impact on quality of life, 2) computer threat to society, 3) the role of the computer, and 4) the computer itself. Although no statistical analysis was done, visual inspection of the plotted data suggests that the teacher sample reacts more negatively to computers than does the general public. This may be because many teachers view computer-aided instruction as a threat to their profession (Howard, 1986).

Lichtman (1979) added six (6) statements to Ahl's format and applied it to a group of 189 pre-service as well as in-service educators. Persons who enrolled in administration courses were considered as "administrators" and persons who not enrolled in administration courses were considered as "teachers." He indicated the results as follows: 1) that teachers view computers in a much more dehumanizing and isolating manner than do other segments of population; especially school administrators, 2) that teachers do not feel secure in their relationships with computers, particularly in regard to privacy of data and mistakes, while administrators are more confident in these areas than are the general population, 3) that both teachers and administrators are more wary of computers in relation to jobs and skills (except their own) than are other people, with teachers much more concerned than administrators, 4) that a smaller number of teachers see improvement in the quality of life through the use of computers than do others and that they see the least improvement in education of any group, while the administrators are overwhelmingly positive in this regard, 5) that while teachers seemed concerned about the computer's effect on jobs in general, few were concerned about their own jobs being taken away.

Raub (1981) surveyed attitudes of college students toward computers and found that fear or anxiety about computers led to negative attitudes toward their use. In the study Raub included a factor analysis that revealed three items: appreciation of computers and a desire to learn more about them, computer usage anxiety, and fears about the computer's negative impact on society.

Griswold (1985) used a 20-item questionnaire to investigate college students' (207 majoring in education and 210 majoring in business) attitudes about computers. Education majors were found to have less favorable attitudes about computers than business majors.

Tsai (1985) used a 30-item Computer Attitude Scale developed by Loyd and Gressard (1984a) to assess 411 high school boys and 369 high school girls about gender background difference in computer attitudes and achievement among high school students. She found that 1) boys scored significantly higher than girls on computer attitudes; 2) boys and girls with previous computer experience were superior to those without previous computer experience on computer attitudes and computer achievement; 3) there were significantly positive correlations of mathematic achievement and computer achievement, and computer attitudes and computer achievement; 4) mathematic achievement and computer attitudes could be co-predictors of computer achievement; mathematic achievement, confidence about computers and anxiety about computers were important predictors; 5) boys and girls with home computers were superior to those without home computers on computer attitudes and computer achievement; 6) significantly positive correlations of parents' attitudes of encouragement toward learning about computers and students' computer attitudes were found, however, there were no significant correlations of parents' attitudes of encouragement toward learning about computers, and students' computer achievement, except for the boys of one senior high school.

Wang and Wu (1986) used the same 30-item Computer Attitude Scale developed by Loyd and Gressard (1984a) to test 187 middle school students about their computer attitudes and related factors. The results indicated that gender, computer experience, ownership of home computers, and computer magazine subscriptions had a significant influence on students' attitudes toward computers. Another study about the effects of academic achievement on computer achievement, and attitudes toward computers (Wu, Wang & Liu, 1987) found that 1) there was no significant difference between high-academic and low-academic achievement group on the subjects' liking, confidence, and anxiety; 2) there was no significant difference between the high-mathematic and low-mathematic group on the subjects' liking, confidence, and anxiety; 3) the high-achievement computer group had a significant influence on the subject's confidence, anxiety, but not on the subjects' liking for computers; 4) the high-academic achievement group had a significant influence on computer achievement, but the high-mathematic achievement group had no influence.

Smith (1986) surveyed computer attitudes of efficacy and sex-typing in relationship to sex, grade-level, and teachers influence. A total of 491 participants (318 students and 173 teachers) from levels 1-12 were examined. Elementary level respondents were significantly more confident than junior or high school level, and students were more confident than teachers. There were no significant differences between males and females in their attitudes of "efficacy" or sense of confidence in their ability to use computers. In 1987 Smith used a sample of 511 participants (421 students and 90 teachers) to examine teachers' and students' efficacy and sex-typing attitudes toward computers (Smith, 1987). Grade level and gender differences were found, with females showing stronger feelings for equity in computer use and careers. Teachers showed significantly higher attitudes of equity than students. The researcher indicated that computer implementation was at an earlier stage in the later study.

There has been an emerging trend to treat computer anxiety as a segment of computer attitude. Many studies (Chen, 1986; Gressard & Loyd, 1984a&b; Howard, 1986; Raub, 1981) include computer anxiety in computer attitudes surveys. But in Kernan and Howard's study (1990) they recommended that computer anxiety and computer attitudes should not be used as if they were interchangeable constructs. One study by Bandalos and Benson (1990) indicated that computer attitude is a multidimensional construct.

Marshall and Bannon (1986) used a sample of 2302 students from grade 7 through university level, 537 teachers, 81 administrators, and 95 library/media specialists, investigating their computer knowledge and attitudes. The results showed that 1) the older the person, the more positive the attitudes toward the computers, 2) there is no differences between males and females in their attitudes toward computers, 3) males have greater knowledge about computers than females, 4) the older the person, the greater the knowledge about computers, 5) teachers and other educators know more about computers than do students. They also indicated that there was some overlap between the males and females in computer achievement, as well as a difference between students and teachers in their knowledge about computers.

Gressard and Loyd (1987) studied the effects of math anxiety and gender on computer attitudes. Three groups of subjects, a total of 356 students, were sampled in the study including 1) 161 high school students who were enrolled in language arts classes, 2) 76 liberal arts college students, and 3) 119 community college students who were enrolled in developmental mathematics courses. The computer experience of the students in each group ranged from one week or less to one year or more. The 30-item Computer Attitude Scale (Loyd & Gressard, 1984a) and Mathematics Anxiety Scale (Fennema & Sherman, 1976) were used for the study. The correlation between math anxiety and computer attitudes were moderate and positive. The correlation between gender and computer attitudes were found to be generally low, and not statistically significant.

Woodrow (1987) adapted Stevens'(1982) survey questionnaire to investigate 146 pre-service and in-service teachers' attitudes toward computers. The results indicate differences in attitudes between in-service teachers and pre-service teachers, with pre-service teachers having more confidence in using computers for work.

Morris (1988) used an 8-item Likert-type Computer Orientation Scales (COS) to examine the relationships between age, education, sex, and household income, and attitudes toward computers to assess 380 citizens, aged from 17 to 90, in some areas of Indiana. The results showed that sex and household income had no effect on computer attitudes. Age and education however, showed direct effects on computer attitudes.

Mahmood and Medewitz (1989) investigated the effects of progressive phases of computer literacy on individuals' attitudes, values, and opinions toward information technology and its applications. The Minnesota Computer Literacy Test (Anderson et al., 1979) was used in the study as the computer literacy instrument. Subjects were 100 sophomore and junior business students enrolled in a computer literacy course. Results showed that computer illiteracy indeed negatively affects subjects' attitudes toward information technology but has no significant effect on their opinions toward its applications. The research also suggested that neither the awareness of what the computer can do nor the knowledge of a programming language is sufficient enough to change subjects' attitudes toward computers.

Kay (1989) argued that many computer attitudes measurements have proven to be either statistically weak or theoretically vague. In his study, the Computer Attitude Measure (CAM) was administered to 383 pre-service teachers to assess three relatively distinct dimensions of computer attitudes: cognitive, affective and behavioral. In accordance with Ajzen and Fishbein's (1977, 1980) theory of reasoned action, the target (the computer) and the action (using the computer) of a particular belief are maintained constant for all items in the CAM. The independence of these subscales was supported by a principal component factor analysis. As well, the CAM was internally reliable and correlated positively with a high degree of computer literacy and experience, and internal locus of control.

Koohang (1989) used a 42-item Computer Attitude Scale to investigate 81 college students' attitudes toward computers. The instrument consists of a 30-item Computer Attitude Scale designed by Loyd and Gressard (1984a) which includes three subscales: computer anxiety, computer confidence and computer liking, and a 12-item designed by the researcher that measures attitudes toward the usefulness of computers. Male students scored higher on every subscale, however, gender differences were found to be significant, only on computer usefulness.

Levin and Gordon (1989) investigated 222 middle class pupils (111 boys and 111 girls) in grades eight through ten in a Tel Aviv high school prior to computer instruction in school. The instrument used in this study was an attitude questionnaire designed to measure affective and cognitive attitudes toward computers. The results showed that prior computer exposure (in particular, having a computer at home), had a strong impact on attitudes toward computers. Sex differences in affective and cognitive attitudes were also observed where boys had significantly more positive affective attitudes toward computers than girls. Boys perceived computers as being more "enjoyable," "special," "important," "friendly," and "cheaper" than girls did. Further more, boys tended to hold more stereotyped attitudes about who is capable of using computers and had more positive attitudes toward the computer as a medium of instruction than girls.

Bear (1990) investigated knowledge of computer ethics and its relationship to attitude toward computers in 60 seventh graders. The result indicated that attitude toward computers is related to knowledge of computer ethics. Students with more favorable computer attitudes scored higher on the computer ethics scale than students with less favorable attitudes, even after statistically controlling for gender and verbal ability.

Marcoulides and Wang (1990) used a 20-item Computer Anxiety Scale (Marcoulides, 1985) to study a total of 437 college students' (225 American and 212 Mainland Chinese) attitudes and actions toward computers. The results showed that computer anxiety is present to a similar degree for both samples of American and Chinese students.

Woodrow (1991) administered four computer attitude scales, namely Stevens' Computer Survey (1982), Reece and

Gable's Attitudes Toward Computers (1982), Loyd and Gressard's Computer Attitude Scale (1986), and Griswold's Computer Use Questionnaire (1983), to 98 student teachers enrolled in an introductory computer course. The statements of the four attitude scales were combined, in random order, to form a comprehensive questionnaire designed to sample the attitudes toward computers of pre-service teachers. All scales were found to give a reliable measure of general attitudes toward computers and their use. The scales primarily evaluated three attitudes dimensions: Computer Anxiety, Computer Liking, and Social and Educational Impact of Computers.

Massoud (1991) investigated the relationship between computer attitudes (anxiety, confidence, and liking) and the selected variables of age, gender and computer knowledge among a sample of 252 adult basic education students. The results suggested that adult basic education students as a whole have a fairly positive attitudes toward computers. Computer knowledge is found to be significantly related to all of the attitudes: anxiety, confidence, and liking. Males are found to have more positive attitudes than females. However, there is no statistically significant difference in Computer Attitudes within the age groups.

In Okebukola's study (1992) the experience factor in computer anxiety and interest was examined for 426 high school students in Western Australia, the result indicates that as experience with computer usage increases, anxiety level drops.

Kwon (1992) investigated computer anxiety among 276 Korean elementary school teachers the ANOVA procedure indicated that 1) no significant gender, age, and computer experience differences existed in the teachers' perception of the use of computers as an educational tool, 2) no significant age and computer experience differences existed in the teachers' perceived lack of individual ability to use a computer, 3) significant gender, age, and computer experience differences did in the teachers' perceived lack of computer knowledge. Tukey's HSD test indicated that 1) teachers with little or no computer experience experienced anxiety to a greater degree than those with some computer experience, 2) the younger teachers, or those who were less than 35 years of age, experienced less computer anxiety, 3) teachers with more extensive computer experience were more confident in using computer than those with less computer experience.

2. Research into Correlates of Computer Attitudes

Based on the research on computer attitudes, several combinations of individual differences studied may mediate negative attitudes about computers. For example, students with mathematics anxiety are likely to have the most fear of computers (Alber & Sedlacek, 1987; Fennema, 1977; Gressard & Loyd, 1987; Griswold, 1983; Marcoulides, 1988; Munger & Loyd, 1989). Since females traditionally have taken fewer math courses than males (Fennema & Sherman, 1977, 1978; Griswold, 1983) the importance of math experience may greatly affect their attitudes toward computers.

A difference in computer attitudes between males and females was shown to be statistically significant (Abler & Sedlacek, 1987; Fetler, 1983, 1984; Gardner, McCewen & Curry, 1986; Levin & Gordon, 1989; Lewis, 1988; Lockheed et al., 1983; Loyd & Gressard, 1986), unlike other studies where such a gender-related effect was not found (Baylor, 1985; Clement, 1981; Koohang, 1986; Loyd & Gressard, 1984b; Morris, 1988; Nickell, 1987). Computer knowledge and experience was found to be significantly related to computer attitudes; which means that high computer knowledge and more computer experience was found to have a statistically significant relationship to the development of more positive attitudes toward computers (Byrnes & Johnson, 1981; Fann, et al., 1988-89; Koohang, 1986; Loyd & Gressard 1984b, 1986; Marcoulides, 1985).

Age was found to be significant to computer attitude. Baack, Brown & Brown (1991) used 20-item Attitudes Toward Computer Usage Scale (ATCUS) and the results indicated significant differences on 17 of the 20 ATCUS items, with the older adults indicating a less favorable attitude toward computers. Similar findings were reported in many studies (Kerschner & Hart, 1984; Kwon, 1992; Loyd & Gressard, 1984b).

3. Computer Attitudes Measurement

One of the first instruments developed to sample attitudes toward computers was the Minnesota Computer Literacy and Awareness Assessment instrument (MCLAA). This instrument includes a twenty item Likert-type scale section designed to measure attitudes toward computers (Anderson, et. al., 1982).

Loyd and Gressard (1984a) developed a 30-item Computer Attitude Scale (CAS) that measures attitudes toward learning about and using computers. They used 155 students in grades 8 through 12 in their study as subjects to validate the scale. Factor analysis indicated that CAS has (1) Computer Anxiety, (2) Computer Confidence and (3) Computer Liking subscales. The result indicates that the CAS is a convenient, reliable, and valid measure of computer attitudes in this population (coefficient alpha reliabilities were reported to be .86, .91, and .91 respectively). Later (Loyd & Loyd, 1985) CAS added a 10-item factor about the perceived usefulness of computers in present or future work to 114 teachers in grade k-12 who were enrolled in classes involving use of microcomputers in education. The reliability coefficient of .88, .93, .89 and .66 for subscales anxiety, confidence, liking and usefulness was reported which indicated that 40-

item CAS can be used reliably and validly to assess computer attitudes of adults who are similar to the group of teachers tested in this study. In 1986 the CAS was administered to 192 elementary, middle, and secondary school teachers enrolled in staff development programs related to computers (Loyd & Gressard, 1986). The coefficient alpha reliabilities were reported as .89, .89, .89 and .95 respectively for computer anxiety, computer confidence, computer liking and total computer attitude score. Massoud (1990) used CAS to survey low-literate adults' attitudes toward computers. The reliability coefficient were reported as .79, .83, .75, and .91 respectively. The result suggested that CAS is a reliable and valid measure of computer attitudes among low-literate adults.

Roszkowski, Delvin and others (1988) used 42 experienced teachers with diverse subject matter expertise to study the temporal stability and validity of the 40-item CAS. The result showed that CAS has an admirable level of stability and predictive validity that could be used for selecting candidates in computer science teacher retraining programs.

Reece and Gable (1982) used 233 seventh- and eighth-grade students to develop an instrument to measure computer attitude. The result was a 10-item instrument called General Attitudes toward Computers which includes three components:

(1) cognitive, (2) behavioral, and (3) affective. Alpha reliability was reported as .87 for the entire test.

Bannon and others (1985) used a total of 2525 participants from over 15 metropolitan and rural school districts and one urban university to validate a 17-item inventory. The factor analysis resulted in an instrument consisting of two factors: 1) Cognitive (7 items) and 2) Affective (7 items). The alpha coefficient of reliability was reported as .929 and .896 respectively.

In Griswold's (1985) study, a 20-item questionnaire was used to investigate differences between education and business majors in their attitudes about computers. The items were judged to encompass four categories: (a) Concrete concepts about computers, e.g., "I am familiar through my previous experience", "Someday I will have a computer in my home"; (b) Abstract concepts, e.g., "Computers dehumanize society,"; "Computers are beyond the typical person's understanding"; (c) Computer capabilities, e.g., "Computers are a tool," "They can improve health care, law enforcement and education"; (d) Education applications, e.g., "Computers could teach math, reading, remedial instruction, and take over parts of my courses." The Cronbach's alpha coefficient for internal consistency of the composite score was reported at .82 in this study.

Violato and others (1989) employed 401 pre-service teachers to study a four-factor model of attitudes toward computers: 1) Sex differences, 2) Comfort, 3) Liking, and 4) Value. The 32-item Teacher Computer Attitude Scale were selected partly from the Computer Attitude Scale (Richards et al., 1986) and partly from the Computer Attitude Scale (Gressard & Loyd, 1984a). A number of items were modified by the researchers in order to more appropriately suit the studied population. The results showed that the endogenous variables were correlated, with the exception of the sex differences factor. Liking was correlated with Comfort and with Value. Sex Differences was correlated with Comfort and Value, however, an examination of simple correlation revealed no obvious correlations between Sex Difference items and Comfort items, and Sex Difference items with Value items.

In Kay's (1989) study, the 30-item Computer Attitude Measure (CAM) was administered to 383 pre-service teachers to assess three distinct dimensions of computer attitudes: cognitive, affective, and behavioral. The alpha coefficients for each subscale were reported as .87, .89 and, .94 respectively. In CAM the cognitive dimension consisted of 10 seven-point Likert items. The affective component of attitudes was assessed using ten, 7-point semantic differential items. The behavioral attitude scale was compromised of 10 seven-point Likert items.

In Levin and Gordon's (1989) study, 18 semantic differential variables reflecting affective reactions was used for Affective Attitudes Measure, the 12-item Computer Functional Capabilities Questionnaire was designed for Cognitive measures, and the General Attitude Measure consisted of 22 statements about computers using the Likert scale was used to measure four attitude factors: 1) desire to become familiar with the computer (Cronbach's alpha (α)=.72), 2) range of capable users (α=.44), 3) the need for computers in our lives (α=.62), and 4) the computer as an instructional medium (α=.77). The reliability coefficient(Cronbach's alpha) for Affective Attitude Measure and Cognitive Measures was reported .79 and .55 respectively.

Kwon (1992) investigated computer anxiety among 276 Korean elementary school teachers. A 27-item instrument was developed including three subscales: 1) use of the computer as an educational tool, 2) fear of lack of ability to use a computer, 3) inadequate computer knowledge. The reliability coefficient (Cronbach's alpha) was reported as .92, .87, and .86 respectively.

Chirwa (1992) developed a 29-item Computer Attitude Scale to investigate a sample of 85 high school students' attitudes toward computers and their use in learning. The specificity of this instrument for targeting only a special group of learners makes it a powerful tool for structuring and evaluating educational programs that incorporate technology into the teaching and learning material in the high school environment. A reliability of .80 was reported.

III. Literature Related to Studies Based Upon Similar Design and Statistical Methodology

In constructing a computer-attitude test, an item pool is initially developed in accordance with the theoretical foundation of the issue concerned. For the most part, items are selected by face validity as the first step. Face validity means that the items are presumed to be logical, but have not been empirically validated. This procedure is less rigorous than content validity, which involves the researcher's judgment of test content (Gay, 1987; Rosenberg, 1956; Sax, 1980). Golden, Sawicki, and Franzen (1984) recommended that item selection be based upon "professional nomination," or suggested by experts. This technique for reliance upon expert judgment, a non-empirical approach, is called the Delphi Technique.

1. Delphi Technique

The Delphi Technique is a non-empirical method of measuring content validity which has been found to be appropriate for application in social science research (Courtney, 1991; Linstone & Turoff, 1975). The Delphi concept was developed through the Air Force-Rand Corporation by Olaf Helmer and Norman Dalkey in the early 1950s when it was used to obtain opinions about urgent defense problems. The procedure is built on the premise of informed intuitive judgments and is intended to obtain professional opinion without bringing the experts together in a face-to-face meeting (questionnaires are usually administered by mail). Information from each of the panel members is assembled by the researcher using successive questionnaires and feedback, with each serial round being designed to produce closer and closer consensus among the judgments of 8-25 experts (Courtney, 1991). Its use in research work follows the steps outlined below:

(1). The first questionnaire requests a judgment about the possible contents of a data gathering instrument. An initial listing of possible items, provided by the researcher, asks each panel member to either retain, reject, or retain by modifying, each of the items.

(2). The second round usually asks each panel member, who is isolated from other members, to rate each of the retained items according to some criteria(such as importance level, probability of success and others) utilizing a five-point Likert-type scale.

(3). The third questionnaire includes the feedback from the second round, asking members to reassess their own opinions or to specify reasons for remaining outside of the consensus of the rest of panel.

(4). The fourth questionnaire, if one is needed for a consensus to occur, includes the list of items, the previous ratings, and consensus and minority views from panel members. This step provides the final chance for revision of the items to be included on the research instrument.

(5). Step 4 is repeated if more iterations are needed in order for consensus (which may be agreement by majority, or concordance within .5 or 1 standard deviations, or by any other feasible benchmark). (Courtney, 1982, 1991)
The time required for the Delphi process is usually 40 to 45 days (Chuaratanaphong, 1984; Kurth-Schai, 1988).

Samahito(1984) has offered the following considerations in the employment of a Delphi panel:

(1). The problem does not lend itself to precise analytical techniques but can benefit from subjective judgments on a collective basis.

(2). The individuals needed to contribute to the examination of a broad or complex problem have no history of adequate communication and may represent diverse background with respect to experience or expertise.

(3). More individuals are needed than can effectively interact in a face-to-face exchange.

(4). Time costs make frequent group meetings infeasible.

(5). The efficiency of face to face meetings can be increased by a supplemental group communication process.

(6). Disagreements among individuals are so severe or politically unpalatable that the communication process must be referred and/or anonymity assured.

(7). The heterogeneity of the participants must be preserved to assure the validity of the results, i.e., avoidance of domination by quantity or by strength of personality. (pp. 46-47)

The Delphi technique, as stated by Linstone and Turoff (1975), is a method for "semi-structuring" a communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem. It has been used by many researchers in such variety of areas as forecasting, curriculum development, educational planning, evaluation, decision making, and instrument development (Cyphert & Grant, 1970; Dalkey, 1969; Emmons & Kaplan, 1970; Facione, 1990; Frazer, 1983; Gordon, 1984; Kurth-Schai, 1988; Methinin, 1993; Sackman, 1974; Stahl & Stahl, 1991; Taqueban, 1989). The Delphi technique is designed to collect and synthesize group opinion in an anonymous, interactive, self-repeating, and self-adjusting manner. The results of the Kurth-schai research showed the Delphi technique to be time efficient, effective in collecting opinions, and empowering in terms of providing enjoyable, educational experiences for the panelists. Bruyer (1987) developed a Food Fantasies Questionnaire, a self-report therapeutic and research instrument. The 42-item questionnaire (consisting of 110 items) was finalized through application of the Delphi technique. The instrument was administered to 52 young women in outpatient individual and/or group therapy for anorexia nervosa, bulimia, compulsive overeating or bulimia nervosa. The computed reliability coefficient for this study was +.94, which is considered to be substantial.

2. Factor Analysis

Factor analysis is a statistical means intended to account for interrelationship among a number of items with respect to some underlying factor (Mehrens & Lehmann, 1973). In the Encyclopedia of Psychology, Dahlke (1984) defined factor analysis as "a general label applied to a set of statistical procedures designed to identify basic dimensions or factors that underlie the relationships among a large number of variables". Cattell (1952) stated that "factor analysis shows us how some variables can be grouped together because they behave in the same way, and it proceeds to delineate new independent, underlying factors which may be responsible for these groupings" (pp.14-15). In the test construction process, the test developer usually starts with a construct, creates a number of items, and administers these items to a group of subjects. Factor analysis is then used to assure whether the items selected really measure the underlying traits that the test developer has specified

(Mehrens & Lehmann, 1973). Technically and theoretically, Dahlke (1989) stated that:

> Factors are actually hypothetical variables or "constructs" that portray the degree of interrelationships among the variables being analyzed. The meaning of a given factor is summarized from the attributes of those variables highly loaded on that factor. Thus, factor analysis enables the researcher to explore hypotheses regarding the basic dimensions underlying collections of related variables. It is an important technique for determining the minimum number of such dimensions needed to account for the variability among those variables.

Similarly, Sax (1980) stated that factor analysis is a mathematical procedure used to identify the minimum number of traits, abilities, or factors that account for test variance and factor loadings. It is a useful method for interpreting construct validity.

One of the characteristics that distinguishes factor analysis from other techniques is that:

> It disentangles complex interrelationships among the phenomena into functional units or separate or interdependent patterns of behavior and identifies the independent influences or causes at work (Rummel, 1970).

Nunnally (1970) stated that factor analysis plays an important role with respect to all types of validity, but it plays somewhat different roles with each. He stated that:

> "Regarding predictive validity, factor analysis is important mainly in suggesting predictors that will work well in practice. With content validity, factor analysis is important mainly in suggesting ways to revise instruments for the better. With construct validity, factor analysis provides some of the tools that are most useful for determining internal structures and cross-structures for sets of variables" (p.151).

Mueller (1986) stated that "in the predictive-validity model the focus is on the criterion: behavior. Attitude measures serve only as a means for predicting this criterion." He also stated that:

> "Unlike the predictive-validity model, construct validity considers attitude to be a legitimate and important entity in its own right, regardless of correlations with overt behavior." (p.69)

Factor analysis is frequently applied in studies of computer attitudes for the purpose of examining construct validity (Hunter et al., 1989; Kernan & Howard, 1990; Loyd and Gressard, 1984a; Loyd & Loyd, 1985; Massoud, 1990). Factor analysis has seemed to many a promising technique for dealing empirically with the multidimensionality of attitudes and for developing refining measures. Whether attitudes are presumed to be unidimensional or multidimensional, factor analysis can be used for purposes of assessing construct validity (Howard, 1986; Fennema & Sherman, 1976). A number of studies similar to the proposed research have used factor analysis for test construction research (Bruyer, 1987; Bushnell, 1993; Hui & Pun (1988); Kokenes, 1972; Kwon, 1992; Pinyuchon, 1993, Shrigley & Trueblood, 1979).

In the construction of an instrument to measure computer attitudes, the content validity (or content-related evidence of validity) and construct validity (or construct-related evidence of validity) are very important. Mueller (1986) stated that:

> Content validity and internal consistency are often used in combination in attitude-scale validation. This combination of content validity plus internal consistency supplies at least minimally acceptable evidence of construct validity for attitude scales (p.72).

The content validity applies less well to the measurement of affective construct (Mueller, 1986). The Delphi technique, with experts from a variety of backgrounds, is used to overcome the difficulty in circumscribing the "universe" of psychological construct and to establish the content-related evidence of validity. While the Delphi technique is used to eliminate personal bias for establishing content-related evidence of validity, factor analysis is used to assess construct-related evidence of validity for the instrument more efficiently and more objectively. The dimensionality and the extent of the internal consistency of the construct can be assessed by using factor analysis.

There has been a concern about the respondents responding to the questionnaire according to social desirability. Some empirical technique have been suggested or used to increase the validity in the attitude instrument construction. Henderson, Morris, and Fitz-Gibbon (1978) suggested two ways to overcome this: 1) to show that the questionnaire actually predicts some future or concurrent behavior of respondents, 2) to construct instrument in such a way (e.g. by making responses anonymous) that an argument can be made to dismiss charges of bias. Mueller (1986) suggested six major procedures that constitute the empirical base for the construct-validity model:

(1). Known-Group difference.

(2). Correlation with measures of similar constructs.

(3). Correlation with unrelated and dissimilar constructs.

(4). Internal consistency.

(5). Response to experimental manipulating.

(6). Opinion of judges.

Lindeman (1967) suggested two kinds of evidence are useful in establishing the construct validity of a measurement instrument:

(1). Expert judgments concerning the extent to which responses to the test items provide knowledge about the individual's possession of the given trait or construct.

(2). On the basis of empirical evidence concerning the statistical relationships between observed behavior and test item performance.

Validation procedures are designed to demonstrate that a device is measuring what it is supposed to measure. Among the many procedures to ensure the validity of the Delphi technique, factor analysis and known-group difference have been used in most related research.

IV. Summary

From the review of related literature, computer attitudes can be defined as an individual's 1) affect for or against, 2) evaluation, 3) liking or disliking, or 4) positiveness or negativeness toward computers (Mueller, 1986). The instrument will be developed in the form of Likert-type scale. The Cronbach's alpha coefficient or Hoyt-Stunkard's coefficient of reliability of .80 or higher will be used to assess a satisfactory reliability. The validity of a computer attitudes instrument will be validated by the Delphi technique, factor analysis and known-group difference testing. Factors such as age, gender and amount of computer experience have been related to computer attitude which will be examined in the course of the present study.

CHAPTER 3

METHODOLOGY AND STATISTICAL DESIGN OF THE STUDY

This chapter focuses on the discussion of methodology and the statistical design of the study. The discussion is presented in three major sections which include the development of the survey instrument, the statistical design of the study, and data collection.

I. Development of the Survey Instrument

1. Preparation of the Initial Item Pool

The purpose of the present study was to develop an instrument for measuring middle school teachers' attitudes toward computers. The necessary first step was to compile items that would potentially represent the constructs of computer attitudes for ROC middle school teachers. The sources for the original questionnaire were derived from the review of literature (especially from the models of Loyd and Gressard (1984a), Griswold (1985), Massoud (1991), Kwon (1992)) and from interviews of selected ROC middle school teachers. Additionally, a survey (Appendix A) covering teachers' beliefs and feelings about computers was utilized in this step. The results from 166 subjects were collected as a part of the source for developing the questionnaire.

Rensis Likert (Likert, 1932, pp.44-53) suggested some criteria one should keep in mind when constructing an attitude scale are:

(1). It is essential that all statements be expressions of desired behavior and not statements of fact.

(2). The second criterion is the necessity of stating each proposition in clear, concise, straight-forward statements and each statement must avoid every kind of ambiguity.

(3). In general it would seem desirable to have a statement so worded that the modal reaction to it is approximately in the middle of the possible responses.

(4). To avoid any space error or any tendency to a stereotyped response it seems desirable to have different statements so worded that about one-half of them have one end of the attitude continuum corresponding to the left or upper part of the reaction alternatives and the other half have the same end of the attitude continuum corresponding to the right or lower part of the reaction alternatives.

(5). If multiple choice statements are used, the different alternatives should involve only a single attitude variable and not several.

Edwards (1957, pp.13-14) suggested the criteria that should be followed when designing an attitudinal scale:

(1). Avoid statements that refer to the past rather than to the present.

(2). Avoid statements that are factual or capable of being interpreted as factual.

(3). Avoid statements that may be interpreted in more than one way.

(4). Avoid statements that are irrelevant to the psychological object under consideration.

(5). Avoid statements that are likely to be endorsed by almost everyone or by almost no one.

(6). Select statements that are believed to cover the entire range of the affective scale of interest.

(7). Keep the language of the statements simple, clear and direct.

(8). Statements should be short, rarely exceeding 20 words.

(9). Each statement should contain only one complete thought.

(10). Statements containing universals such as *all*, *always*, *none* and *never* often introduce ambiguity and should be avoided.

(11). Words such as *only*, *just*, *merely*, and others of similar nature should be used with care and moderation in writing statements.

(12). Whenever possible, statements should be in the form of simple sentences rather than in the form of compound or complex sentences.

(13). Avoid the use of words that may not be understood by those who are to be given the completed scale.

(14). Avoid the use of double negatives.

Oppenheim (1966, pp.105-117) suggested that:

(1). The best guide to the writing of attitude statements is to say that they should be meaningful and interesting, even exciting, to the respondents.

(2). Attitude is emotional, we must not be afraid to use phrases relating to feelings and emotions.

(3). Statements should avoid double negatives and should be short and uncomplicated.

(4). Attitude statements are better when they have a certain freshness forcing the respondent to think and take a stand.

(5). We will want items covering the attitude from one extreme to the other, but we won't want too many extremes; and we need roughly equal proportions of positive and negative items.

The development of the attitudinal statements followed the criteria recommended by Likert (1932), Edwards (1957) and Oppenheim (1966). The sixty-five (65) initial item pool included statements that described teachers' general attitudes toward computers. Among them, thirty-eight (38) items were positively stated and twenty-seven (27) items were negatively stated (Appendix B). Fewer positive items were constructed at this step was due to the fact that many positive items suggested by the survey sample were statements that were considered to be factual or capable of being interpreted as factual. The survey was administered between March 24 and April 25, 1993.

2. Delphi Panel

Determination of the validity of the instrument is required to determine how well the test items reflect the content they are intended to measure. Content-related evidence of validity can be established by application of the Delphi technique. "Content validity is most often determined on the basis of 'expert judgment'" (Lindeman, 1967, P.37). This method, the Delphi Technique, is a non-empirical approach to the measurement of content-related evidence of validity for social science research.

A panel of seven (7) experts was chosen for the Delphi procedure. The Delphi panelists included (Appendix C) two psychologists (one who had been working in the field of social psychology for more than 17 years and another who had been a professor of psychological measurement for more than 20 years), and two computer science professors (one from a national university and the other from a private university). Both of the computer science professors were involved in teaching computer subjects and doing research on computer usage. Other members included one male and one female middle school teacher. Both were deeply involved in a computer teaching and training program. In addition, the panel consisted of one computer training expert from the government training institute who was involved in the national teacher's computer training program.

Of these seven experts, one was located in Chung-Li city (Tauyuan county, Taiwan, R.O,C.) and the other six were all from Taipei city, Taiwan, Republic of China. Two (2) were females (one was a middle school teacher and the other was a computer training expert from the government unit) and five (5) were males.

The Delphi procedure adopted for this study include the following steps:

(1). The researcher chose the panelists through a variety of channels, including the review of literature, to identity the experts, recommendations from departments of computer science education and psychology at universities, major book publishing companies, and information from the ROC Ministry of Education.

(2). The researcher met with each member to discuss and share the purposes and contributions of this study. One week later, the draft instrument items which were collected from the initial item pool procedure was personally delivered to each panel member for his/her judgment.

In the first Delphi round, panel members were asked to screen each computer attitude inventory statement, and either retain, reject, or retain by revising the statements. Space was provided on the form for statements which required revisions or for those which needed to be added. Space was also included for comments on unacceptable, ambiguous, or redundant wording which appeared in the statements. After the questionnaire was examined and returned to the researcher, the comments, revisions, and/or added statements were compiled and revised.

In the second Delphi round, the Delphi members received the adjusted potential instrument with a cover letter (Appendix D) either by mail or delivered by the researcher, including the revised or added statements resulting from the first Delphi round. The second Delphi round was a method for establishing importance as an item in the instrument. The panelists, based upon each item's clarity and its perceived ability to differentiate positive and negative attitudes toward computers among middle school teachers, were asked to rate the importance of each item on a four-point scale in the following range:

4 = very important

3 = important

2 = of little importance

1 = unimportant

After the items were rated in response to its importance and returned, the items receiving ratings of greater 3 on the average were adopted for the final questionnaire. This final adjusted questionnaire from the Delphi procedure was then ready for use in the pilot study.

3. Pilot Study

The second step in preparing the instrument was to field test the final adjusted questionnaire. Courtney (1990a) suggests that the general method of field testing to determine content-related evidence of validity after the item pool is finalized is as follows:

(1). Randomly select 70 to 100 pilot subjects from the population of interest and ask the subjects to indicate agreement-disagreement with statements in the instrument on a five-point response scale, with scale values for negative items being reversed.

(2). The pilot responses are summed and statistically evaluated, using the percentage of respondents marking each scale value, means, standard deviations, and item discrimination data. In addition, validity and reliability attributes are analyzed.

The instrument for the pilot study

Thus, after completion of the two rounds of Delphi procedure, an instrument consisting of forty-two (42) items was used for the pilot field test. Each item was developed into a Likert scale format. Twenty (20) of the items were positively worded statements and twenty-two (22) of the items were negatively worded statements. The positive and negative items were randomly ordered in the instrument. A cover letter and guidelines for the test were attached to the instrument (Appendix E). The subjects were asked to respond to each item by checking one of the following options: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. Thus, the score reflected ranges from 5 (Strongly Agree) to 1 (Strongly Disagree) for positive items. Negative items were scored in reverse. The responses to the positively and negatively worded items were recorded and assigned scores as follows:

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Positive items	5	4	3	2	1
Negative items	1	2	3	4	5

The use of a 5-point Likert scale in the pilot study gave subjects the option of a neutral or undecided response. When attitude statements are piloted in this way it can provide important data by which subjects can judge an item for emotional intensity (Shrigley & Koballa, 1984). Using this approach, an undecided percentage of 25% or higher makes an attitude statement suspect. There have been other aspects about the points of scales used in measuring attitudes. The use of an even-point scale is a way of restricting the responder from rating a middle and possible noncommittal position on the scale (Courtney, 1990a). According to Mueller (1986), increasing the number of response categories adds variance and increases reliability. He also indicates that increasing the number of categories beyond the point which respondents can no longer reliably distinguish psychologically between adjacent categories simply adds random (error) variance to the score of the distribution. A 4-point scale was selected for the final study. The selection of the Likert scale approach for this study is based on its advantages, including its simplicity and the efficiency of producing the same reliability with fewer items, in comparison to other more complex methods (Likert, 1932). Instrument language and processes for instrument development was originally in Chinese and translated into English for purposes of reporting.

Sample for the pilot study

One middle school program located in Taipei city was randomly selected as the sample school for the pilot study. The teacher population for the school consisted of 100 staff members. One hundred questionnaires were distributed to the school and administered by the Dean of the school. A total of seventy-eight(78) responses were collected. Two other schools which were randomly selected as contrast samples to ensure that the results of the pilot study from the first school were reliable. One school had a teacher population of 100 and the other a teacher population of 50. Gender information by school data for the pilot study is included in Table 3.1.

The returned responses were 85 and 46, respectively. Overall, the return rates from the three schools used for the pilot study were 78%, 85% and 92%. The pilot portion of the research was administered between May 29, 1993 and June 6, 1993.

Table 3.1 Gender by school data for the Pilot Study

Gender	Sch. A	Sch. B	Sch. C	Total
Male	26(33.33)	28(32.94)	17(36.96)	71(33.97)
Female	52(66.67)	57(67.06)	29(63.09)	138(66.03)
Total	78	85	46	209

Note: The data indicate the frequency and gender ratio in each school.

Following pilot field testing, the questionnaire was given a final revision. The result was a 28-item instrument (Appendix F) which was used for the final study.

4. Item Analysis

The total scores for the preliminary survey subject sample on the Computer Attitude Scale were ranked and ordered. The high and low scores were designed as contrasting criteria on groups. The top 27 percent and bottom 27 percent were used for item analysis (Courtney, 1990a; Sax, 1980; Shrigley & Kobolla, 1984).

5. Reliability of the Instrument

Internal consistency reliability is concerned with the interrelatedness of the items comprising a scale (Green, Lissitz & Mulaik, 1977). High inter-item correlations suggest that the scale items have been subject to comparable standards of measurement. An estimate of the internal consistency and reliability of the scores assigned by the respondents as reflections of attitudes toward computers were assessed using the Hoyt-Stunkard coefficient of reliability (Hoyt & Stunkard, 1952). This method, using analysis of variance, is recommended for calculating the reliability of unrestricted scoring items of Likert-type scales (Courtney, 1990b).

6. Construct-Related Evidence of Validity

Validity refers to the appropriateness of the interpretation of the results obtained by the administration of an evaluation instrument to a given group of subjects, and not to the instrument in use. Thus, validity is influenced by uniform aspects of measurement, including test format, the conditions of administration, and the language level in use.

Lindeman (1967) writes that construct validity "concerns the extent to which a test tells us something about a meaningful characteristic of the individual" (p.38). The content-related evidence of validity of a test is judged on the basis of how adequately the test represents some defined universe or domain of content. Construct-related evidence of validity, however, involves the test's ability to measure the individual's actual difference from others. Construct-related evidence of validity is important in the validation of purported characteristic (construct) for the newly developed instrument.

Construct-related evidence of validity for the instrument developed for this study was determined according to the following sequence: 1) definition of computer attitudes, 2) selection of items which matched the definition, 3) a Delphi panel for expert opinion of item selection, 4) item analysis, 5) factor analysis, 6) determination of internal consistency, 7) consideration of known-group differences, and 8) consideration of a theoretical framework (Abdel-Gaid et al., 1986; DeVellis, 1991; Kwon, 1992; Lindeman, 1967; Mueller, 1986; Popham, 1990). First, the definition of the computer attitudes was established, then an item pool was generated from a review of the related research and interviews with middle school teachers. Additionally, a survey (Appendix A) covering teachers' beliefs and feelings about computers was utilized in this step. Second, a Delphi panel was used for the determination of the degree to which the scale items satisfactorily represented the content domain.

Nunnally (1970) suggested that factor analysis is a fundamental technique for identification of clusters of related variables of factors. In particular, "a test which has been developed using Likert scaling procedures should result in a constructs when factor analysis is applied to the data" (Courtney, 1990a, p.20).

Accordingly, factor analysis was used to establish unidimensional nature of the test items and to provide construct-related evidence of validity. If the test is found to reflect a single dimension, which is characterized as a factor loading equal to or in excess of .50 or with spurious items if the minimum loading is set at less than .50, then it will be considered to be unidimensional and possess construct validity (Courtney, 1990a).

The mathematical model for this form of factor analysis is as follow:

$$V_t = V_{co} + V_{sp} + V_{e,}$$

Where V_t = total variance,
V_{co} = variance that two or more measures have share in common,
V_{sp} = variance which is specific to each individual . measure, and
V_e = variance attributed to error.

Those items found to have factor loadings of +.50 or higher were considered as clustered within a factor.

For attitude scales, the clustering process may well establish the presence of several subfactors, all measuring attitudes toward computers. The 'Scree' method was utilized where multi-dimensional conditions existed for the data. The R-mode analysis examined the intercorrelated variance of every item with every other item. In the rotated solution of factor analysis, the number of factors retained may drastically change in the rotated structure. The "Scree" approach proposed by Cattell (1966) was chosen for this analysis. This procedure involves plotting the eigenvalues with those falling above a straight line fit through the smaller values being retained.

Next, the frequency distribution, means, standard deviation for each of items and Hoyt-Stunkard's coefficient of reliabilities in the subscales as well as in the total scale were examined for evidence of emotional intensity

(Shrigley & Koballa, 1984) and homogeneity (Mueller, 1986). In addition, the Computer Attitude Scale was analyzed to determine score differences within known-groups who supposedly have and have not had positive attitudes toward computers.

In consideration of the theoretical framework, computer experience has been shown to reduce computer anxiety and result in a more positive attitude toward computers. Each computer attitude subscale was analyzed in terms of computer experience.

II. The Statistical Design of the Study

1. Population

The population included the public middle school teachers in the Taipei city school district (72 middle schools and 7905 teachers), Taiwan, R.O.C.

2. Sample Size

The size of the sample was based on the recommendation that the "rule of thumb" for employing the R-mode technique with factor analysis is to utilize no fewer than 10 responses per item, except where samples are taken from homogeneous populations. According to the sample size table (Table 3.2) provided by Cohen (1988), the minimum sample size required for a factorial design matrix of 2 x 4 x 4, when the effect size =.25, the power of the test $(1 - \beta) = .80$, and level of significance $(\alpha) = .05$, is 384. In this study, 512 middle school teachers were selected for the final study. This sample size provided a power level which was larger than required when $1 - \beta = .80$, which assured that the probability of Type II errors would not be committed in the significance testing at the rate greater than twenty(20) percent of the time. Table 3.2 indicates the specification requirements for sample size.

Table 3.2

Sample size demands for the main and interaction effects in the G x A x E(2 x 3 x 2 and 2 x 4 x 4) factorial design

	Specifications										
Effect	a	(1) u	(2) u	f	power	(1) n'	(2) n'	(1) n_c	(2) n_c	(1) N	(2) N
G	.05	1	1	.25	.80	64	64	12	12	144	288
A	.05	2	3	.25	.80	52	45	14	16	168	384
E	.05	1	3	.25	.80	64	45	12	16	144	384
GxA	.05	2	3	.25	.80	52	45	14	16	168	384
GxE	.05	1	3	.25	.80	64	45	12	16	144	384
AxE	.05	2	9	.25	.80	52	25	14	12	168	288
GxAxE	.05	2	9	.25	.80	52	25	14	12	168	288

where N = minimum sample size needed under specifications,

a = α (Type I error),

u = degree of freedom,

f = the effect size(the standardized difference that the test could detect),

power = $1 - \beta$ (β = Type II error),

n_c = the sample size in each cell,

n' = table value for sample size in Cohen's table,

$$n_c = \frac{(n' - 1)\ (u + 1)}{\text{number of cells}} + 1,$$ "number of cells" is the number of(the highest order of) cells in the analysis (Cohen, 1988).

Note: G: Gender, A: Age, E: Experience.

3. The Selection of the Final Study Sample

Six (6) schools were randomly selected (omitting 3 from pilot study) from the Taipei city school district for the final stage of the study's data collection. The teacher populations were 90, 150, 127, 83, 70, and 65 respectively. The questionnaires were distributed and administered by the Dean of Study or by the Principal in each school. The numbers of valid collected responses were 74, 146, 108, 67, 61, and 56. The percentage return rates were 82, 97, 85 81, 85 and 86, respectively. The total response rate of 88% (512/585) was considered to be very high. Gender ratios are reported in Table 3.3.

Table 3.3 Summary table of gender by school(final study)

Gender		Sch. 1	Sch. 2	Sch. 3	Sch. 4	Sch. 5	Sch. 6	Total
M	(1)	23	38	25	21	11	19	137
	(2)	4.49	7.42	4.88	4.10	2.15	3.71	*26.76*
	(3)	16.79	27.74	18.25	15.33	8.03	13.87	
	(4)	*31.08*	*26.03*	*23.15*	*31.34*	*18.03*	*33.93*	
F	(1)	51	108	83	46	50	37	375
	(2)	9.96	21.09	16.21	8.98	9.77	7.23	*73.24*
	(3)	13.60	28.80	22.13	12.27	13.33	9.87	
	(4)	*68.92*	*73.97*	*76.85*	*68.66*	*81.97*	*66.07*	
Total		74	146	108	67	61	56	512
		14.45	28.52	21.09	13.09	11.91	10.94	100.0

Note:Number indicates(1)frequency, (2)percent in total, (3)row percentage(within gender), and (4)column percentage (within school). Italic:Gender ratio within each school.

The data indicated that the ratio of male to female teachers was about 1:3. It was close to the gender ratio for

ROC middle schools in cities (male to female ratio was about 2:5).

4. Dependent and Independent Variables

(1). The dependent variable for the study consisted of the individual's summed final score on the computer attitude test. Sample means, standard deviations, item-total correlations, variances, and standard errors of the means were calculated as a part of the analysis.

(2). The demographic data gathered as part of this study included age, gender, years of computer experience and other factors that related to computer utilization. These factors were considered as the independent variables for this study.

5. Statistical Hypotheses

The hypotheses which were tested followed the pattern which is inherent to a fixed design 3-way analysis of variance model. The major hypotheses are stated below:

H_1: There is no significant gender effect.

H_2: There is no significant age group effect.

H_3: There is no significant years of experience effect.

Subsidiary hypotheses associated with the design included the following interaction tests:

H_4: There is no significant interaction between levels of gender and age group.

H_5: There is no significant interaction between levels of gender and experience.

H_6: There is no significant interaction between levels of age group and experience.

H_7: There is no significant interaction between levels of gender, age group, and experience.

6. Statistical Model

Analysis Of Variance (ANOVA) procedures was used to assess the impact of age, gender and computer experience on computer attitudes scores among the subjects of study. The following design pattern represents the three-way, fixed layout used for this study (Table 3.4). The factor 'school' was also tested and shown not to be significant (Appendix M).

Table 3.4 Three-variable design for ANOVA procedure

Gender levels	Male(1)				Female(2)			
Age levels	1	2	3	4	1	2	3	4
Experience levels	1	2	3	4	1	2	3	4

For this design, the mathematical model was:

$$Y_{ijkl} = \mu + G_i + A_j + E_k + G*A_{ij} + G*E_{ik} + A*E_{jk} + G*A*E_{ijk} + ERROR_{ijkl}$$

Y : the test score
μ : the fixed constant
G : gender, i = 1, 2
A : age, j = 1, 2, 3, 4
E : experience, k = 1, 2, 3, 4
G * A : interaction of gender and age
G * E : interaction of gender and experience
A * E : interaction of age and experience
G * A * E : interaction of gender, age, and experience
ERROR : Residual.

The layout for the Analysis of Variance is shown in Table 3.5.

Table 3.5: ANOVA TABLE for 2 x 4 x 4 factorial design

Source of variation	d.f.	SS	MS	F
Gender	1	SSG	MSG	MSG/MSE
Age	3	SSA	MSA	MSA/MSE
Experience	3	SSP	MSP	MSP/MSE
G x A	3	SSGA	MSGA	MSGA/MSE
G x E	3	SSGE	MSGE	MSGE/MSE
A x E	9	SSAE	MSAE	MSAE/MSE
G x A x E	9	SSGAE	MSGAE	MSGAE/MSE
Error	n - 31	SSE	MSE	
Total	n - 1			

Note: n is the sample size for the research

The α=.05 level of significance was used as the basis for the rejection of a hypothesis. When computing the F-values for the fixed model, the Residual (Error) term acted as the denominator for the calculation of each of the seven (7) F-values used to test the null hypotheses in the three-variable fixed design. These F-ratios were defined as shown in Table 3.5.

III. Data Collection

Several procedural steps were necessary to collect the data for this study. The first step was to make official contact with the Ministry of Education and the Bureau of Education in Taipei city to get permission and to secure the sampling frame (school list) for the study. Secondly, schools were selected for both the pilot and the final phases of the study. Following the determination of the schools, the researcher personally contacted the Principal and the Dean of Study for each selected school to get consent for the study and to discuss test administration. For the known-group difference testing, the Coordinator of Education and Training Division at the Institute for Information Industry (III) was contacted. The selected teachers were provided with test instruments, accompanied by a cover letter. Questionnaires were administered by school authorities either in the individual's office or in school meetings. The responses were collected by school authorities who returned the results to the researcher. Finally, the return results were examined for completeness and clarity of marking in order for the coding to be made before entry into the computer for statistical analysis.

Chapter 4

RESULTS OF THE DATA ANALYSIS

The chapter is presented in three sections, which include analyses of the results from the Delphi study, the pilot study, and results of the final computer attitudes analysis of data collected from ROC public middle school teachers.

I. Results of the Delphi Process

1. <u>The First Round Delphi Step</u>

After personal contact with Delphi panelists, the initial item pool, with a cover letter (Appendix B) for the instrument that measured computer attitudes was sent to each panelist for their evaluation. The guidelines (Appendix B, Attachment 1&2) for evaluation were provided as a part of the procedure. The results (Appendix G) of the first round of the Delphi study, showed that nine (9) negative items and six (6) positive items were eliminated due to ambiguity or redundancy of items. Fifteen (15) items were rejected by more than two (2) panelists. One (1) negative item was added to the item pool for evaluation in the second Delphi round. There were 22 positive items and 29 negative items retained for the second Delphi round (Table 4.1a). The first Delphi round took 19 days (from April 19, 1993 to May 7, 1993) to complete.

Table 4.1a Results of the first Delphi round

	Number of Positive items	Number of Negative items
Before 1st Delphi	29	36
retained	11	14
revised	11	14
rejected	7	8
added	0	1
After 1st Delphi	22	29

2. <u>The Second Round Delphi Step</u>

The items which were retained and revised in the first round were prepared for the second Delphi stage. In the second round, each item was evaluated in terms of its level of importance using a 4-point Likert-type scale (Appendix D). The importance of each item was judged in terms of clarity and the perceived ability to differentiate (Likert, 1932, p.34) among middle school teachers and their positive and negative attitudes toward computers. Items which had the lowest total scores were removed from the item pool for the pilot study. Seven (7) negative and two (2) positive items were eliminated during the second Delphi round (Table 4.1b &

Appendix H). The second round of the Delphi took 11 days (May 15, 1993 to May 24, 1993).

Table 4.1b Results of the second Delphi round

	Number of Positive items	Number of Negative items
Before 2nd Delphi	22	29
Items eliminated	2	7
After 2nd Delphi	20	22

The entire Delphi process, including data analysis for the two rounds, extended over a 40-day period of time (April 17, 1993 to May 26, 1993). The time needed for the Delphi study was similar to that of researchers who had conducted similar research (Chuaratanaphong, 1984; Kurth-Schai, 1988). A pilot field study was started following the Delphi. These results are provided below.

II. Results of the Pilot Study

1. Discriminant Analysis Results

Based on the respondents' total scale scores, the mean differences for each item were calculated for the top 27% and the bottom 27% (Sax, 1980). A Student's t-test indicated that items 1, 24, and 38 did not differentiate between these two groups of teachers. Hence, these items were removed from the final instrument.

2. Correlation Analysis Results

Correlations were calculated between total scale scores, with item scores for all respondents in each item indicating the reliability for each item (Mueller, 1986). Items 1, 2, 6, 8, 9, 14, 22, 24, 28, 30 and 38 had the lowest correlations with total scores (Table 4.2). These items were not included in the final instrument.

3. Evidence of Emotional Intensity

The five-point Likert scale provided important data by which subjects judged an item for emotional intensity. According to Shrigley & Koballa (1984), an undecided percentage of 25% or higher should make an attitude statement suspect. Items 4, 9, 22, 30, 32, 33, 38, 39 met this criterion. Except for item 4 and 33, all of these were eliminated for the final study. The percentage responding to each option, mean scores and item-total correlations for each item from 209 pilot sample subjects are shown in Table 4.2.

There were several items eliminated for reasons other than the above; namely, for (1) low item-total correlation (r=.50 or less), and (2) over 25% responses in the Undecided option.

Table 4.2 The percentage of responses for each option, mean score, and item-total correlation for each item (n=209)

Item #		SA%	A%	UD%	D%	SD%	Mean	R
+	1*	14.83	62.20	17.70	5.26	0.00	3.87	.35
-	2*	1.91	35.89	16.27	34.45	11.48	3.18	.40
-	3	3.35	21.05	22.01	43.06	10.53	3.36	.55
+	4**	9.09	55.02	26.32	9.09	0.48	3.63	.51
-	5	0.96	3.83	12.92	58.85	23.44	4.00	.69
+	6*	41.15	51.67	3.83	2.39	0.96	4.30	.43
-	7	1.91	23.44	23.92	44.98	5.74	3.29	.53
-	8*	0.96	25.36	23.92	44.02	5.74	3.28	.48
-	9**	4.78	34.45	31.58	24.88	4.31	2.89	.36
-	10	0.48	12.44	11.96	64.11	11.00	3.72	.62
+	11	24.88	63.64	7.66	2.87	0.96	4.09	.51
+	12	16.27	59.81	19.14	4.31	0.48	3.87	.69
-	13	0.48	28.23	20.10	45.45	5.74	3.23	.53
+	14*	14.83	67.94	12.44	4.31	0.48	3.92	.48
+	15	23.92	57.89	11.00	6.70	0.48	3.98	.67
-	16	0.00	9.09	13.40	66.51	11.00	3.79	.52
+	17	12.44	55.02	23.92	8.61	0.00	3.71	.73
-	18	0.96	18.66	11.48	59.81	9.09	3.57	.68
-	19	1.44	12.92	17.70	55.98	11.96	3.64	.64
-	20	0.96	7.18	8.13	66.03	17.70	3.92	.59
+	21	18.18	57.42	16.27	6.70	1.44	3.84	.61
-	22***	0.96	22.01	37.80	33.97	5.26	3.21	.37
-	23	0.48	38.28	15.31	38.28	7.66	3.14	.63
+	24*	12.92	68.42	11.00	7.66	0.00	3.87	.28
-	25	0.00	13.88	17.70	57.89	10.53	3.65	.62
-	26	1.91	22.01	24.40	47.37	4.31	3.30	.56
+	27	8.13	63.64	16.75	11.48	0.00	3.68	.54
-	28*	0.96	14.83	16.27	60.77	7.18	3.58	.45
-	29	1.44	13.88	18.18	60.29	6.22	3.56	.52
+	30***	1.91	58.37	33.97	5.74	0.00	3.56	.42
-	31	0.00	6.70	16.27	64.59	12.44	3.83	.72
+	32**	3.83	56.94	33.49	5.74	0.00	3.59	.51
+	33**	6.22	48.33	30.62	14.83	0.00	3.46	.72
-	34	0.96	9.09	13.88	64.59	11.48	3.77	.61
+	35	8.13	57.89	23.92	9.57	0.48	3.64	.69

Table 4.2 Continued

Item #	SA%	A%	UD%	D%	SD%	Mean	R
- 36	1.44	10.53	20.10	61.24	6.70	3.61	.51
+ 37	17.70	69.86	8.61	3.83	0.00	4.01	.66
+ 38***	5.26	51.67	35.41	7.66	0.00	3.54	.37
+ 39**	9.09	61.24	25.36	4.31	0.00	3.75	.57
+ 40	7.66	63.64	24.40	4.31	0.00	3.74	.61
- 41	0.00	6.22	20.57	63.64	9.57	3.77	.53
+ 42	7.18	64.11	20.57	8.13	0.00	3.70	.65

Note: 1.* Items with lower correlation to total scores.
2.** Items with over 25% of response in undecided option.(+:positive, -:negative statements)
3.*** Items with lower correlation to total scores and over 25% of responses in the undecided option.
4.R indicates the correlation between item scores and total scale scores.
5.High UD%(over 25%) and low R(.50⁻) are underlined.

Item 4 had 26.32% of the responses falling in the undecided option, and the correlation to total scores was moderate (r=.51). The item was not eliminated because it was considered to be important to the study. Item 29 was not meet the two criteria(UD%=18.8, and R=.52), but it was correlated (r=.57) with item 26 (UD%=24.4, and R=.56). They were both concerned with dehumanization by computers and item 26 had higher item-total correlation (R=.56 vs. R=.52); hence, item 29 was not included in the final instrument. Item 7 was eliminated in the final questionnaire because it only fell close to both of the elimination criteria (UD%=23.92, r=.53). In addition, it was judged not to be a good item for teachers with no computer experience. Item 33 had more than a 25% response in the undecided option (33.5%), but it was highly correlated with total scores (r=.72), hence it was retained for the final instrument.

One way to judge if an item is good enough to be retained in the instrument is to check its correlation with other items in the instrument (Mueller, 1986) to ensure its internal consistency. The good item tends to have higher correlation with other items than items which are not as good. The item with a low correlation with other items is not a good candidate to be included in the instrument. In other words, items with insignificant correlations (p>.05) with other items will not be good items. The 42-item instrument had the following numbers of insignificant correlations (Table 4.3).

Table 4.3 The number of insignificant correlations(H_0:r=0; p>.05) for the computer attitude instrument(pilot study)

Item#	<u>1</u>	<u>2</u>	3	4	5	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	10	11
# of p>.05	12	8	2	3	0	5	3	6	11	0	5
Item#	12	13	<u>14</u>	15	16	17	18	19	20	21	<u>22</u>
# of p>.05	1	4	6	0	6	0	1	0	2	0	8
Item#	23	<u>24</u>	25	26	27	<u>28</u>	<u>29</u>	<u>30</u>	31	<u>32</u>	33
# of p>.05	2	14	3	2	5	8	3	8	3	2	0
Item#	34	35	36	37	<u>38</u>	39	40	41	42		
# of p>.05	2	0	3	0	10	2	1	5	1		

Note:Items with underline were not included in the final study.

As shown above, items 1, 2, 6, 8, 9, 11, 14, 16, 22, 24, 27, 28, 30, 38 had 5 or more insignificant correlated items. Based on this criterion eleven (11) out of the 14 items were eliminated for the final study.

The pilot study produced an instrument which included 13 positive items and 15 negative items that were used for the final study.

4. Factor Analysis for the Pilot Study

Factor analysis was used to establish the unidimensional nature of the test items and to provide construct-related evidence of validity. A maximum likelihood factor analysis with varimax rotation was performed on the 42 pilot instrument computer attitude items. From an application of the scree test (Cattell, 1966), examination of the plotted eigenvalues suggested that two interpretable factors would account for 40 percent of the total variance. Factor 1 indicates teachers' positiveness toward the computer and Factor 2 indicates teachers' negativeness toward the computer. The items and loadings for the results of the 2 factors from the pilot study are included in Table 4.4.

Factor 1 included of 22 items and Factor 2 consisted of 20 items. Factor 1 indicated teachers' positiveness toward computers.

Table 4.4 Item statements and factor loadings from the results of Pilot Study

Item#	Statements	Loading F1	F2
37	If I had more time, I would like to work more with computers	.75	
15	I want to learn more about computers	.71	
12	I like to take every opportunity to learn about computers	.67	
42	I think computers can be used in many ways	.67	
35	I plan to use computers as much as possible to solve problems	.66	
40	I think the use computers is a very good instructional method	.65	
27	The computer is an important tool for today's teachers	.65	
17	I like computers	.65	
14	Being able to use a computer lets me feel a sense of achievement	.64	
33	Thinking about using computers is exciting to me	.63	
21	I would really like to buy a computer for my own use	.62	
11	I think being able to use a computer would be very enjoyable	.61	
24	If I don't learn how to use a computer I will feel out-of-date	.57	
31	Computer can't be used in my subject area, so I don't need to learn about them	.56	
39	Using a computer saves me a lot of time	.52	
6	If computers can help improve my teaching, I want to to learn about them	.49	
1	Teaching quality can be improved by using a computer	.49	
4	A computer can stimulate my creativity	.48	
32	Students' learning efficiency can be improved by using a computer	.48	
19	I don't think computers are useful in my teaching	.47	

Table 4.4 - Continued

Item#	Statements	Loading F1	Loading F2
20	I think learning about computers takes up too much time	.45	
30	Instruction in computer use can improve students' motivation	.41	
25	I am afraid of computers		.77
23	Because I don't know enough about computers, I avoid using them		.72
16	I feel uncomfortable when other people talk about computers		.66
41	Thinking about learning to use computers makes me feel scared		.65
8	Using computers is frustrating to me		.63
13	Computers are too complicated for me		.61
18	I know computers are very useful, but I don't want to spend time learning about them		.60
2	When I use a computer, I am usually afraid of damaging it		.55
26	Using computer instruction will take away the human touch in education		.54
5	I don't want to have anything to do with computers		.52
34	I am already so busy with my teaching, I shouldn't have to learn about computers		.51
7	If I can't keep using my computer skills, I will forget what I have learned		.49
10	I don't like to talk about computers		.48
29	Computer instruction will erode the teachers' personal guidance role		.46
3	Relying on computers too much makes people lazy		.46
36	Using computers will increase my work pressure		.46

Table 4.4 - Continued

Item#	Statements	Loading F1	Loading F2
28	I worry about people's jobs being taken over by computers		.44
9	Computers can't solve complicated human problems		.42
38	I have confidence in my ability to learn about computers		.36
22	I can do what a computer does just as well by using other methods		.32

Examples of items included in Factor 1 were, (1) Cognitive: Using a computer saves me a lot of time, (2) Affective: I like computers, and (3) Conative or behavioral-tendency: I plan to use computers as much as possible to solve problems. Factor 2 indicated the teachers' negativeness toward computers. Factor 2 included such items as (1) Cognitive: Using computers will increase my work pressure, (2) Affective: I am afraid of computers, and (3) Conative or behavioral-tendency: I don't like to talk about computers.

5. <u>Reliability for the Pilot Study</u>

Hoyt-Stunkard's coefficient (Table 4.5) was utilized for calculating reliability. The internal consistency for pilot teachers from the first school was R=.9443 (n=78), the second school, R=.939 (n=85) and the third school, R=.9497 (n=46). In combining the 3 schools (n=209), R was determined to be +.943, which was considered to be a very substantial reliability. Cronbach's α was calculated as +.943 which coincided with Hoyt-Stunkard's R.

Table 4.5 Hoyt-Stunkard's coefficient of reliability (pilot study)

Group	Source	DF	Sum of Squares	Mean Square	R
Sch A	Items	41	272.4826	6.6459	
	Resp	77	629.1896	8.1713	
	Resid.	3157	1435.8745	0.4548	.9443
Sch B	Items	41	282.7308	6.8959	
	Resp	84	703.5227	8.3753	
	Resid.	3444	1753.9597	0.5093	.9390
Sch C	Items	41	183.8432	4.4839	
	Resp	45	428.2241	9.5161	
	Resid.	1845	883.2759	0.4787	.9497
3 Sch	Item	41	699.2965	17.0560	
	Resp	208	1761.1011	8.4668	
	Resid.	8528	4112.8701	0.4823	.9430

Hoyt-Stunkard's coefficient of reliability (R) is calculated as follows (Courtney, 1990b; Hoyt & Stunkard 1952):

$$R = \frac{\text{MS of Respondent} - \text{MS of Residual}}{\text{MS of Respondent}}$$

III. Results of the Final Study

1. Characteristics of the Final Sample

For analytical purposes, participants were grouped according to gender, age and computer experience. The sample included teachers from ages 23 to 65 (average age for male and female teachers were 41.33 and 37.77, respectively), which covered the entire range of teacher ages in ROC middle schools. Nineteen (19) percent of the subjects had no computer experience, 61 percent of the teachers had a little to two years of computer experience, and about 6 percent of the teachers had computer experience covering more than five years. The possession (i.e., ownership) of computers, the use of the computer and the length of computer training, provided additional sources of information about computer experience. It should be noted that more than half (54.49%) of the teachers had personal computers at home, and about 77% of the teachers had experienced using the computer in school. A little less than half (44.14%) of the teachers never had in-service computer training. A summary of the sample's demographic characteristics is included in Table 4.6.

Table 4.6 Characteristics of the Final Study sample

Variable	Group	Number	Percent
Gender	Male	137	26.76
	Female	375	73.24
Age	23-30	101	19.73
	31-40	202	39.45
	41-50	168	32.81
	51-65	41	8.01
Experience	No	97	18.95
	0< yr≤ 2	314	61.33
	2< yr≤ 5	71	13.87
	5< yr	30	5.86
Ownership	No	233	45.51
	Yes	279	54.49
Use	No	118	23.05
	Yes	394	76.95
Training	No	226	44.14
	0 <hr≤ 20	151	29.49
	20 <hr≤ 50	73	14.26
	50 <hr≤100	34	6.64
	100<hr	28	5.47

2. Mean and Standard Deviation for the Final Instrument

The 28-items of the computer attitude instrument (Appendix F) were administered for data collection in the final study. Mean scores, standard deviations and p-values for testing the mean difference between males and females for each item are included in Table 4.7. The percentage of responses in each scale score are included in Appendix I.

It should be noted that only 1 item (item 14: I think learning about computers takes up too much time) had a mean score where female teachers scored higher than male teachers. There were 16 items where means showed significant differences ($p < .05$) between male and female teachers. The total mean scores showed a significant difference between male and female teachers in their attitudes toward computers. The differences were found on items concerned with the important of the role of computers, creativity that the computer could stimulate, learning more and using more computers, use of computers in instruction, buying a computer, complication of computers, avoidance of using computers, time saving of computers, dehumanization of computers, fear of computers, and excitement about learning to use computers. No differences were found in items about the computers dependence of people, against computers, don't like to talk or hear about computers, not enjoying using computers, knowing computers are very useful but not wanting to spend time learning about them, time consuming to learn

Table 4.7 Means, standard deviations and p-values in two sample(male vs. female) t-test for each item

	Total (n=512)		Male (n=137)		Female (n=375)		Sig.
Item#	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	P-Val
1	3.13	.6483	3.25	.7048	3.08	.6214	.0104
2	2.69	.7100	2.79	.7711	2.65	.6839	.0568
3	3.08	.6592	3.14	.6810	3.05	.6500	.1477
4	2.74	.6627	2.95	.7507	2.66	.6111	.0001
5	2.95	.6204	3.04	.6952	2.91	.5879	.0542
6	3.17	.6712	3.30	.7005	3.16	.6553	.0117
7	3.01	.6016	3.02	.6470	3.00	.5850	.7830
8	2.97	.6554	3.10	.6783	2.92	.6408	.0053
9	3.20	.6515	3.27	.6806	3.18	.6396	.1601
10	2.93	.6730	2.94	.7647	2.92	.6373	.8242
11	3.04	.6697	3.17	.7060	2.99	.6499	.0053
12	2.71	.7055	2.87	.7420	2.66	.6833	.0017
13	2.87	.6364	3.06	.6616	2.80	.6131	.0001
14	3.10	.6554	3.05	.8023	3.12*	.5932	.4129
15	2.90	.6160	3.08	.6190	2.83	.6025	.0001
16	2.90	.6637	3.03	.7567	2.86	.6210	.0173
17	2.78	.6817	2.96	.7363	2.72	.6500	.0004
18	2.87	.6835	3.03	.7168	2.82	.6628	.0017
19	2.76	.6822	2.92	.7180	2.71	.6608	.0019
20	2.93	.6332	3.04	.6846	2.90	.6095	.0192
21	3.05	.6062	3.12	.7129	3.02	.5565	.1326
22	2.75	.7064	2.91	.7715	2.70	.6729	.0041
23	2.92	.6485	2.95	.6787	2.91	.6377	.5691
24	2.85	.6278	2.92	.6424	2.82	.6213	.1269
25	3.09	.6378	3.18	.6989	3.06	.6114	.0469
26	2.92	.6472	3.02	.6694	2.89	.6360	.0381
27	2.99	.6145	3.09	.6356	2.95	.6035	.0301
28	2.90	.6578	3.07	.7033	2.84	.6299	.0004
ToT	82.17	11.4875	85.28	12.9887	81.05	10.6822	.0008

Note: 1. Underlines on the last column indicate a significant mean score difference between male and female final test respondents at the α = .05 level.
2. * indicates items with female teachers having higher scores.

about computers, not liking to use computers in instruction, excitement about the computer, being too busy to learn about computers, and work pressure that computers could bring.

The results indicated that both male and female teachers were positive about the computer, with male teachers having higher positiveness toward computers than females. In terms of negativeness toward computers, male and female teachers showed no difference. Overall, middle school teachers were not against using computers, but female teachers were more "passive" than their male counterparts.

3. Discriminant Data Analysis for the Final Instrument

The total scores from the final sample on the Computer Attitude Scale and rank ordering the total scores served as the basis for calculating this analysis. The low and high scores were designated as contrasting criterion groups. The top 27 percent and the bottom 27 percent were used for item analysis (Courtney 1990a, Sax, 1980). The results of the discriminant analysis for items for the final study are included in Table 4.8.

The item discriminant analysis indicated that all items in the instrument had significant ability (as shown by the t-test between mean scores of the top 27% and the bottom 27% of respondents, where both groups were different at the α=.0001 level) to differentiate between low and high score groups of subjects that responded to the computer attitude questionnaire.

Table 4.8 Discriminant data for the top 27%(n=139) and the bottom 27%(n=139) in each item- final study

Item #	Top 27%		Bottom 27%		Sig. level P-Val	State. (+,-)
	Mean	StdDev	Mean	StdDev		
1	3.48	.5431	2.79	.6860	*	+
2	3.11	.7231	2.29	.5928	*	-
3	3.60	.5738	2.53	.6627	**	-
4	3.20	.5670	2.28	.6374	**	+
5	3.42	.6126	2.47	.5814	**	-
6	3.78	.4625	2.62	.6185	*	+
7	3.46	.5552	2.60	.6093	**	-
8	3.44	.6606	2.56	.6033	**	-
9	3.73	.5491	2.80	.6613	*	+
10	3.48	.5692	2.47	.6626	**	-
11	3.61	.5837	2.53	.5935	**	+
12	3.21	.7068	2.25	.6381	**	-
13	3.37	.4984	2.40	.6105	*	+
14	3.66	.5843	2.67	.6065	**	-
15	3.39	.5873	2.32	.5545	**	+
16	3.46	.5681	2.32	.6045	**	+
17	3.29	.6308	2.32	.6143	**	-
18	3.33	.7051	2.45	.6502	**	+
19	3.16	.7081	2.31	.6238	**	-
20	3.44	.5532	2.52	.6741	*	-
21	3.53	.5556	2.60	.6353	*	-
22	3.39	.5466	2.08	.5822	**	+
23	3.49	.5432	2.31	.6758	**	-
24	3.30	.6215	2.33	.5822	**	-
25	3.68	.4821	2.61	.6758	*	+
26	3.44	.5661	2.47	.6520	**	+
27	3.53	.5150	2.50	.6413	*	-
28	3.40	.5985	2.31	.6259	**	+
TOT	96.41	7.4062	68.71	5.7426	*	

Note: * indicates p-value = .0001.
** indicates p-value < .0001.
TOT indicates the total score for the entire test.

4. Correlation Analysis for the Final Instrument

The high correlation between total scale scores for all respondents and items scores for all respondents indicated that the computer attitude questionnaire was a reliable test for the subjects selected (Table 4.9).

Table 4.9 The item-total correlations and number of insignificant inter-item correlations(final study)

Item #	R All	R Male	R Female	# of r that p>.05 All	Male	Female
1	.44	.40	.45	1	9	2
2	.52	.66	.44	0	0	0
3	.68	.77	.64	0	0	0
4	.55	.58	.52	0	1	0
5	.64	.66	.62	0	1	0
6	.67	.64	.68	0	0	0
7	.60	.75	.54	1	1	1
8	.59	.63	.56	0	1	0
9	.58	.61	.56	0	0	0
10	.64	.64	.65	1	2	0
11	.65	.71	.61	0	0	0
12	.60	.65	.56	0	1	0
13	.62	.63	.61	0	1	0
14	.62	.62	.65	0	1	0
15	.72	.76	.70	0	0	0
16	.69	.69	.68	0	0	0
17	.61	.70	.55	0	1	0
18	.53	.59	.50	0	0	0
19	.51	.52	.49	0	2	0
20	.65	.71	.61	1	1	1
21	.66	.66	.65	0	0	0
22	.73	.69	.74	0	0	0
23	.73	.74	.73	0	0	0
24	.65	.72	.62	0	0	0
25	.69	.65	.70	0	0	0
26	.62	.62	.62	0	0	0
27	.71	.79	.67	0	0	0
28	.67	.69	.64	0	0	0

Note:1.All(n=512), Male(n=137), Female(n=375).

2. R indicates the correlation between item scores and the total scale scores.
3. # of r that $p > .05$ indicates the number of insignificant correlations under H_0: $r = 0$

The results of the correlation analysis indicated that all except item 1 had satisfactory correlation with the total scores. The number of insignificant inter-item correlations under the hypotheses of testing H_0: $r = 0$ indicated that all except item 1 were nearly zero. In fact, if we exclude item 1, the inter-item correlation for all other test items would be significantly different from zero at the $\alpha = .0001$ level.

The results showed that there were some differences in the item-total correlation and inter-item correlation between male and female teachers.

The low item correlation for the first items in the test was examined. In the pilot study, item 1 had R=.35, which was the second lowest item-total correlation reported. The item was not included in the final test. In the final study, the first item in the test had R=.44, which was the lowest (the item was item 27 in the pilot test where R was .54).

5. Reliability of the Final Instrument

The Hoyt-Stunkard coefficient was utilized in calculating internal reliability (Table 4.10). Results for the first school was R=.9342 (n=74), the second R=.9404 (n=146), the third R=.9308 (n=109), and the fourth R=.9364 (n=67), the fifth school, R=.9517 (n=61), and the sixth school, R=.9575 (n=56). When the results of the 6 schools (n=512) were combined, R=.943 (Table A.2, Appendix J), which was considered to be very high. Cronbach's α coefficient showed identical reliability (R =+.943).

Table 4.10 Hoyt-Stunkard's coefficient of reliability (final instrument)

Group	Source	DF	Sum of Squares	Mean Square	R
Sch 1	Items	27	49.4980	1.8332	
	Resp	73	255.0888	3.4944	
	Resid.	1971	453.0734	0.2299	.9342
Sch 2	Items	27	62.1005	2.3000	
	Resp	145	860.3016	5.9331	
	Resid.	3915	1384.0066	0.3535	.9404
Sch 3	Items	27	89.1717	3.3027	
	Resp	108	366.4934	3.3934	
	Resid.	2916	684.1854	0.2346	.9308
Sch 4	Item	27	49.6567	1.8391	
	Resp	66	227.5682	3.4480	
	Resid.	1782	390.7004	0.2192	.9364
Sch 5	Item	27	31.2576	1.1577	
	Resp	60	308.8162	5.1469	
	Resid.	1620	402.5281	0.2485	.9517
Sch 6	Item	27	31.7117	1.1745	
	Resp	55	316.4974	5.7545	
	Resid.	1485	362.7883	0.2443	.9575

6. Factor Analysis for the Final Instrument

Factor analysis was used to establish the unidimensional nature of the test items and to provide construct-related evidence for validity. A maximum likelihood factor analysis with varimax rotation was performed on the 28 computer attitude items. From the application of the scree test (Appendix K) examination of the plotted eigenvalues suggested that two interpretable factors would account for 47 percent of the total variance. Factor 1 indicated teachers' positiveness toward the computer and Factor 2 indicated teachers' negativeness toward the computer. The items and factor loadings for the final study data are included in Table 4.11.

Table 4.11 Item statements and factor loadings from the results of final study

Item#	Statements	Loading F1	Loading F2
25	If I had more time, I would like to work more with computers	.71	
28	I think computers can be used in many ways	.68	
26	I think the use of computers is a very good instructional method	.67	
6	I want to learn more about computers	.66	
16	I like to take every opportunity to learn about computers	.65	
15	I like computers	.64	
1	The computer is an important tool for today's teachers	.63	
4	A computer could stimulate my creativity	.62	
22	Thinking about using computers is exciting to me	.62	
11	I would really like to buy a computer for my own use	.56	
13	I plan to use computer as much as possible to solve problems	.55	
18	Using a computer saves me a lot of time	.54	
9	I think being able to use a computer would be very enjoyable	.49	
19	Using computer instruction will take away the human touch in education	.43	
2	Relying on computers too much makes people lazy	.38	

Table 4.11 - Continued

Item#	Statements	Loading	
		F1	F2
20	I am afraid of computers		.81
27	Thinking about learning to use computers makes me feel scared		.76
10	I know computers are very useful, but I don't want to spend time learning about them		.74
12	Computers are too complicated for me		.72
7	I feel uncomfortable when other people talk about computers		.69
17	Because I don't know enough about computers, I avoid using them		.64
23	I am already so busy with my teaching, I shouldn't have to learn about computers		.63
3	I don't want to have anything to do with computers		.57
24	Using computers will increase my work pressure		.55
21	Computers can't be used in my subject area, so I don't need to learn about them		.54
5	I don't like to talk about computers		.53
14	I think learning about computers takes up too much time		.50
8	I don't think computers are useful in teaching		.45

Twelve (12) items in Factor 1 had factor loadings of .50 or above. Three (3) items (items 2, 9 and 19) loaded less than .50 in Factor 1. In Factor 2 there were 12 items with factor loadings of .50 or above. Only one item (item 8) loaded less than .50 on Factor 2. Items 2, 8, 9 and 19 are considered to be spurious items (Table A.3, Appendix J). The

Hoyt-Stunkard reliability coefficients were .904 for Factor 1, .911 for Factor 2 and .943 for the entire test (Table A.2, Appendix J). The correlations between the two factors and the entire test are included in Table A.1 (Appendix J).

7. Known-Group Differences

In the Known-group difference procedure (Mueller, 1986; p.70) two groups of teachers were identified. For the present study, one was a group of teachers participating in the National Computer Training Program (NCTP) "known" to hold positive attitudes toward computers; the other was a group of "old-type" middle school teachers "known" to hold negative(or less positive) attitudes toward computers.

The training program (NCTP) had two different levels of class: one was called "information application class" (Class 1) for teachers not graduated from computer science or computer science related majors. The other class, called "seed's class" (Class 2) was with teachers who had successfully passed the "information application class." The two classes both consisted of elementary and middle school teachers. The purpose for Class 1 was to train teachers to have basic computer knowledge and the purpose for Class 2 was to train teachers to apply their computer expertise in teaching and in helping the school's computerization. Class 1 was a 10-week, 250-hour training program and Class 2 was a 20-week, 500-hour training program.

The training hours included lecture and practicum for both classes. The teachers either volunteered or were selected by schools to participate in this program. The "old-type" schools classification indicated that the school was old and that the facility (including computer equipment) was not as good as the newer schools. Surveys and interviews with teachers indicated that teachers in old-type schools tended to have more frustration about their out-of-date facility and have less positive attitudes toward computers. The sample characteristics for known-group difference are included in Table 4.12. The data showed that the teachers participating in the National Computer Training Program had more computer experience (57% vs. 17% had more than 2 years of computer experience), were younger (80% vs. 39% under age 40), had more computer training (85% vs. 7.5% had more than 100 hours of in-service computer training), and had more experience in the use of computers (90% vs. 78% have used computers in school). More were owners of a computer (87% vs. 57% in ownership of a computer) than were teachers in the old-type school. Among the NCTP group, the female teachers were outnumbered by male teachers (about 1 to 4).

Table 4.12 Sample characteristics for the known-groups

Variable	Group	Subgroup	Freq.	%
Gender	NCTP	Male	54	80.59
		Female	13	19.41
	Old-Sch	Male	21	31.34
		Female	46	68.66

Table 4.12 - Continued

Variable	Group	Subgroup	Freq.	%
Age	NCTP	21-30	26	38.81
		31-40	28	41.79
		41-50	12	19.92
		51-65	1	1.49
	Old-Sch	21-30	1	1.49
		31-40	25	37.31
		41-50	29	43.28
		51-65	12	17.91
Experience	NCTP	No	1	1.49
		0 < yr ≤ 2	28	41.79
		2 < yr ≤ 5	21	31.34
		5 < yr	17	25.37
	Old-Sch	No	11	16.42
		0 < yr ≤ 2	44	65.67
		2 < yr ≤ 5	10	14.92
		5 < yr	2	2.98
Ownership	NCTP	No	9	13.43
		Yes	58	86.57
	Old-Sch	No	29	43.28
		Yes	38	56.72
Use	NCTP	No	7	10.45
		Yes	60	89.55
	Old-Sch	No	15	22.39
		Yes	52	77.61
Training	NCTP	No	0	0.00
		0 < hr ≤ 20	3	4.48
		20< hr ≤ 50	0	0.00
		50< hr ≤100	7	10.45
		100<hr	57	85.07
	Old-Sch	No	28	41.79
		0 < hr ≤ 20	23	34.33
		20< hr ≤ 50	8	11.94
		50< hr ≤100	3	4.48
		100<hr	5	7.46

Note:yr indicates number of years of computer experience; hr indicates number of hours of computer training.

The results of known-group differences (NCTP vs. Old-Sch.) in terms of the mean scores and standard deviation in each item (1-28) for the final 28-item computer attitude questionnaire are included in Table 4.13a.

Table 4.13a The results of known-group difference - 1

Item number	NCTP(n=67)		Old-Sch(n=67)		$P_r > \lvert T \rvert$ or P-value
	Mean	StdDev	Mean	StdDev	
1	3.23	.7916	3.01	.5638	.0472
2	2.91	.6681	2.43	.6565	.0001
3	3.51	.6123	2.97	.5496	$.0001^{-}$
4	3.16	.7092	2.58	.6067	$.0001^{-}$
5	3.31	.6082	2.85	.5295	$.0001^{-}$
6	3.56	.6086	3.09	.5702	$.0001^{-}$
7	3.47	.5325	3.00	.4264	$.0001^{-}$
8	3.37	.5989	2.86	.5192	$.0001^{-}$
9	3.47	.5867	3.18	.4581	.0013
10	3.42	.5812	2.88	.5909	$.0001^{-}$
11	3.51	.6123	2.92	.6352	$.0001^{-}$
12	2.89	.8002	2.67	.5874	.0673
13	3.25	.6818	2.81	.6090	.0001
14	3.25	.7456	2.94	.6247	.0094
15	3.37	.6705	2.82	.6011	$.0001^{-}$
16	3.42	.5312	2.86	.6251	$.0001^{-}$
17	3.28	.6920	2.67	.6828	$.0001^{-}$
18	3.01	.7486	2.83	.6651	.1456
19	2.87	.6489	2.61	.5492	.0159
20	3.27	.5924	2.91	.5143	.0003
21	3.37	.5459	2.92	.5312	$.0001^{-}$
22	3.13	.6489	2.59	.6045	$.0001^{-}$
23	3.30	.6280	2.81	.6569	$.0001^{-}$
24	3.09	.7732	2.76	.6298	.0080
25	3.40	.6045	3.00	.5222	.0001
26	3.16	.6178	2.79	.5912	.0005
27	3.31	.6562	2.98	.4765	.0012
28	3.21	.7289	2.82	.5200	.0006

Note:1. $.0001^{-}$ indicates that p-value less than .0001
NCTP: National Computer Training Program

2. Mean is the group mean in a 4-point Likert scale.

From the known-group difference analysis the mean score for the positive group was significantly higher than the mean score for the negative group in every test item (except items 12, and 18 were not significant at the α=.05 level), the data supporting the validity of the attitude scale. The total mean scores and results of t-test between different groups in the known-group study are included in Table 4.13b.

Table 4.13b Results of known-group difference - 2

Group	Size	Mean	Std Dev.	P-value
NCTP	67	91.46	12.37	
Old-Sch.	67	79.39	9.81	.0001⁻
Class 1	31	88.84	12.53	
Class 2	36	93.72	11.94	.1077
Volunteer	61	92.97	11.38	
Non-Volunt.	6	76.17	12.51	.0011
Elementary	37	92.40	12.98	
Middle	30	90.30	11.68	.4927

Note: Mean is the group total mean score for each group.

The mean score for the NCTP group was significantly higher than that for the Old-type school teachers (91.46 (n=67) vs. 79.39 (n=67), p<.0001). The positive group showed higher degrees of positive attitudes towards computers than their negative counter- parts.

The mean score for volunteers taking the training program was higher than the scores for teachers selected by schools (Mean: 92.97 (n=61) vs. 76.16 (n=6), p=.0011) which indicates that teachers with a higher willingness to learn about the computer tend to have a better attitude toward computers.

The mean score for Class 2 was higher than that for Class 1, but not significant at the $\alpha=.05$ level (93.72 (n=36) vs. 88.84 (n=31), p=.1077).

When tested, the mean score difference between the elementary school and the middle school teachers on the Computer Attitude Scale was not significant (Elementary mean=92.41, Middle school mean=90.30, p=.4927).

The General Linear Model (GLM, or Multivariate) analyses (Table 4.13c & Table 4.13d) indicated that gender and age effects among the NCTP group were not significant at the $\alpha=.05$ level (p=.1523, and .0677 respectively), but computer experience had a significant effect at the $\alpha=.05$ level (p=.0161). For the Old-type school, gender and age effects in Computer Attitude Scale scores were not significant at the $\alpha=.05$ level (p=.1199, and .3707 respectively), but these were significant differences among teachers with different lengths of computer experiences (p=.0033).

The analysis of variance indicated that gender and age differences in Computer Attitude Scale scores were not significantly different within the NCTP group and Old-type school. The computer experience did show significant differences in Computer Attitude Scale scores within the two groups.

Table 4.13c Analysis of variance for NCTP group

Source of variance	df	MS	F	p_r>F
Gender	1	227.59	2.11	.1523
Age	3	272.51	2.53	.0677
Experience	3	406.94	3.78	.0161
Gender x Age	2	299.68	2.78	.0715
Gender x Experience	1	296.07	2.75	.0737
Age x Experience	4	122.79	1.14	.3486
Gender x Age x Experience	1	21.49	0.20	.6570

Note: Type II SS was used from SAS GLM Procedure. In Type II SS each effect is adjusted for all other effects possible (SAS/STAT User's Guide, p.115, 1990).

Table 4.13d Analysis of variance for Old-Sch. group

Source of variance	df	MS	F	p_r>F
Gender	1	189.68	2.50	.1199
Age	3	81.00	1.07	.3707
Experience	3	392.79	5.18	.0033
Gender x Age	2	27.78	0.37	.6950
Gender x Experience	1	0.05	0.00	.9790
Age x Experience	4	65.89	0.87	.4889
Gender x Age x Experience	1	1.61	0.02	.8846

Note: Type II SS was used from SAS GLM Procedure.

8. Analysis of Variance Results for the Final Study

Because of unequal cell size for each main effect, results were analyzed by multivariate analysis (General

Linear Model (GLM) procedure). The results of the multivariate analysis for the seven (7) null hypotheses (Chapter 3) for, respectively, the positiveness toward computers (F1) and negativeness toward computers (F2) and the entire test (ALL), are presented in Table 4.14.

Table 4.14 Results of GLM procedure for the seven(7) null hypotheses (Factor 1, 2 and All items)

Hypothesis	Variable	F1	F2	ALL
H_1	Gender	R	NR	R
H_2	Age	R	R	R
H_3	Experience	R	R	R
H_4	Gender x Age	NR	NR	NR
H_5	Gender x Experience	NR	NR	NR
H_6	Age x Experience	NR	NR	NR
H_7	Gender x Age x Experience	NR	NR	NR

Note:R indicates the hypothesis was rejected and NR indicates the hypothesis was not rejected at α=.05 level.

The results of the first GLM procedure, with the total scale scores from items loaded as Factor 1- teachers' positiveness toward computers considered as the dependent variable, are presented in Table 4.15a. These results indicate that there were statistically significant differences on all main effects, including gender, age, and computer experience effects.

Table 4.15a The GLM analysis for Factor 1(15 items)
(Factor 1 - positiveness toward computers)

Source of variance	df	MS	F	p_r>F
Gender	1	344.91	9.77	.0001
Age	3	167.17	4.74	.0001
Experience	3	615.77	17.44	.0001
Gender x Age	3	67.79	1.92	.1196
Gender x Experience	3	32.84	0.93	.3315
Age x Experience	9	46.58	1.32	.2238
Gender x Age x Experience	7	19.47	0.55	.7946

Table 4.15b Tukey's HSD for paired mean difference
(Factor 1 - positiveness toward computers)

Variable	Group	Size	Mean	StdDev	Sig.
Gender	Male	137	46.03	7.09	A
	Female	375	43.19	6.11	B
Age	23-30	101	45.48	6.66	A C
	31-40	202	44.87	6.42	A C
	41-50	168	41.99	6.12	B D
	51-65	41	43.76	6.33	C D
Experience	No	97	40.73	5.54	C
	0 < yr ≤ 2	314	43.63	6.18	B
	2 < yr ≤ 5	71	47.21	6.00	A
	5 < yr	30	50.07	6.68	A

Note: The results with the same letter(the last column, read vertically for each variable) are not different at α=.05 significant level.

Tukey's HSD (Peterson, 1985, p.78-9) was used to analyze the paired mean difference (Table 4.15b). The results indicated the positive computer attitude scores had significant gender differences. No significant differences were found between age groups 1 and 2, age groups 3 and 4, and age groups 1, 2 and 4. Significant age differences were found between age groups 1 and 3, and age group 2 and 3, In terms of computer experience, only groups 3 and 4 had no significant differences.

The results of the second GLM procedure, with the total scale scores from items loaded as Factor 2- teachers' negativeness toward computers considered as the dependent variable, are presented in Table 4.16a. The data indicate that there were no statistically significant gender effects and that there were statistically significant age and experience effects.

Table 4.16a The GLM analysis for Factor 2(13 items) (Factor 2- negativeness toward computers)

Source of variance	df	MS	F	p_r>F
Gender	1	26.32	0.99	.3209
Age	3	173.76	6.52	.0002
Experience	3	791.72	29.70	.0001
Gender x Age	3	66.38	2.49	.0596
Gender x Experience	3	60.98	2.29	.0778
Age x Experience	9	42.11	1.58	.1183
Gender x Age x Experience	7	28.86	1.08	.3731

The results of Tukey's HSD paired mean difference analysis (Table 4.16b) indicate that gender difference in negative computer attitude score was significant. There were significant age differences between age groups 1 and 3, age groups 1 and 4, age groups 2 and 3, and age groups 2 and 4. No significant age differences between age groups 1 and 2, and age groups 3 and 4. All groups showed significant differences in computer experience.

Table 4.16b Tukey's HSD for paired mean difference (Factor 2- negativeness toward computers)

Variable	Group	Size	Mean	StdDev	Sig.
Gender	Male	137	39.27	6.79	A
	Female	375	37.92	5.41	B
Age	23-30	101	39.61	6.33	A
	31-40	202	39.36	5.38	A
	41-50	168	36.73	5.54	B
	51-65	41	36.05	5.92	B
Experience	No	97	34.59	4.97	D
	$0 < yr \leq 2$	314	38.15	5.28	C
	$2 < yr \leq 5$	71	41.20	5.34	B
	$5 < yr$	30	44.63	6.29	A

Note: The results with the same letter (the last column, read vertically for each variable) are not different at the α=.05 significant level.

The results of the third GLM procedure, with the total scale scores from all items in the instrument considered as the dependent variable, are displayed in Table 4.17a. The results indicate that there were no statistically significant interaction effects for gender, age, and experience. The age, and experience effects were statistically significant at the α=.01 (p=.0001) level and the gender effect was statistically significant at the α=.05 level (p=.0161).

Table 4.17a The GLM analysis for the instrument (28 items) (ALL - positiveness and negativeness toward computers)

Source of variance	df	MS	F	P_r>F
Gender	1	572.57	5.47	.0198
Age	3	631.88	6.03	.0005
Experience	3	2692.97	25.70	.0001
Gender x Age	3	245.22	2.34	.0726
Gender x Experience	3	144.20	1.38	.2492
Age x Experience	9	150.62	1.44	.1690
Gender x Age x Experience	7	73.81	0.70	.6683

Table 4.17b Tukey's HSD for paired mean difference (ALL-positiveness and negativeness toward computers)

Variable	Group	Size	Mean	StdDev	Sig.
Gender	Male	137	85.26	12.99	A
	Female	375	81.05	10.68	B
Age	23-30	101	85.01	12.20	A
	31-40	202	84.13	10.89	A C
	41-50	168	78.68	11.03	B D
	51-65	41	79.85	10.60	C D
Experience	No	97	75.40	9.67	D
	0 < yr ≤ 2	314	81.73	10.52	C
	2 < yr ≤ 5	71	88.18	10.36	B
	5 < yr	30	94.53	12.61	A

Note: The results with the same letter(the last column, read vertically for each variable) are not different at the α=.05 significant level.

The results of Tukey's HSD paired mean difference analysis (Table 4.17b) indicated that gender differences in computer attitude were significant. Age differences were significant between age groups 1 and 3, age groups 1 and 4, and age groups 2 and 3. The computer attitude score indicated significant differences among all of teachers with different lengths of computer experience.

These final study results are summarized as follows (Appendix L, Table A.4-A.8; Appendix M, Table A.9-A.11). Demographic charts for pilot, final, and known-group difference data are displayed in Appendix O.

A. Gender

The results of GLM analysis showed that gender differences were significant for Factor 1, but not for Factor 2. Male teachers had higher positiveness toward computers than female teachers, but exhibited no difference in their negativeness toward computers. Overall, male teachers had higher positiveness toward computers. The follow-up Tukey's HSD test analysis showed that there existed gender differences in computer attitude. Both genders had positive attitudes toward computers (male mean score=85.26, female mean score=81.05 and median score=70), with male teachers having higher positive attitudes toward computers.

B. Age

GLM analysis indicated that teachers' computer attitudes were significantly different between age groups. Tukey's HSD test analysis showed that computer attitudes were not significantly different for the 23-30 and 31-40 age groups, and no difference was found between the 41-50 and 51-65 age groups. The first two age groups were shown to be significantly different from the second two age groups in computer attitudes (Mean scores were 85.01, 84.13, 78.68, and 79.85, respectively). The results indicate that younger teachers had higher positive attitudes toward computers.

C. Computer Experience

GLM analysis and Tukey's HSD test analysis indicated that computer attitudes were significantly different for teachers with different lengths of computer experience.

D. Results of (Appendix L) other factors that related to computer experience are discussed below.

(1). Ownership

Teachers with computers at home scored higher on the Computer Attitude Scale than teachers with no computers at home. Mean scores were 83.11 (n=279) and 81.05 (n=233). These means were not significantly different. The differences in Computer Attitude Scale scores were found significant among male teachers and not among female teachers. Mean scores were 86.61 (n=84) vs. 83.11 (n=53) for male teachers and were 81.61 (n=195) vs. 80.44 (n=180) for female teachers.

(2). Use of computers in school

Teachers who experienced using the computer in school, and those who had not, showed no difference in their attitude toward computers(mean scores were 82.53 (n=394) and 80.97

(n=118)). The differences in Computer Attitude Scale scores were found significant among male teachers and not among female teachers. The mean scores were 86.10 (n=107) vs. 82.23 (n=30) for male teachers and were 81.20 (n=287) vs. 80.54 (n=88) for female teachers.

(3). Hours of in-service computer training

Teachers with none and with 20 hours or less computer training showed no differences in their Computer Attitude Scale scores. Teachers with 50 hours or less and 100 hours or less computer training were not significantly different in their Computer Attitude Scale scores. Teachers with 100 hours or less and teachers with over 100 hours of computer training showed no difference in their Computer Attitude Scale scores. Overall, teachers who had more hours of computer training scored higher than those who were not trained at that level. The results indicated that the computer training had a positive impact on teachers' attitudes toward computers.

E. Results that related to the current development of training programs and computer usage for ROC public middle school teachers

(1). General computer attitudes among teachers

Eighty-six (85) percent of teachers had scores on the Computer Attitude Scale above 70 (median score). It indicates the majority of middle school teachers had "average to above average" attitudes toward computers. Male teachers had higher computer attitudes compared to their female counterparts. Table 4.18 indicates that 26.26% of the male teachers had scores on the Computer Attitude Scale (CAS) above 90, but only 17.33% of the female teachers surveyed had scores on the CAS above 90.

Table 4.18 Percentage of the teachers on the CAS scores

Scores	< 70	70	71-79	80-90	91-112
ALL(%)	13.67	1.37	23.63	41.60	19.73
Male(%)	13.14	0.73	17.52	42.34	26.28
Female(%)	13.87	1.60	25.87	41.33	17.33

(2). The need for using the computer in teachers' work

Seventy six (76) percent of male and 69 percent of female teachers reported that they needed to use computers in their work. Teachers who reported that they need to use the computer in their work scored significantly higher (at the α=.05 level) on the Computer Attitude Scale than did teachers who did not need to use computers (83.48 (n=362) vs. 79.01 (n=150)).

(3). Willingness to use the computer

Teachers who reported higher willingness to use the computer scored significantly higher (at the α=.05 level) than those who did not. The mean score for the Very Strong group was 97.12 (n=59), for High, Average, Low, and No willingness to use groups were 86.23 (n=202),76.90 (n=217), 65.52 (n=29), and 67.40 (n=5), respectively.

(4). Sources of computer knowledge

Twenty (20) percent of the teachers surveyed reported no computer experience (Male 16% vs. Female 21%). Teachers who had computer experience scored significantly (at the α=.05 level) higher in Computer Attitude Scale scores than those who had no computer experience (Mean score were 83.69 (n=411) vs. 76.02 (n=101)).

Twenty six (26) percent of the teachers surveyed reported that they were self-taught in terms of their computer knowledge (Male 38% vs. Female 21%). The self-taught teachers had significantly (at the α=.05 level) higher scores on the Computer Attitude Scale than those who were not self-taught (mean score were 85.93 (n=132) vs. 80.87 (n=380)).

Forty three (43) percent of the teachers surveyed reported friends and colleagues as their resources for learning about the computer (Male 42.3% vs. Female 42.4%). Teachers who had friends and colleagues as their resources to learn about computers scored significantly (at the α=.05 level) higher on the Computer Attitude Scale than teachers who had none (mean score were 83.50 (n=217) vs. 81.21 (n=295)).

Twenty six (26) percent of the teachers surveyed reported that they had learned to use computers while they studied in universities (Male 28% vs. Female 26%). Teachers who learned computer use while they studied in universities scored significantly higher (at the α=.05 level) on the Computer Attitude Scale than teachers who had not (mean score were 85.96 (n=135) vs. 80.82 (n=377)).

Twenty three (23) percent of the teachers surveyed reported that they participated in government computer training programs (Male 29% vs. Female 20%). Teachers who had government computer training scored significantly higher (at the α=.05 level) on the Computer Attitude Scale than teachers who had not had the training (mean score were 86.78 (n=115) vs. 80,84 (n=397)).

Twelve (12) percent of the survey teachers reported that they had computer training sponsored by private computer company (Male 15% vs. Female 11%). Both groups of teachers had no differences in their Computer Attitude Scale scores (mean score were 83.71 (n=63) vs. 81.96 (n=449)).

Ten (10) percent of the survey teachers surveyed reported that they had attended a private computer classes (Male 9.5% vs. Female 9.9%). Neither group of teachers showed differences in their Computer Attitude Scale scores (mean score were 84.20 (n=50) vs. 81.95 (n=462)).

Eight (8) percent of the teachers surveyed reported that they had "Other training" (Male 7% vs. Female 8%). Teachers who got "Other-training" scored significantly higher (at the $\alpha=.05$ level) on the Computer Attitude Scale than those who did not (mean score were 86.50 (n=40) vs. 81.81 (n=472)).

Thirty four (34) percent of the teachers surveyed had suggestions of different sorts for improving the current use of computers in schools (Male 35% vs. Female 33%). Teachers who had suggestions for improving the current computer usage in schools scored significantly (at the $\alpha=.05$ level) higher than teachers who had not(mean score were 85.28 (n=173) vs. 80.59 (n=339)).

(5). Gender differences in future computer usage and computer training programs

(a). Computer training

The data in Table 4.19 indicate that more male teachers get longer hours of in-service computer training than females. About 47 percent of female teachers and 36 percent of male have not had in-service computer training. About 21 percent of male teachers and about 9 percent of female teachers had more than fifty (50) hours of computer training.

(b). Willingness to use the computer

About twenty-two (22) percent of the male teachers reported that they had a very strong willingness to use the computer. Only eight (8) percent of the female teachers reported high to very strong level of willingness. Many of the male teachers (66%) reported that they had high or very strong willingness to use the computer. Forty-five (45) percent of female teachers reported that they had this level of willingness to use the computer. There was only one (1) percent of the teachers who reported they don't have a willingness to use the computer. Surprisingly, these were all female teachers.

Table 4.19 Gender differences in computer usage and training

Variable	Level	ALL(%)	MALE(%)	FEMALE(%)
Training	1	44.14	35.77	47.20
	2	29.49	27.01	30.40
	3	14.46	16.06	13.60
	4	6.64	11.68	4.80
	5	5.47	9.49	4.00
Willingness	1	0.98	0.00	0.98
	2	5.66	3.65	6.40
	3	42.38	29.93	46.93
	4	39.45	44.53	37.60
	5	11.52	21.90	7.73

Note:Level of Willingness: 1- Not to Use, 2- Low, 3- Average, 4- High, and 5- Very Strong.

(6). Computer usage and computer experience

The data in Table 4.20 indicate that about nineteen (18.95) percent of the teachers surveyed had no computer experience, sixty-one (61) percent of the teachers surveyed had at least a little to two years computer experience, and only fourteen (14) percent of the teachers had two (2) to five (5) years of computer experience. Six (6) percent of the teachers had more than five (5) years of computer experience.

Table 4.20 Computer experience and computer usage

Exp. level	1(18.95)	2(61.33)	3(13.87)	4(5.86)
Use(%)	43.30	83.12	88.73	93.33
No use(%)	56.70	16.88	11.27	6.67

Note:Level of computer experience :1- No experience, 2- Little to 2 years, 3- More than two(2) to 5 years, and 4- More than 5 years.

The data also indicate that there were about seven (7) percent of teachers that got a lot of computer experience, but did not use the computer in schools. There were forty-three (43) percent of teachers that use the computer in school without having prior computer experience. Overall, teachers who got more computer experience had more usage of computers.

(7). Computer training and computer usage

The data in Table 4.21 indicate that most of the teachers surveyed (75%) had less than 20 hours of computer training, and the teachers who had the highest level of training were not the teachers who used computers the most.

The level 4 (50 to 100 hours of computer training) teachers experienced the highest computer usage in school, followed by teachers who had level 2 (20 to 50 hours of computer training) of computer training. This may indicate that high level computer usage in school has not yet happened.

Table 4.21 Computer training and computer usage

Trn.level	1(44.14)	2(29.49)	3(14.26)	4(6.64)	5(5.47)
Use(%)	65.04	86.09	83.56	94.12	85.71
No use(%)	34.96	13.91	16.44	5.88	14.29

Note:1.Level of training: 1- No training, 2- Little to 20 hours, 3- Twenty-one(21) to 50 hours, 4- Fifty-one(51) to 100 hours, and 5- More than 100 hours.

2.Number in parentheses indicates the percentage of teachers trained at that level.

(7). Age difference in computer training

The data in Table 4.22 indicate that about sixty-six (66.34) percent of the youngest teacher groups (ages 21-30) had no in-service computer training.

Table 4.22 Computer training by age groups

Age\Trn year\hr	1 None	2 1-20	3 21-50	4 51-100	5 >100
1(21-30)	67 66.34	17 16.83	10 9.90	4 3.96	3 2.97
2(31-40)	71 35.15	60 29.70	37 18.32	20 9.90	14 6.93
3(41-50)	68 40.48	59 35.12	23 13.69	9 5.36	9 5.36
4(51-65)	20 48.78	15 36.59	3 7.32	1 2.44	2 4.88

Note:Number indicates frequency and percentage

Among age groups 2, 3, and 4 there were 35, 40, and 49 percent of the teachers who had no in-service computer training. Only fifteen (15) percent of the oldest teacher group (ages 51-65) had more than twenty (20) hours of in-service computer training. Among age groups 1, 2, and 3 there were 17, 35, and 25 percent of the teachers who had this level of computer training.

(8). Computer attitudes and computer usage among schools

The results of GLM and Tukey HSD paired mean analyses (Appendix M, Table A.9-A.11) indicated no school differences in teachers' attitudes toward computers. The analysis showed significant gender differences in Computer Attitude Scale scores in schools 4, 5, and 6 and not in schools 1, 2 and 3. Schools 1, 2 and 3 in the survey sample were located near the center of the city and schools 4, 5 and 6 were more suburban.

Table 4.23 Computer usage in schools

School	1	2	3	4	5	6
Use(%)	78.38	78.08	70.37	77.61	72.13	89.29
No use(%)	21.62	21.92	29.63	22.39	27.87	10.71

The six (6) sample schools, except for one, had the same level of computer usage (Table 4.23). This indicates that most teachers experienced the same level of computer usage at the current stage of development.

(9). Computer attitudes and teaching subjects (Appendix L, Table A.7 & A.8)

No differences were found between teachers teaching Chinese and teachers teaching English(mean scores were 79.83 (n=120) and 78.61 (n=62). No differences were found between math, physics and biology teachers(mean scores were 85 (n=72), 85.60 (n=45) and 83.76 (n=17), respectively). No differences were found between history teachers and geography teachers (mean score were 80.72 and 79.33). It should be noted that physical education, music and art teachers all had very positive attitude toward computers (mean score were 84.08 (n=24), 85.12 (n=8), and 80.36 (n=11) respectively). The earth science and Boy Scouts teachers were the groups with the highest scores on the Computer Attitude Scale (mean score were 95.5 (n=6) and 89.70 (n=10)).

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

The chapter is presented in four sections which include a summary of intent, findings and implications for the research, problems and suggestions for future ROC information development programs, and summary of conclusions, as well as recommendations for conducting future research.

I. Summary of Intent, Findings and Implications

1. The Computer Attitudes Instrument

Computer usage in schools has long been one of the priorities of focus for many advanced countries and ROC has not been the exception. In the past, computer training was first made available to students in universities, then to vocational school students, and later to high school students. This top-down computer development may be necessary for the first stage of computer development that trained enough people to use computers in business, and trained enough teachers for teaching computer usage in schools. For the long term, the bottom-up computer literacy development programs that foster the concept of this modern technology from age young are the ultimate goal. The middle school teachers at the current stage of computer information development in ROC play a vital role in this process. Teachers' attitudes toward computers not only influence their willingness to learn about computers, but also have an important impact on students' motivation to learn about and use computers. The intention of the current research was twofold: first, to develop a valid and reliable instrument that measured ROC middle school teachers' attitudes toward computers; second, to show if there existed gender, age, and computer experience differences in computer attitudes among ROC middle school teachers. The investigation of other factors that related to computer experience and computer usage that might influence teachers' computer attitudes are presented as a by-product of the research.

The final instrument was developed through the following steps:

A. The initial item pool that included sixty-five (65) positive and negative statements about the computer was established from a review of related literature, interviews with middle school teachers, and a survey of 166 middle school teachers' beliefs and feelings about the computer. The two rounds of Delphi utilized seven (7) specialists for evaluating the content that led toward a better operational definition for computer attitudes. Forty-two (42) items were retained after the two Delphi rounds.

B. The pilot field test used 209 middle school teachers to further refine the computer attitudes instrument for ROC middle school teachers. The calculations of mean and standard deviation, discriminant data analysis, item-total correlations, inter-item correlations, and factor analysis were used to analyze the pilot data.

C. The final instrument included twenty-eight (28) items that covered teachers' positiveness and negativeness toward computers and was administered to 512 ROC public middle school teachers in the Taipei city school district. The data analyses included the calculations of mean, standard deviation, inter-item correlations, item-total correlations, discriminant data analysis, and known-group difference testing. The Hoyt-Stunkard coefficient of reliability calculation was +.943 and demonstrated that the developed instrument had a very high internal consistency reliability (Bruyer, 1987; Harris, 1968, Appendix N). A factor analysis showed that two factors accounted for forty-seven (47) percent of the total variance. The first factor was labeled "teachers' positiveness toward computers" and the second factor was labeled "teachers' negativeness toward computers." The components for both of the two factors included (1) A cognitive component which is a belief held about computers; (2) An affective component, which indicates a person's inward feelings toward the computer; and (3) A behavior component which reflected an individual's action toward the computer.

The two-factor result was found in one of the very original studies of computer attitudes by Robert Lee (1970). Factor I in Lee's study was "favorable" in character and Factor II was "unfavorable" in character. The three components of attitude construct has been stated by Smith (1946), Triandis (1971) and others. The inter-factor correlation was +.75 and two factors were correlated +.936 and +.924 respectively with the total scale scores. Thus, the instrument was shown to be reliable and valid for measuring the computer attitudes for ROC middle school teachers. Reece and Gable (1982) and many other psychologists describe how teachers value the computer, feel about the computers and what they intend to do about the computer. These have been shown to be adequate to measure teachers' attitudes toward computers.

2. The Investigation of Computer Attitudes in ROC Middle School Teachers

A. Gender

Gender differences in computer attitudes were found to be significant in Factor 1-teachers' positiveness toward the computer, but not in Factor 2- teachers' negativeness toward the computer. Overall, male and female teachers both showed positive attitudes toward computers, but female teachers were more "passive" in terms of willingness to use or to learn more about computers. The male teachers had more computer experience and were given more opportunity to have computer training than were the female teachers. This may contribute to these differences.

B. Age

Age differences in computer attitudes were found to be significant. The younger age groups had higher positive attitudes toward computers than did the older age groups. The older age groups (age 40 or above) lacked training during their college preparation and received less computer training later, which may contribute to these differences. One interesting finding was that the oldest group (age 50 to age 65) had higher positive attitudes than did the second oldest group (age 40 to age 50). These results were found in four (4) out of the six (6) sample schools. One possible explanation was that there were only very few teachers in the oldest group (consisting of only 8% (n=41) of the total sample compared to the second oldest group (33%, n=168)). Another possible reason, as stated in Baack and Brown's study (1991) was that "the older adults were less eager to involve themselves with computers in a hands-on, interactional [interactive] way. They did acknowledge the value of computers and technology in general, and did not express great anxiety over computer use." The oldest age group may show their positiveness as a way of indicating that they can accept new technology, as do younger people, or simply because they are older and have had more time to enjoy things that surround them, including computers.

C. Computer experience

There were significant differences between teachers with different lengths of computer experiences in their attitudes toward computers. Teachers with longer computer experience showed higher positive attitudes toward computers when compared with teachers with shorter computer experience. This finding was consistent for both male and female teacher groups. Teachers in two schools (schools 1 and 4, Table A.11, Appendix M) showed that the highest attitudes toward computers were not from teachers with the longest period of computer experience (more than 5 years), but from the second longest group (two to 5 years). This may indicate that the current low level of computer usage in schools may frustrate teachers who have had very long periods of computer experience.

3. Findings in Other Factors that Related to Computer Utilization

A. Ownership of home computers

Sixty-one (61) percent of male teachers and 52 percent of female teachers in the survey sample reported that they had computers at home. Teachers with computers at home showed higher positive attitudes toward computers, but significant differences were only found among the male teachers and not among the female teachers. One explanation for this may be that the computers at home, especially for the female teacher groups, may be used primarily by other family members, or they may be the ones who buy the computer and not the ones who use the computer.

B. Computer usage in school

Seventy-eight (78) percent of male teachers and seventy-seven (77) percent of female teachers experienced using computers in school. Teachers who were experienced in using computers in school showed higher attitude scores than did teachers who had no experience using computers in school. However, significant differences were only found among the male teachers and not among the female teachers. Except for teachers teaching computers, most of the teachers used computers in schools mainly for student grade calculations. Overall, the male teachers had a higher level of computer usage, and in broader areas. This may help explain why the difference in attitude between male teachers who had high computer use and those who had none was significant, while for their female counterparts it was not.

C. Computer training

The survey data showed that about half of the female and one-third of the male teachers had no in-service computer training and more male teachers than female teachers had higher levels of computer training. Teachers who had more hours of computer training showed higher positive attitudes toward computers than teachers who had not. Computer training included training programs sponsored by the government, universities, private computer companies, and in-school training as the main sources for teachers' computer experience. The data showed that teachers in the 31 to 40 age group got more in-service training than any other age group, and the youngest group (ages 21 to 30) was included among the teachers who got the least in-service computer training. This may indicate that the youngest teachers had just finished receiving their computer training from college and were considered to have a sufficient skill level for the current level of computer usage in schools.

4. Some Theoretical Indications

A. Math teachers showed higher computer attitude scores.

Many research studies indicated that the importance of math experience may affect people in their attitudes toward computers. The current research data show that math, and natural science teachers had higher positive attitude toward computers than teachers teaching languages (Chinese and English), but they were not the teachers with the highest positive attitudes toward computers. Math experience did show a positive influence on teachers' attitude toward computers, but it was not the only factor involved.

B. People with higher positive attitude toward computers like to learn more about, to use, or to buy more computers.

The survey results showed the following:

(a) Sixty-six (66) percent of the teachers who indicated that they "Strongly Agree" with the item "I would really like to buy a computer for my own use" reported "Very Strong" willingness to use the computer compared to twelve (12) percent of the teachers who indicated "Low" willingness to use the computer.

(b) Forty-four (44) percent of the teachers who indicated "Strongly Agree" in the item "I plan to use computers as much as possible to solve problems" reported "Very Strong" willingness to use the computer compared to ten (10) percent of the teachers who indicated "Low" willingness to use the computer.

(c) Sixty-one (61) percent of teachers who marked "Strongly Agree" to the item "I like computers", reported a "Very Strong" willingness to use the computer compared to less than two (1.7) percent of the teachers indicating "Low" willingness to use the computer.

(d) Forty-six (46) percent of the teachers who indicated "Strongly Agree" to the item "Using a computer saves me a lot of time " reported "Very Strong" willingness to use the computer compared to twelve (12) percent of the teachers who indicated "Low" willingness to use the computer.

(e) Seventy-eight (78) percent of the teachers who indicated "Strongly Agree" to the item "If I had more time, I would like to work more with computers" reported "Very Strong" willingness to use the computer compared to less than four (3.4) percent of the teachers who indicated "Low" willingness to use the computer.

(f) Sixty-one (61) percent of the teachers who indicated "Strongly Agree" to the item "I think computers can be used in many ways", reported "Very Strong" willingness to use the computer compared to 3.4% of the teachers who marked "Low" willingness to use the computer.

Similar results were found in "ownership of computers" for all except one of the items stated above. For example, Seventy-one (71) percent of the teachers who indicated "Strongly Agree" to the item "I would really like to buy a computer for my own use" had home computers compared to forty-four (44) percent of the teachers who indicated that they were "Disagree" to the item. Sixty-two (62) percent of the teachers reported "Strongly Agree" to the item "I plan to use computers as much as possible to solve problems" had home computers compared to none who indicated "Strongly Disagree" to the item. One interesting finding was that while sixty-six (66) percent of the teachers who indicated that they "Strongly Agree" to the item "I like computers" had home computers, the eighty-three (83) percent of the teachers who indicated "Strongly Disagree" to the item also had home computers.

Another interesting finding was that teachers who gave suggestions for future computer usage in school had significantly higher attitudes toward computers than did teachers who did not.

The results showed that teachers with higher positive attitudes toward computers had more positive "actions" or "behavioral tendencies" toward computers. It should be noted that ownership of computers is a past experience but willingness to use computers can be predictive of future behavior. The item "I like computers" failed to indicate a lesser degree of ownership of computers for the "Strongly Disagree" group than for the "Strongly Agree" group. The results indicated that teachers who liked computers may not own a computer. Home computers may be used by other family members and the very small portion of teachers (n=5) in this category may be a plausible reason for this result. The item was the only "affective item" (others were cognitive or conative items) tested above. Overall, the developed instrument was promising in terms of this prediction.

5. Other Findings that Related to Future Computer Usage in ROC Middle Schools

A. The majority of male and female teachers will have "average to above average" levels of willingness to use the computer.

The survey data showed that about half (47%) of the female teachers reported the "Average" level of willingness to use computers and about half (46%) of the male teachers reported a "High" level of willingness to use computers. Overall, the majority of male and female teachers showed "average to above average" willingness to use the computer and more male teachers showed a "Very Strong" willingness to use the computer than did female teachers (22% vs. 7.7%). This is a good indication that both female and male teachers have a high level of willingness to use computers in the future. Male teachers will probably dominate the highest level of future computer usage in schools.

B. Male teachers had higher levels of computer training and teachers with more sources of computer knowledge had higher computer attitude scores.

Forty-seven (47) percent of the female teachers and thirty-six (36) percent of the male teachers reported that they had no in-service computer training. Twenty-one (21) percent of the male and nine (9) percent of the female teachers reported that they had more than fifty (50) hours of in-service computer training. The results indicated that male teachers got more and higher levels of computer training than did female teachers.

The results indicated that teachers who got their computer knowledge or training from any source had higher attitude scores towards computers than teachers who had not. The indication is that any source of computer knowledge or training helps to form positive attitudes toward computers and teachers with more sources of computer training show higher attitudes toward computers.

C. Significant differences in computer attitudes were found between male teachers who had home computers and those who had not. Male teachers who experienced using computers in school had significantly higher attitudes toward computers than did male teachers who had not. These two cases were not found among female teachers.

D. Gender differences in computer attitudes were found among the suburban school teachers and not among the urban school teachers.

In urban schools, seventy-four (74) percent of the male teachers and eighty-four (84) percent of female teachers had less than two (2) years of computer experience compared to 61% vs. 85% for the suburban school teachers. The results showed that differences in computer experience between male and female teachers were larger (24% vs. 10%) in suburban schools than for urban schools. In urban schools, sixty-three

(63) percent of male teachers and fifty (50) percent of female teachers had a high or very strong willingness to use the computer compared to 73% vs. 36% for the suburban school teachers. The differences in willingness between male and female teachers in suburban schools were larger (37% vs. 13%) than for urban.school teachers.

The average ages for urban and suburban school teachers were 37.59 (n=328) and 40.72 (n=184). The mean ages for urban male and female teachers were 41.58 (male, n=86) and 36.18 (female, n=242) and were 40.90 (male, n=51) and 40.50 (n=133) for suburban school teachers. In urban schools seventy-nine (79) percent of male vs. sixty (60) percent of female teachers had less than 20 hours of computer training compared to 74% vs. 66% for suburban school teachers.

Given the fact that the gender differences in age and training were larger in the urban schools and gender differences in computer experience and willingness to use the computer were larger in the suburban schools indicates that bigger differences in computer experience in the suburban schools may cause this gender difference in computer attitudes only found in the suburban school teachers. Even though the gender difference was not significant in urban middle school teachers, the much bigger age difference between the male and female urban teachers may be balancing out the scores on the Computer Attitude Scale. The bigger gender difference in willingness to use the computer among suburban school teachers may indicate that future computer attitudes and computer usage would have bigger gender differences among suburban schools than for urban schools. These results may be applied to middle schools that are located in the countryside.

II. Problems and Suggestions for Future ROC Computer Information Development Programs

The teachers surveyed indicated that there were obstacles which hindered the willingness of teachers to learn about or to use the computer in schools at the current computer development stage. Suggestions for improving teachers' computer attitudes and computer usage in schools are provided.

1. Obstacles to Current Computer Usage in Schools

The most stated problems for current computer usage in schools are summarized as follows:

A. Lack of computer equipment and budget- not enough hardware to use and insufficient budget allotments to buy and maintain the computer facilities.

B. Management problems- no specific person or unit responsible for managing the computer room.

C. Lack of good computer courseware- not enough appropriate CAI software and some good courseware would not run on out-of-date computers.

D. Lack of computer teachers and curriculum- in middle schools there has been no formal computer curriculum and no formal "computer teachers" However, it should be noted that according to the meeting held by the ROC Ministry of Education on June 29, 1993, a formal computer curriculum for middle school students will be implemented by 1995.

E. Too heavy teaching loads which prevent many teachers from learning computers.

F. Many teachers perceive computers as not being necessary to their instruction.

G. Principal and administration were not given enough support for computer use and teachers' training.

H. Lack of computer text books that were appropriate to middle school teachers and students.

2. Suggestions for Future Computer Training and Usage

A. Creating more inside-school training programs- Because of scheduling problem with the current centralized training programs many teachers are prevented from participating.

B. Developing more software that suits the teachers' needs.

C. All teachers should have an equal opportunity to attend computer training.

D. Keeping computer facilities up-to-date.

E. Promoting and encouraging more computer usage in school.

F. Formalizing the computer curriculum and computer instruction for teachers.

G. Government providing more short-term computer training for novice teachers as well as experienced teachers.

H. Teachers need to have their own computers and not have to share computers with students.

I. Broaden the area of computer usage in school.

J. Provide stronger leadership and support from the top administration in schools.

The study indicates that the female teachers compared to their male counterparts 1) had less computer experience, 2) received less computer training, 3) had lower willingness to use computers, and 4) had less positive attitudes toward computers. Female teachers currently outnumber male teachers in ROC middle schools two (2) to one (1). Helping female teachers to form more positive computer attitudes is of paramount importance. The training program needs to make sure that female teachers are not left out. Balancing the difference between urban and suburban schools, as well as the difference between schools in cities and in the countryside, is important to a future computer development program.

III. Summary of Conclusions

Based on the analysis of the data obtained from the computer attitudes questionnaire from ROC middle school teachers, the following conclusions may be stated:

A. The ROC middle school teachers' computer attitudes may be objectively measured by the inventory developed for the current research.

B. The use of interviews, survey of opinions, Delphi panel, and data analyses, including correlation analysis, known-group difference testing and factor analysis, and the pilot field test, shows that a valid and reliable instrument for measuring teachers' computer attitudes can be developed.

C. Middle school teachers with different age and computer experiences were found to be significantly different in their attitudes toward computers. Gender differences were found in the positiveness toward computers factor, but not in the negativeness factor toward computers. No differences were found in computer attitudes between female teachers who had home computers and those who had not. No differences were found in computer attitudes between female teachers who experienced using computers in schools and those who had not. Differences were found among male teachers for both of these cases. Overall, female teachers were more "passive" toward computers.

D. The majority of male and female teachers had "average to above average" attitudes and willingness to use computers and more male teachers had higher levels of computer training than did females.

E. Middle school teachers with more computer training, more usage of computers, and more sources of computer knowledge had higher positive attitudes toward computers.

F. The bigger difference in computer experience between male and female suburban school teachers may cause the gender difference in computer attitudes between suburban male and female teachers to be significant, and the bigger age difference between male and female urban school teachers may "balance out" the "gender effect" that makes the gender difference in computer attitudes between male and female urban school teachers to be insignificant.

G. Math and science teachers had higher attitudes toward computers than did language teachers, but were not the highest in computer attitudes among teachers in terms of teaching subjects. Art, music, physical education teachers had very high attitudes toward computers. Earth science and Boy Scout teachers were among those with the highest attitudes toward computers.

IV. Recommendations for Future Study

Based on the current findings, the following recommendations may be helpful for doing similar research in the future.

1. Survey Techniques:

   A. Interviews with teachers are an adequate technique for generating affective items for the initial item pool. Collecting people's beliefs or feelings about the attitudinal objects for the initial item pool may be done through the survey questionnaire. The affective items were found to be better addressed through face-to-face interaction with the target subjects.

   B. Personal contact with the Delphi panelists is important. The traditional Delphi technique did not encourage face-to-face contact between panel members. The researcher is a very important liaison in this process. Personal (researcher) contact with panel members provides not only the opportunity for the researcher to discuss more details about the intended research with panel members, but it also shortens the time for this process. Personal contact also provides a very important effect of encouraging people to show their concerns that makes panelists feel more respected and more willing to put time in on the evaluation of the research.

2. Future Studies

A. This research study should be replicated in areas other than in the Taipei City School District.

B. The research procedure should be conducted on groups of people other than teachers.

C. The research should be conducted with pre-service teachers.

D. A computer attitude instrument should be developed for use with elementary school teachers and private middle school teachers (although private middle schools only constitute about nine (9) percent of the total of the ROC middle school teacher population).

E. The instrument should be used as a tool for evaluating the attitude of teachers who participate in computer training programs.

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APPENDICES

Appendix A

Survey for the Initial Item Pool

I. Cover letter

In recent years in order to develop computer science education our government has made many efforts to improve the computer equipment and teacher training in all levels of schools. Middle school teachers play a vital role in this process. In order to understand middle school teachers' attitudes toward computers, a series of research about computer usage have been carried out by the researcher with the help of government units.

The purpose of this study is to express your attitude toward computers-it includes your beliefs(your evaluation computers, e.g. what is the value that computers can bring to you, education and society), and feelings(your feelings about computers, e.g. if you like, dislike or are afraid of computers) about computers.

Please write down your positive and negative opinions about computers no matter if you have or do not have previous experience with computers.

I appreciate your help. May you have a nice term.

Researcher   Horng-Hwang Liou

March 23, 1993

II. The questionnaire

A. Demographic data

1.Your teaching subject is:____________________

2.Your gender is: Male_____ Female_____

3.Your age is:____________

4.How many years have you studied and used computers:______ years ______ months.

B. Please write down your beliefs and feelings about computers.

1.State in very simple and clear sentences.

2.The number of statements has no limit.

(1).Positive beliefs and feelings

(2).Negative beliefs and feelings

(3).Do you need computers in your work? How is your willingness towards learning and using computers?

-END-

Appendix B

Cover Letter and Proposed Computer Attitude Inventory for the First Delphi Round

1. Cover Letter

April 25, 1993

Dear Dr. ...:

I have heard a lot about you. It is my honor to have you on my research panel.

The DELPHI technique was developed by the Rand Corporation in 1950 (Linestone & Turoff, 1975). It is a non-face-to-face decision-making process that lets a consensus be reached through the repeated involvement of specialists. The benefits of this process is as Stahl and Stahl (1991) stated: "The decision is made by all of the participants and not by the majority." The current research is try to use the Delphi technique in the design of the questionnaire. The process will use your input first to filter the best items and then the researcher will depend upon the opinions from the Delphi panelists to complete the final version of the questionnaire.

The following are the proposed items that will be included in the inventory to assess computer attitudes for ROC middle school teachers in my study. I would like your selection of items, based on (1) the definition of computer attitude defined by the current research (Attachment no.1). (2) the guidelines suggested by Likert, Edwards and Oppenheim (Attachment no.2) and (3) your experiences. Depend on the item appropriateness in your judgment each item will be 1) retained 2) rejected, and 3) retained by modifying. Please comment on the items that you rejected or add items if needed.

I appreciate your time and expertise. Thank you very much.

Sincerely yours,

Researcher Horng-Hwang Liou

P.S. I would deeply appreciated it if you can return your comment by (date specified).

2. Proposed Computer Attitude Inventory

Note:* indicates positive statements

1. Computers are too complicated for me.

1) Retain 2) Reject 3) Retain by Modifying
Comment:..

....

*2. I would like to learn more about computers.

1) Retain 2) Reject 3) Retain by Modifying
Comment:..

....

3. Computers make me feel stupid.

1) Retain 2) Reject 3) Retain by Modifying
Comment:..

....

*4. I enjoy using computers.

1) Retain 2) Reject 3) Retain by Modifying
Comment:..

....

- Continue -

5. I feel frustrated when I use computers.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

6. Because I am not familiar with computers I try as much as possible to avoid using them.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

7. When I use computers I worry about breaking them.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

8. I worry about students using computers to play games and not to learn.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*9. Being able to use a computer is a kind of achievement.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

10. I don't think computers are useful in my subject area of teaching.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

- Continue -

*11. I would like to learn about computers but up to now I haven't had the opportunity.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

12. Thinking about learning about computers makes me nervous.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

13. Learning about computers is for computer teachers.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

14. My slow typing speed affects my willingness to learn about computers.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*15. I feel I have a good sense of logic, so I shouldn't have trouble learning about computers.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*16. A computer is an indispensable tools for teachers.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

- Continue -

17. Computers can't be used in stuff that I teach, so I don't want to learn about it.

    1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

18. I am really tied up with preparing my teaching work, so why should I learn about computers.

    1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*19. Thinking about learning about computers is exciting to me.

    1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*20. Learning about computers is not difficult for me.

    1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*21. Computers are fascinating to me.

    1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

22. I don't understand how some people can spend so much time working with computers and seem not to get tired.

    1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

- Continue -

*23. Once I started to work with computers it would hard for me to stop.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

24. I don't like talking about computers with other people.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*25. I will use computers in many ways in my life.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

26. Learning about computers is very time consuming.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*27. Computers could improve students learning efficiency.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

28. To learn about computers is to make trouble for yourself.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

- Continue -

29. I can do what a computer can do just as well by using other methods.

1) Retain 2) Reject 3) Retain by Modifying

Comment:...

....

*30. Using computers saves me a lot of time.

1) Retain 2) Reject 3) Retain by Modifying

Comment:...

....

*31. Computers could improve a student's motivation.

1) Retain 2) Reject 3) Retain by Modifying

Comment:...

....

32. Not having learned about computers makes people feel out-of-date.

1) Retain 2) Reject 3) Retain by Modifying

Comment:...

....

*33. Age has nothing to do with learning about computers.

1) Retain 2) Reject 3) Retain by Modifying

Comment:...

....

34. It is hard for me to learn about computers because I am not good at English(note:for non-English speaking people).

1) Retain 2) Reject 3) Retain by Modifying

Comment:...

....

- Continue -

*35. If I had the money I would buy a computer.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

36. Using computers for instruction will take away the important human touch in education.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

37. Computer instruction will take away the teacher's role in showing the path and teaching problem solving.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

38. Computers can't solve complicated human problems.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

39. Computers will bring unexpected harm to users.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

40. Over use of computers will cause degeneration of the human brain and laziness.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

- Continue -

41. I will not use computers because to learn how to use them is too time-consuming.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*42. Leaning about computers per se is enjoyable.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*43. Using computers in instruction would be an interesting way of teaching.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

44. I worry about students having more knowledge about computers than the teacher does.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

45. I feel uncomfortable when others are talking about computers.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*46. Using computers would be enjoyable.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

- Continue -

47. I am afraid of computers.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

48. I feel computer development has gone too far.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

49. Computers are indifferent.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*50. The potential of computers is unlimited.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

51. I worry that computers will take away jobs from people.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

52. I don't want to have anything to do with computers.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

- Continue -

*53. Using computers in instruction will improve the quality of teaching.

1) Retain   2) Reject   3) Retain by Modifying

Comment:..

....

54. Computer technology is improving too fast and I feel I can never catch up.

1) Retain   2) Reject   3) Retain by Modifying

Comment:..

....

55. After learning about computers, if I don't keep using them, I will end up as if I never learned about them.

1) Retain   2) Reject   3) Retain by Modifying

Comment:..

....

*56. If computers can help me to reach my instruction goals I'd like to learn about them.

1) Retain   2) Reject   3) Retain by Modifying

Comment:..

....

*57. It is enjoyable for being a student again to learn about computers.

1) Retain   2) Reject   3) Retain by Modifying

Comment:..

....

58. Because I don't use computers very often, I don't feel the urgency of learning them.

1) Retain   2) Reject   3) Retain by Modifying

Comment:..

....

- Continue -

*59. I am interested in computers and also like to learn about them.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*60. If I had time I would learn about computers.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*61. There is no gender difference in learning about computers.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

62. I know there are lots of good things about computers, but I don't want to take time to learn about them.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

*63. Computers could stimulate my creativity.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

64. I have ambivalent feeling toward computers.

1) Retain 2) Reject 3) Retain by Modifying

Comment:..

....

- Continue -

65. If there were a computer available, I would try to use it to solve my problems.

1) Retain 2) Reject 3) Retain by Modifying

Comment:...

....

Note:The questionnaire in the current research include (1)cognitive items, (2)affective items, and(3)conative items that are related to computer attitudes.

Attachment No.1:

The current research refer to the definition used by Thurstone (1921, 1931, 1946). Mueller (1986) adopts Thurstone's definition and notes that "It can be restated in any of the following ways." He stated that "attitude is (1) affect for or against, (2) like or dislike, or (4) positiveness or negativeness towards a psychological object."

The current research adopts the following definition for computer attitudes: "Computer attitudes is defined as an individual's positiveness or negativeness towards computers."

Attachment No.2:

The current research uses guidelines suggested by Likert (1932), Edwards (1957), and Oppenheim (1966) to develop computer attitude statements.

Rensis Likert (Likert, 1932, pp.44-53) suggested that some criteria one should keep in mind when constructing an attitude scale are:

(1). It is essential that all statements be expressions of desired behavior and not statements of fact.
(2). The second criterion is the necessity of stating each proposition in clear, concise, straight-

forward statements and each statement must avoid every kind of ambiguity.

(3). In general it would seem desirable to have statement so worded that the modal reaction to it is approximately in the middle of the possible responses.

(4). To avoid any space error or any tendency to a stereotyped response it seems desirable to have a different statements so worded that about one-half of them have one end of the attitude continuum corresponding to the left or upper part of the reaction alternatives and the other half have the same end of the attitude continuum corresponding to the right or lower part of the reaction alternatives.

(5). If multiple choice statements are used, the different alternatives should involve only a single attitude variable and not several.

Edwards (1957, pp.13-14) suggested the criteria that should be followed when design an attitudinal scale:

(1). Avoid statements that refer to the past rather than to the present.

(2). Avoid statements that are factual or capable of being interpreted as factual.

(3). Avoid statements that may be interpreted in more than one way.

(4). Avoid statements that are irrelevant to the psychological object under consideration.

(5). Avoid statements that are likely to be endorsed by almost everyone or by almost no one.

(6). Select statements that are believed to cover the entire range of the affective scale of interest.

(7). Keep the language of the statements simple, clear and direct.

(8). Statements should be short, rarely exceeding 20 words.

(9). Each statement should contain only one complete thought.

(10). Statements containing universals such as *all*, *always*, *none* and *never* often introduce ambiguity and should be avoided.

(11). Words such as *only*, *just*, *merely*, and others of similar nature should be used with care and moderation in writing statements.

(12). Whenever possible, statements should be in the form of simple sentences rather than in the form of compound or complex sentences.

(13). Avoid the use of words that may not be understood by those who are to be given the completed scale.

(14). Avoid the use of double negatives.

Oppenheim (1966, pp.105-117) suggested that:

(1). The best guide to the writing of attitude statement is to say that they should be meaningful and interesting, even exciting, to the respondents.

(2). Attitude is emotional, we must not be afraid to use phrases relating to feelings and emotions.

(3). Statements should avoid double negatives and should be short and uncomplicated.

(4). Attitude statements are better when they have a certain freshness forcing the respondent to think and take a stand.

(5). We will want items covering the attitude from one extreme to the other, but we won't want too many extremes; and we need roughly equal proportions of positive and negative items.

Appendix C

List of Delphi Panel Members

Note: Name, work place, education and expertise for seven Delphi panel members.

Dr. Kwang-Kuo Hwang
Department of Psychology
National Taiwan University
University of Hawaii, Ph.D., 1976.
Social psychology.

Dr. Ching-Ming Lu
Department of Psychological Counseling
National Taiwan Normal University
University of North Colorado, Ph.D., 1973.
Psychology measurement, Testing.

Dr. Herng Yau
Department of Physics
National Taiwan Normal University
University of California, Ph.D., 1985.
Computer science, physics.

Dr. Lumn-Syin Lwo
Department of Information Management
Ming-Chwung College of Management (Taipei)
Oregon State University, Ph.D., 1992.
Computer science, Information management.

Professor Hae-Li Shiang
Institute for Information Industry (III)
Education & Training Division
Software Manpower Development Center
Kent State University, M.S., 1977.
System analysis, Data base, Program languages.

Mr. Wei-Hong Chen
Taipei First Girls Senior High School;Hung-Dau Middle School (Training Center for Computer Education Program)
National Taiwan Normal University, B.S. 1984.
Physics, Computer science, School computerization, Software design.

Miss. Li-Jan Kao
Fu-Hsing Middle School (Taipei)
Ferng-Jya University, Taiwan, B.S. 1981. III 1982.
MIS, Computer graphic, Computer music, Software design, Chinese word processing.

Appendix D

Cover Letter and Items for Second Delphi Round

1. Cover letter

Dear professor...: May 12, 1993

With your expertise in the field, the first round evaluation of "Computer Attitudes For ROC Public Middle School Teachers" questionnaire has been successfully accomplished. I deeply appreciate your time and input.

The initial item pool has been revised according to your suggestion. For a better questionnaire, based on the importance in understanding middle school teachers' attitudes toward computers that each item can provide, I would like your selection on (1)very important, (2)important, (3)of little importance, (4)not important for every item.

Thanks for your help.

Researcher Horng-Hwang Liou

Note:1.Very Important:indicate that the statement is clear to testers and its perceived ability to differentiate positiveness and negativeness toward computers among middle school teachers.

2.Not Important:indicate that the statement is ambiguous to testers and it lacks ability to differentiate positiveness and negativeness toward computers among middle school teachers.

3.Important and of Little Importance:the level of importance locates between Very Important and Not Important.

Please put yourself in the place of a middle school teacher (with or without computer experience) to evaluate the appropriateness for each item

The score for each option is as follows:

4 - Very Important (VI)
3 - Important (I)
2 - of Very Little Importance (LI)
1 - Not Important (NI)

2. Computer Attitude Inventory

Note: Number in parenthesis indicates the item number in the initial item pool

ITEMS AFTER REVISION (NEGATIVE STATEMENTS)	VI	I	LI	NI
1. Computers are too complicated for me(1).	4	3	2	1
2. Computers make me feel stupid(3).	4	3	2	1
3. Using computers is frustrating to me(5).	4	3	2	1
4. Because I don't know enough about computers, I avoid using them(6).	4	3	2	1
5. When I use a computer, I am usually afraid of damaging it(7).	4	3	2	1
6. I worry about students using computers to play games and not to learn(8).	4	3	2	1
7. I don't think computers are useful in teaching(10).	4	3	2	1
8. Thinking about learning to use computers makes me feel scared (12)	4	3	2	1
9. Computers can't be used in my subject area, so I don't need to learn about them(17).	4	3	2	1
10. I am already so busy with my teaching, I shouldn't have to learn about computers(18).	4	3	2	1
11. I don't understand how some people can spend so much time working with computers and seem not to get tired(22).	4	3	2	1
12. I don't like to talk about computers(24).	4	3	2	1
13. I think learning about computers takes up too much time(26).	4	3	2	1
14. What computers can do I could do just as well by using other methods(29).	4	3	2	1
15. Using computers for instruction will take away the human touch in education(36).	4	3	2	1

	V	I	L	N
	I	I	I	I
16. Computer instruction will take away the teacher's important role in showing the path and teaching problem solving(37).	4	3	2	1
17. Computers can't solve complicated human problems(38).	4	3	2	1
18. Computers may pose environmental dangers to people that are not yet known(39).	4	3	2	1
19. Over use of computers will cause degeneration of the human brain and laziness(40).	4	3	2	1
20. I feel uncomfortable when other people talk about computers(45).	4	3	2	1
21. I am afraid of computers(47).	4	3	2	1
22. I feel computers are indifferent(49).	4	3	2	1
23. I worry that computers will taking away jobs from people(51).	4	3	2	1
24. I don't want to have anything to with computers(52).	4	3	2	1
25. Computer technology is improving too fast and that makes me feel I can never catch up(54).	4	3	2	1
26. After learning about computers, if I don't keep using them, and I will end up as if I never learned about computers(55).	4	3	2	1
27. I know there are lots of good thing about computers, but I don't want to take time to learn about them(62).	4	3	2	1
28. I like computers but I am afraid of accepting them(64).	4	3	2	1
29. Computer would increase my work pressure(added).	4	3	2	1

ITEMS AFTER REVISION (POSITIVE STATEMENTS)

	V		L	N
	I	I	I	I
1. I like computers(21).	4	3	2	1
2. I like to learn more about computers(2).	4	3	2	1
3. Being able to use a computer is a kind of achievement(9).	4	3	2	1
4. I would like to learn about computers but up to now I haven't had the opportunity(11).	4	3	2	1

	V	I	L	N
	I	I	I	I
5. A computer is an indispensable tools for teachers(16).	4	3	2	1
6. Thinking about learning about the computer is exciting to me(19).	4	3	2	1
7. Learning about computers is not difficult for me(20).	4	3	2	1
8. I will use computers in many ways in my life(25).	4	3	2	1
9. Student's learning efficiency can be improved by using the computer(27).	4	3	2	1
10. It saves me lots of time by using computers(30).	4	3	2	1
11. Computers could improve a student's learning motivation(31).	4	3	2	1
12. Not having learned about computers makes people feel out-of-date(32).	4	3	2	1
13. If I had the money I would buy a computer(35).	4	3	2	1
14. Leaning about computers per se is enjoyable(42).	4	3	2	1
15. It would be an interesting way of teaching by using the computer in instruction(43).	4	3	2	1
16. Using computers would be enjoyable(46).	4	3	2	1
17. The potential of computers is unlimited(50).	4	3	2	1
18. Using computer in instruction will improve the quality of teaching(53).	4	3	2	1
19. If computers can help me to reach my instruction goals I'd like to learn about them(56).	4	3	2	1
20. If I had time I would learn about computers(60).	4	3	2	1
21. Computers could stimulate my creativity(63).	4	3	2	1
22. I will use the computer as much as possible to help me solve problems(65).	4	3	2	1

Appendix E

Cover Letter and Instrument for the Pilot Study of Computer Attitudes

May 30, 1993

Dear teachers: (My respected middle school teachers)

In recent years our government has made many efforts to improve the computer equipment in middle schools. At the same time the training programs for computer literacy have been emphasized for both teachers and students. This would prepare teachers and students to meet the challenges of the 21st century.

With the help of the Ministry of Education I have undertaken a study which is directed to the acquisition of information about the teachers' attitudes toward computers. My first objective is to develop an instrument to measure the teachers' computer attitudes. You have been chosen in my research sample to help create this instrument that will be used to assess middle school teachers' attitudes towards computers. Your help would contribute greatly to this process.

Wishing you a productive and a wonderful term.

Sincerely yours,

Researcher Horng-Hwang Liou

Instruction:

Directions for completing the questionnaire are as follows:

The questionnaire asks your attitudes toward computers. There are no right or wrong answers. You will probably agree with some items and disagree with others. The research is interested in the extent to which you agree or disagree with the items. First impressions are usually best in responding to such statements. Decide if you agree or disagree and the extent of your reaction. Then circle the appropriate alternative to the right. Please do not take too much time and please mark every item. If an item alternative does not adequately represent yourself, pick up the one which is closest to the way you feel. Please make sure you circle only one alternative for each item, and that all items are completed.

For each item, please check(√) the rating (SA, A, UD, D, SD) in the column which most closely represents your feelings toward computers. The meaning of these rating are as follows:

SA - Strongly Agree
A - Agree
UD - Undecided
D - Disagree
SD - Strongly Disagree

Example:

	SA	A	UD	D	SD
23. The computer is a very useful tool in education.	( )	(√)	( )	( )	( )

If you have questions, please ask the monitor, if you don't have questions, please respond to each of the following questions.

I. Computer Attitude Questionnaire

	SA	A	UD	D	SD
1. Teaching quâlity can be improved by using a computer	( )	( )	( )	( )	( )
2. When I use a computers, I am usually afraid of damaging it	( )	( )	( )	( )	( )
3. Relying on computers too much makes people lazy	( )	( )	( )	( )	( )
4. A computer can stimulate my creativity	( )	( )	( )	( )	( )
5. I don't want to have anything to do with computers	( )	( )	( )	( )	( )
6. If computers can help improve my teaching, I want to learn about them	( )	( )	( )	( )	( )
7. If I can't keep using my computer skills, I will forget what I have learned	( )	( )	( )	( )	( )
8. Using computers is frustrating to me	( )	( )	( )	( )	( )
9. Computer can't solve complicated human problems	( )	( )	( )	( )	( )
10. I don't like to talk about computers	( )	( )	( )	( )	( )
11. I think being able to use a computer would be very enjoyable	( )	( )	( )	( )	( )
12. I like to take every opportunity to learn about computers	( )	( )	( )	( )	( )
13. Computers are too complicated for me	( )	( )	( )	( )	( )
14. Being able to use a computer lets me feel a sense of achievement	( )	( )	( )	( )	( )
15. I want to learn more about computers	( )	( )	( )	( )	( )
16. I feel uncomfortable when other people talk bout computers	( )	( )	( )	( )	( )
17. I like computers	( )	( )	( )	( )	( )

	SA	A	UD	D	SD
18. I know computers are very useful, but I don't want to spend time learning about them	( )	( )	( )	( )	( )
19. I don't think computers are useful in teaching	( )	( )	( )	( )	( )
20. I think learning about computers takes up too much time	( )	( )	( )	( )	( )
21. I would really like to buy a computer for my own use	( )	( )	( )	( )	( )
22. I can do what a computer does just as well by using other methods	( )	( )	( )	( )	( )
23. Because I don't know enough about computers, I avoid using them	( )	( )	( )	( )	( )
24. If I don't learn how to use a computer, I will feel out-of-date	( )	( )	( )	( )	( )
25. I am afraid of computers	( )	( )	( )	( )	( )
26. Using computer instruction will take away the human touch in education	( )	( )	( )	( )	( )
27. The computer is an important tool for today's teachers	( )	( )	( )	( )	( )
28. I worry about people's jobs being taken over by computers	( )	( )	( )	( )	( )
29. Computer instruction will erode the teachers' personal guidance role	( )	( )	( )	( )	( )
30. Instruction in computer use can improve students' motivation	( )	( )	( )	( )	( )
31. Computer can't be used in my subject area, so I don't need to learn about them	( )	( )	( )	( )	( )
32. Students' learning efficiency can be improved by using a computer	( )	( )	( )	( )	( )
33. Thinking about using computers is exciting to me	( )	( )	( )	( )	( )
34. I am already so busy with my teaching, I shouldn't have to learn about computers	( )	( )	( )	( )	( )
35. I will use the computer as much as I could to solve problems	( )	( )	( )	( )	( )

8. What are your sources of learning computers? (Multiple choices, check what applies to you)

   1.( ) No experience
   2.( ) Self-taught
   3.( ) Friends or Colleagues
   4.( ) University
   5.( ) Government training program
   6.( ) Training program sponsored by the computer company
   7.( ) Private computer training classes
   8.( ) Other sources __________(please indicate).

9. Option:

   (1). Please indicate problems in using and teaching the computer in school.

   (2). What are your suggestions for improving teachers' computer use and learning motivation in school?

- END -

Appendix F

The Instrument for the Final Study of Computer Attitudes

I. Cover letter (see Appendix E)

II. Computer attitude questionnaire

		SA	A	D	SD
1.	The computer is an important tool for today's teachers	( )	( )	( )	( )
2.	Relying on computers too much makes people lazy	( )	( )	( )	( )
3.	I don't want to have anything to do with computers	( )	( )	( )	( )
4.	A computer can stimulate my creativity	( )	( )	( )	( )
5.	I don't like to talk about computers	( )	( )	( )	( )
6.	I want to learn more about computers	( )	( )	( )	( )
7.	I feel uncomfortable when other people talk about computers	( )	( )	( )	( )
8.	I don't think computers are useful in teaching	( )	( )	( )	( )
9.	I think being able to use a computer would be very enjoyable	( )	( )	( )	( )
10.	I know computers are very useful, but I don't want to spend time learning about them	( )	( )	( )	( )
11.	I would really like to buy a computer for my own use	( )	( )	( )	( )
12.	Computers are too complicated for me	( )	( )	( )	( )
13.	I plan to use computers as much as possible to solve problems	( )	( )	( )	( )
14.	I think learning about computers takes up too much time	( )	( )	( )	( )
15.	I like computers	( )	( )	( )	( )

		SA	A	D	SD
16.	I like to take every opportunity to learn about computers	( )	( )	( )	( )
17.	Because I don't know enough about computers, I avoid using them	( )	( )	( )	( )
18.	Using a computer saves me a lot of time	( )	( )	( )	( )
19.	Using computer instruction will take away the human touch in education	( )	( )	( )	( )
20.	I am afraid of computers	( )	( )	( )	( )
21.	Computers can't be used in my subject area, so I don't need to learn about them	( )	( )	( )	( )
22.	Thinking about using computers is exciting to me	( )	( )	( )	( )
23.	I am already so busy with my teaching, I shouldn't have to learn about computers	( )	( )	( )	( )
24.	Using computers will increase my work pressure	( )	( )	( )	( )
25.	If I had more time, I would like to work more with computers	( )	( )	( )	( )
26.	I think the use of computers is a very good instructional method	( )	( )	( )	( )
27.	Thinking about learning to use computers makes me feel scared	( )	( )	( )	( )
28.	I think computers can be used in many ways	( )	( )	( )	( )

III. Demographic data(See Appendix E)

-END-

Appendix G

The Results of the First Delphi Round

Item#	*1*	2	*3*	4	*5*	*6*	*7*	*8*	*9*	*10*	11	*12*	13
Retain	5	7	4	3	4	6	4	3	5	7	4	6	3
Revise	2	0	2	2	2	0	2	3	2	0	2	1	1
Reject	0	0	1	2	1	1	1	1	0	0	1	0	3
Item#	14	15	*16*	*17*	*18*	19	20	21	*22*	23	*24*	25	*26*
Retain	4	3	4	5	3	4	3	3	3	2	6	3	4
Revise	1	2	2	2	3	2	4	4	3	2	0	4	2
Reject	2	2	1	0	1	1	0	0	1	3	1	0	1
Item#	27	28	*29*	30	31	32	33	34	35	*36*	*37*	*38*	*39*
Retain	5	3	5	7	6	7	5	3	4	6	4	6	5
Revise	2	1	2	0	1	0	2	2	2	0	2	1	1
Reject	0	3	0	0	0	0	0	2	1	1	1	0	1
Item#	*40*	41	42	43	44	*45*	46	*47*	48	*49*	50	*51*	*52*
Retain	5	3	4	3	3	6	3	5	2	2	4	7	6
Revise	1	2	2	3	2	0	4	2	1	2	2	0	0
Reject	1	2	1	1	2	1	0	0	4	3	1	0	1
Item#	53	*54*	*55*	56	57	58	59	60	61	*62*	63	*64*	65
Retain	7	4	5	3	3	4	3	3	4	4	7	4	3
Revise	0	2	2	3	1	0	1	2	2	2	0	0	3
Reject	0	1	0	1	3	3	3	2	1	1	0	3	1

Note:1. Items with underline are statements retained in the second round Delphi study. Retained negative statements are specified by ITALIC.

2. Item 49 and 64 were revised and retained by the researcher for the second Delphi round.

3. Item 61 was considered as one of the objective for this study, and the "gender difference" could be obtained from the total score on Computer Attitude Scale. Hence the item was not included.

Appendix H

The Results of the Second Delphi Round

Item#	1	2	3	4	5	6	7	8	9	10	11	12	13
Negat.	25	18	22	27	24	20	24	27	24	26	20	22	23
Posit.	26	27	27	27	24	22	24	26	23	27	26	27	27
Item#	14	15	16	17	18	19	20	21	22	23	24	25	26
Negat.	25	24	22	24	16	25	23	22	19	27	26	20	26
Posit.	20	22	24	21	26	24	26	24	25				
Item#	27	28	29										
Negat.	24	20	23										

Note:1. Numbers indicate the total scores for positive and negative statements (add scores from the seven (7) panelists).

2. Items with score underlined were eliminated for the pilot study.

Appendix I

The Percentage for the Four Scale Scores in the Final Study Instrument

Item#	Group	% in the 4 scale scores			
		1	2	3	4
1	All	1.60	10.70	61.10	26.60
	Male	2.19	8.76	51.09	37.96
	Female	1.33	11.47	64.80	22.40
2	All	4.10	33.20	52.30	10.40
	Male	4.38	29.20	49.64	16.79
	Female	4.00	34.67	53.33	8.00
3	All	2.30	11.10	63.10	23.40
	Male	2.92	8.03	60.58	28.47
	Female	2.13	12.27	64.00	21.60
4	All	2.50	30.70	57.00	9.80
	Male	5.11	15.33	59.12	20.44
	Female	1.60	36.27	56.27	5.87
5	All	1.80	16.60	66.60	15.00
	Male	2.19	15.33	58.39	24.09
	Female	1.60	17.07	69.60	11.73
6	All	1.80	10.00	57.20	31.10
	Male	2.19	7.30	48.91	41.61
	Female	1.60	10.93	60.27	27.20
7	All	1.40	13.50	68.00	17.20
	Male	2.19	13.14	64.96	19.71
	Female	1.07	13.60	69.07	16.27
8	All	1.60	18.40	61.70	18.40
	Male	0.73	16.06	55.47	27.74
	Female	1.87	19.20	64.00	14.93
9	All	1.80	7.80	58.80	31.60
	Male	1.46	8.76	51.09	38.69
	Female	1.87	7.47	61.60	29.07

- Appendix I continued -

Item#	Group	% in the 4 scale scores			
		1	2	3	4
10	All	1.40	22.30	58.40	18.00
	Male	2.92	23.36	50.36	23.36
	Female	0.80	21.87	61.33	16.00
11	All	1.40	16.40	59.20	23.00
	Male	1.46	13.14	51.82	33.58
	Female	1.33	17.60	61.87	19.20
12	All	3.50	32.60	52.70	11.10
	Male	2.92	25.55	52.55	18.98
	Female	3.73	35.20	52.80	8.27
13	All	1.00	24.80	60.70	13.50
	Male	0.73	16.79	58.39	24.09
	Female	1.17	27.73	61.60	9.60
14	All	2.00	10.90	61.90	25.20
	Male	5.84	11.68	53.28	29.20
	Female	0.53	10.67	65.07	23.73
15	All	1.20	20.90	64.60	13.30
	Male	0.73	13.14	63.50	22.63
	Female	1.33	23.73	65.07	9.87
16	All	2.10	20.90	61.50	15.40
	Male	3.65	16.06	54.01	26.28
	Female	1.60	22.67	64.27	11.47
17	All	2.00	30.70	54.70	12.70
	Male	2.19	22.63	52.55	22.63
	Female	1.87	33.60	55.47	9.07
18	All	2.70	22.30	60.00	15.00
	Male	2.19	17.52	55.47	24.82
	Female	2.93	24.00	61.60	11.47
19	All	2.70	29.50	56.20	11.50
	Male	2.19	23.36	54.74	19.71
	Female	2.93	31.73	56.80	8.53
20	All	2.00	17.60	65.40	15.00
	Male	2.92	12,41	62.04	22.63
	Female	1.60	19.47	66.67	12.27

- Appendix I continued -

Item#	Group	% in the 4 scale scores			
		1	2	3	4
21	All	1.60	16.40	59.20	23.00
	Male	1.46	13.14	51.82	33.58
	Female	0.80	12.00	71.47	15.73
22	All	2.70	32.00	52.30	12.90
	Male	5.11	18.98	55.47	20.44
	Female	1.87	36.80	51.20	10.13
23	All	2.50	17.60	65.00	14.80
	Male	3.65	14.60	64.96	16.79
	Female	2.13	18.67	65.07	14.13
24	All	2.00	22.50	64.30	11.30
	Male	0.73	22.63	60.58	16.06
	Female	2.40	22.40	65.60	9.60
25	All	2.30	9.20	65.60	22.90
	Male	2.92	8.03	56.93	32.12
	Female	2.13	9.60	68.80	19.47
26	All	1.60	20.30	62.30	15.80
	Male	1.46	16.79	59.85	21.90
	Female	1.60	21.60	63.20	13.60
27	All	1.80	14.10	67.60	16.60
	Male	1.46	11.68	63.50	23.36
	Female	1.87	14.93	69.07	14.13
28	All	2.50	19.30	63.50	14.60
	Male	3.65	10.22	61.31	24.82
	Female	2.13	22.67	64.27	19.93

Appendix J

Factor Analysis for the Final Study

Table A.1 Means, standard deviations, and correlations for the Computer Attitude subscales and Total scale

Scales	# of items	Mean	SD	F 1	F 2	TOTAL
F 1	15	43.95	6.50	1.0000	.7483	.9361
F 2	13	38.28	5.83		1.0000	.9237
TOTAL	28	82.17	11.48			1.0000

Note:n=512, F 1 & F 2 were subtotal scores for F 1& F 2.

Table A.2 Hoyt-Stunkard's coefficient of reliability (Factor 1, Factor 2 and Total scale) - final study

Group	Source	DF	Sum of Squares	Mean Square	R
F 1	Items	14	190.86	13.6329	
	Resp	511	1441.53	2.8210	
	Resid.	7679	1932.21	0.2701	.9043
F 2	Items	12	76.63	6.39	
	Resp	511	1337.47	2.6174	
	Resid.	6132	1430.44	0.2333	.9109
TOTAL	Items	27	268.23	9.9345	
	Resp	511	2429.62	4.7546	
	Resid.	13797	3712.02	0.2690	.9434

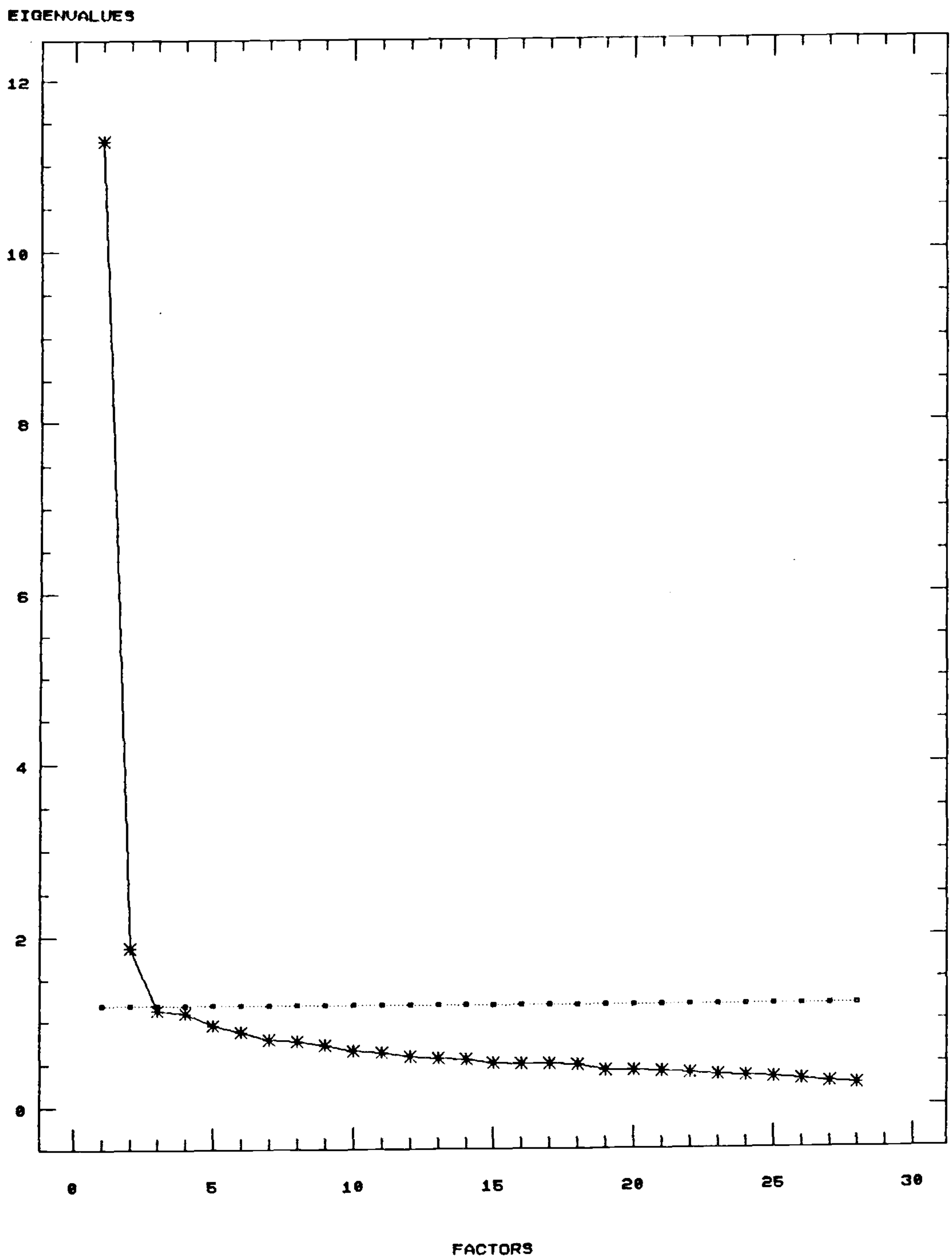
Table A.3 Varimax rotated factor loading for two Computer Attitude Scales

		Factor Loadings	
Subscales	Item #	Factor 1	Factor 2
Positiveness Subscales (Cognitive, Affective, Conative)	25	.71	.27
	28	.68	.27
	26	.67	.20
	6	.66	.29
	16	.65	.34
	15	.64	.40
	1	.63	-.04
	4	.62	.16
	22	.62	.42
	11	.56	.37
	13	.55	.33
	18	.54	.19
	9	.49	.32
	19	.43	.28
	2	.38	.32
Negativeness (Cognitive, Affective, Conative)	20	.13	.80
	27	.27	.76
	10	.19	.74
	12	.12	.72
	7	.20	.69
	23	.40	.63
	3	.40	.57
	24	.38	.55
	21	.39	.54
	5	.39	.53
	14	.39	.50
	8	.35	.45

Variance explained by each factor Factor 1:6.6140
Factor 2:6.5395

Appendix K

Scree Plot of Eigenvalues for the Final Computer Attitudes Instrument



Appendix L

Summary Results of the Final Study

Table A.4 Means, standard deviations, and Tukey test for all variables in the final study

Variable	Level	Number	Mean	SD	Tukey
Gender	1(M)	137	85.26	12.99	A
	2(F)	375	81.05	10.68	B
Age	1	101	85.01	12.20	A
	2	202	84.19	10.89	A
	3	168	78.68	11.03	B
	4	41	79.85	10.60	B
Experience	1	97	75.40	9.67	D
	2	314	81.73	10.52	C
	3	71	88.18	10.36	B
	4	30	94.53	12.61	A
School	1	74	81.41	9.64	B
	2	146	83.73	10.52	B A
	3	108	82.10	9.71	B
	4	67	79.39	9.81	B
	5	61	79.18	12.07	B
	6	56	87.55	12.64	A
Ownership	1(Yes)	279	83.11	12.17	A
	0(No)	233	81.05	10.51	B
Use	1	394	82.53	11.81	A
	0	118	80.97	10.28	A
Need	1	362	83.49	11.41	A
	0	150	79.00	11.08	B
Training	1	226	80.52	11.34	C
	2	151	80.95	9.95	C
	3	73	84.33	11.20	B
	4	34	87.18	13.05	B A
	5	28	90.43	13.62	A
Willing	1	5	67.40	10.31	C D
	2	29	65.52	5.28	D
	3	217	76.90	7.76	C
	4	202	86.23	8.49	B
	5	59	97.12	11.01	A

-Table A.4 continued -

Variable	Level	Number	Mean	SD	Tukey
Suggestion	1(Yes)	173	85.28	11.70	A
	0(No)	339	80.59	11.05	B
No Exp.	1	101	76.02	10.57	B
	0	411	83.69	11.20	A
Self-T.	1	132	85.93	12.59	A
	0	380	80.87	10.79	B
Friends	1	217	83.48	11.64	A
	0	295	81.21	11.29	B
University	1	135	85.96	10.99	A
	0	377	80.82	11.37	B
Government	1	115	86.78	10.75	A
	0	397	80.84	11.36	B
Private-C.	1	63	83.71	12.06	A
	0	449	81.96	11.40	A
Private-L.	1	50	84.20	13.55	A
	0	462	81.95	11.23	A
Others	1	40	86.50	9.96	A
	0	472	81.81	11.53	B

Note:1. Tukey HSD test - The results with the same letter were not significant at the $\alpha = .05$ level.
2. Mean indicates mean score on Computer Attitude Scale.

- Appendix L continued -

Table A.5 Means, standard deviations for age data for all variables in the final study

Variable	Level	Number	Mean	SD
Gender	1(M)	137	41.33	9.85
	2(F)	375	37.77	7.88
Age	1	101	27.35	2.21
	2	202	35.62	2.99
	3	168	45.21	2.72
	4	41	55.39	4.19
Experience	1	97	41.85	7.76
	2	314	38.85	8.43
	3	71	35.02	7.76
	4	30	35.97	9.25
School	1	74	42.23	8.83
	2	146	35.77	7.10
	3	108	36.89	8.79
	4	67	43.75	6.57
	5	61	41.46	8.26
	6	56	36.30	8.99
Ownership	1(Yes)	279	39.15	9.19
	0(No)	233	38.20	7.79
Use	1	394	38.28	8.43
	0	118	40.17	8.97
Need	1	362	38.42	8.29
	0	150	39.45	7.79
Training	1	226	37.59	9.23
	2	151	40.68	8.51
	3	73	38.85	7.13
	4	34	37.38	6.81
	5	28	38.54	7.52
Willing	1	5	38.20	6.94
	2	29	46.24	6.13
	3	217	39.71	8.79
	4	202	37.55	8.18
	5	59	35.44	7.77
Suggestion	1(Yes)	173	37.85	8.51
	0(No)	339	39.16	8.60

- Table A.5 continued -

Variable	Level	Number	Mean	SD
No Exp.	1(Yes)	101	41.69	8.04
	0(No)	411	37.99	8.57
Self-T.	1	132	37.07	8.31
	0	380	39.29	8.62
Friends	1	217	38.38	8.29
	0	295	38.97	8.81
University	1	135	31.94	6.74
	0	377	41.14	7.85
Government	1	115	39.62	7.86
	0	397	38.46	8.78
Private-C.	1	63	40.08	8.43
	0	449	38.53	8.60
Private-L.	1	50	34.20	7.58
	0	462	39.21	8.55
Others	1	40	40.07	8.84
	0	472	38.60	8.56

Note: Mean indicates the mean age not the mean score on CAS.

- Appendix L continued -

Table A.6 Age distribution data - final study

Age	N	Mean	SD	Age	N	Mean	SD
23	3	79.00	5.19	44	14	80.93	10.72
24	12	86.25	10.30	45	18	73.89	9.85
25	12	90.08	7.51	46	26	78.58	14.11
26	10	84.40	12.51	47	14	77.64	9.31
27	7	93.29	15.81	48	23	83.65	10.01
28	20	82.45	16.35	49	6	72.67	6.59
29	13	79.85	6.58	50	13	73.38	8.02
30	24	85.38	11.70	51	7	81.00	14.19
31	22	86.41	12.75	52	7	82.29	4.50
32	24	74.25	10.31	53	3	78.00	14.53
33	17	86.59	10.81	54	5	81.40	18.98
34	14	86.79	11.96	55	4	81.25	11.87
35	16	81.44	9,17	56	2	77.00	7.07
36	19	87.58	13.53	57	3	80.33	6.11
37	22	83.32	11.67	58	1	66.00	.
38	27	84.15	11.17	59	0	.	.
39	16	83.25	7.61	60	2	70.50	6.36
40	25	79.20	7.69	61	1	76.00	.
41	16	76.81	8.99	62	2	78.00	5.66
42	23	81.43	11.37	63	2	88.00	7.07
43	15	80.67	11.61	64	1	79.00	.
				65	1	76.00	.

Note: n=512.

- Appendix L continued -

Table A.7 Results of teaching subjects and computer attitudes

Subject	Number	Mean	SD	Subject	Number	Mean	SD
1	120	79.83	11.44	12	1	77.00	.
2	62	78.61	10.69	13	13	83.69	10.19
3	72	85.00	12.62	14	8	85.13	9.34
4	45	85.60	12.37	15	4	76.00	4.69
5	17	83.76	11.96	16	11	80.36	10.41
6	8	80.87	11.87	17	10	89.70	12.01
7	24	84.12	10.84	18	6	95.50	12.31
8	24	84.08	8.31	19	5	85.80	9.42
9	25	80.72	10.60	20	9	78.33	9.79
10	21	79.33	11.47	21	6	82.50	5.28
11	19	81.95	11.64	22	2	82.50	0.71

Note:1:Chinese, 2:English, 3:Math, 4:Physics & Chemistry, 5:Biology, 6:Health Ed., 7:Counseling, 8:Physical Ed., 9:History, 10:Citizenship, 11:Geography, 12:Nature, 13:Art of Engineering, 14:Music, 15:Administration, 16:Art, 17:Boy Scout, 18:Earth Science, 19:Special Ed., 20:Unknown, 21:Cooking, 22:Social science.

- Appendix L continued -

Table A.8 CAS scores based on two classifications of teaching Subjects

Classification 1				Classification 2			
Subject	N	Mean	SD	Subject	N	Mean	SD
1	144	79.40	11.02	1	95	80.15	11.91
2	110	84.59	11.66	2	49	77.96	11.21
3	49	81.84	10.27	3	56	84.30	11.85
4	92	82.57	9.81	4	53	85.03	11.62
				5	49	81.84	10.27
				6	82	82.51	9.77

Note:1. Classification 1: 1- Chinese & English, 2- Math, Physics & Chemistry, and Earth Science, 3- Geography, History, and Citizenship, 4- Others.

2. Classification 2: 1- Chinese, 2- English, 3- Math, 4- Physics & Chemistry, and Biology, 5- History, Geography, and Citizenship, 6- Others.

Appendix M

Results of School Differences in Computer Attitudes and Computer Usage

Table A.9 The GLM analysis for the final Computer Attitude Scale scores

Source of variance	df	MS	F	p_r>F
Gender	1	694.95	7.00	.0085
Age	3	403.01	4.06	.0073
Experience	3	2585.57	26.05	.0001
School	5	165.56	1.67	.1412
Gender*Age	3	345.12	3.48	.0161
Gender*Experience	3	181.04	1.82	.1422
Gender*School	5	469.11	4.73	.0003
Age*Experience	9	111.19	1.12	.3469
Age*School	15	89.69	0.90	.5601
Experience*School	15	88.28	0.89	.5762
Gender*Age*Experience	4	58.83	0.59	.6680
Gender*Age*School	12	54.09	0.55	.8847
Gender*Experience*School	10	51.17	0.52	.9792
Age*Experience*School	25	131.09	1.32	.1408
Gender*Age*Experience*School	6	129.49	1.30	.2538

Note: Type II SS was used from SAS GLM procedure.

- Appendix M continued -

Table A.10 Tukey HSD paired mean analysis for the final study (gender by school)

School	Gender	Number	Mean	SD	All	F1	F2
Sch 1	M	23	81.56	9.91	A	A	A
	F	51	81.33	9.62	A	A	A
Sch 2	M	38	84.13	14.81	A	A	A
	F	108	82.71	12.08	A	A	A
Sch 3	M	25	82.36	11.44	A	A	A
	F	83	82.17	9.20	A	A	A
Sch 4	M	21	83.90	11.45	A	A	A
	F	46	77.33	8.31	B	B	A
Sch 5	M	11	91.55	11.85	A	A	A
	F	50	76.46	10.39	B	B	B
Sch 6	M	19	93.63	13.19	A	A	A
	F	37	84.43	11.29	B	B	B

Note:1. Tukey HSD test - The results with the same letter were not significant at the α = .05 level.

2. Mean and SD indicates mean and SD for All test items.

- Appendix M continued -

Table A.11 Tukey HSD paired mean analysis for the final study (age and experience by school)

	AGE					COMPUTER EXPERIENCE				
School	AD	N	Mean	SD	Tukey	EXP	N	Mean	SD	Tukey
Sch 1	1	8	89.63	11.29	A	1	14	74.00	6.92	A
	2	25	80.48	9.55	B	2	48	80.00	7.28	B
	3	32	81.09	9.40	B	3	8	93.88	8.71	C
	4	9	77.78	5.99	B	4	4	91.50	15.27	C
Sch 2	1	36	83.53	14.17	A	1	24	75.38	12.23	A
	2	74	85.35	11.31	A	2	93	83.09	11.79	B
	3	32	77.81	13.62	B	3	23	87.52	12.43	B C
	4	4	81.00	11.46	A	4	6	98.83	15.09	C
Sch 3	1	30	85.03	9.84	A	1	25	77.72	8.03	A C
	2	41	83.76	9.82	A B	2	63	82.73	10.03	A B
	3	29	78.89	7.23	B C	3	13	83.85	10.92	A B
	4	8	74.25	10.66	C	4	7	88.86	10.92	B C
Sch 4	1	1	79.00	.	A	1	11	70.73	9.06	A F
	2	25	81.24	7.63	A	2	44	79.39	8.98	B E
	3	29	79.24	9.74	A	3	10	88.30	6.80	C D
	4	12	80.75	13.66	A	4	2	82.50	2.12	D E F
Sch 5	1	8	83.75	8.79	A	1	18	75.22	8.60	A E
	2	17	82.41	14.19	A	2	35	77.89	11.90	A D
	3	33	75.91	11.34	A	3	7	92.86	9.92	B C
	4	3	84.67	6.03	A	4	1	100.00	.	C D E
Sch 6	1	18	87.17	13.73	A	1	5	78.80	14.38	A E
	2	20	90.00	11.30	A	2	31	84.94	10.75	A B
	3	13	84.69	14.74	A	3	10	87.40	11.46	A D
	4	5	86.60	8.85	A	4	10	100.2	11.14	C D F

Note: Tukey HSD test - The results with the same letter were not significant at the α = .05 level.

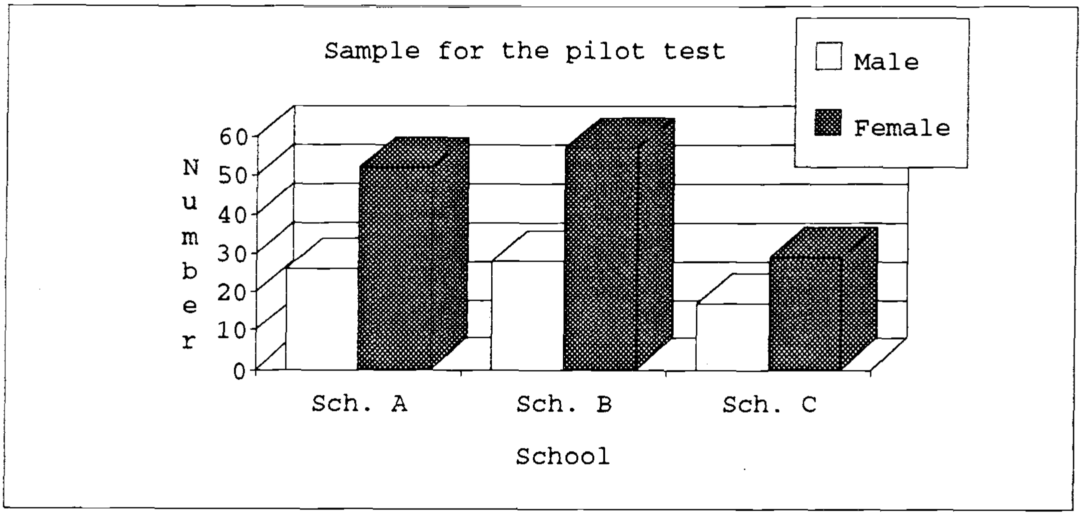
Appendix N

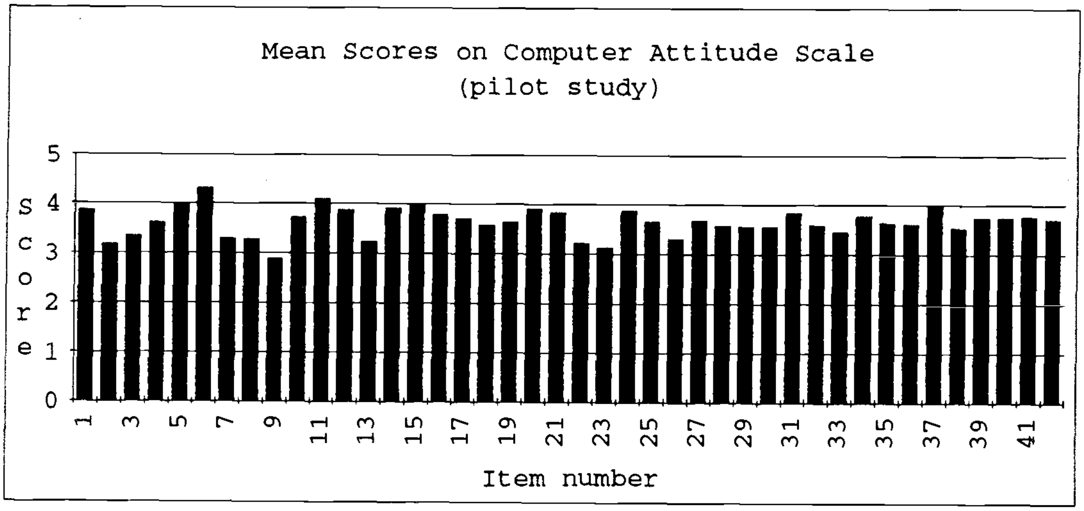
Guidelines for Assessing the Degree of Reliability

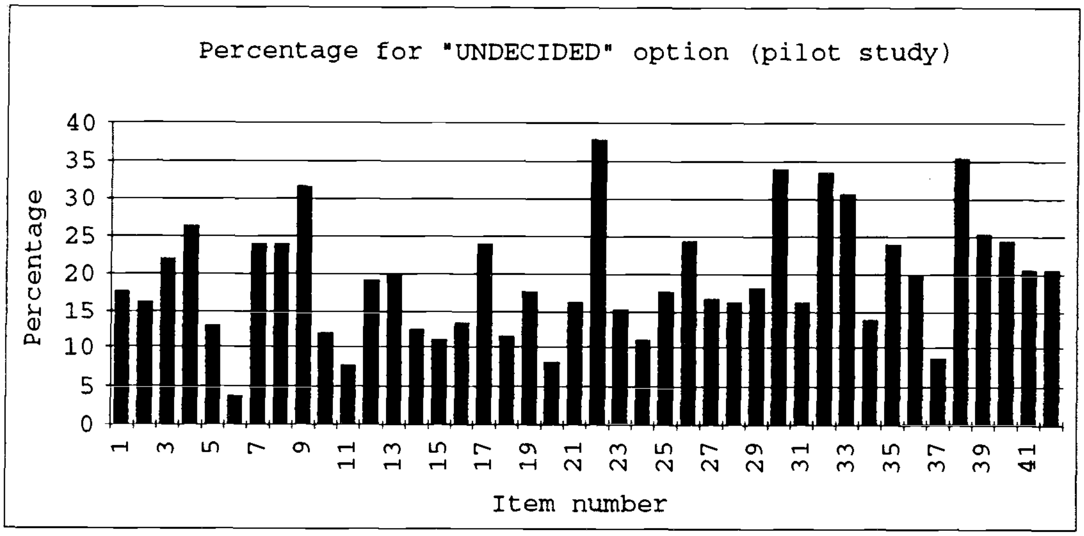
.95 to .99	Very high, rarely found
.90 to .94	high
.80 to .89	fairly high, adequate for individual measurement
.70 to .79	rather low, adequate for group measurement but not very satisfactory for individual measures
below .70	low, entirely inadequate for individual measurement, although useful for group averages and school survey (Harris, 1968, p.23).

Appendix O

Demographic Charts for Pilot, Final, Known-Group Difference, and Other Related Data


Sample for the pilot test
Male
Female
Number
60
50
40
30
20
10
0
Sch. A
Sch. B
Sch. C
School


Mean Scores on Computer Attitude Scale
(pilot study)
Score
5
4
3
2
1
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41
Item number


Percentage for "UNDECIDED" option (pilot study)
Percentage
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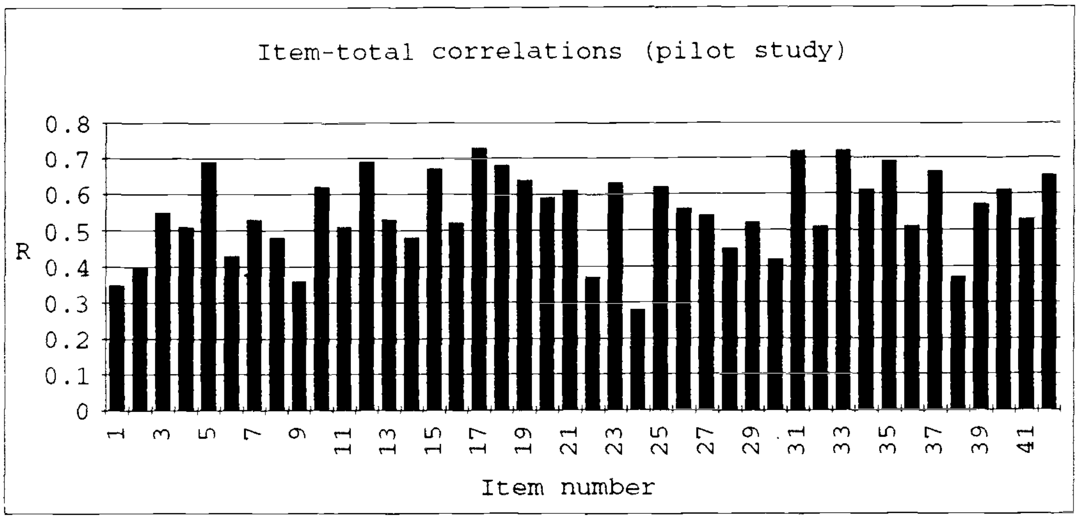
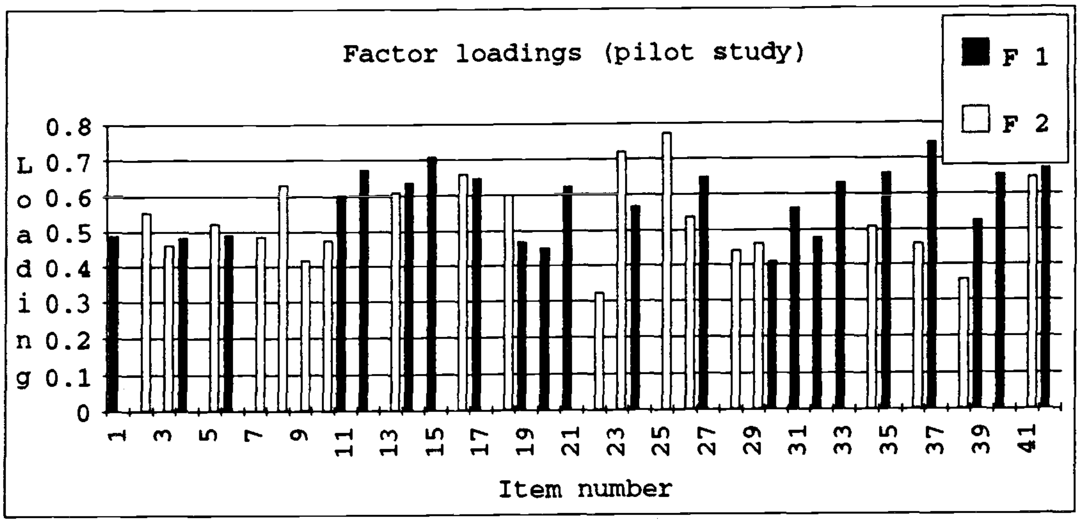
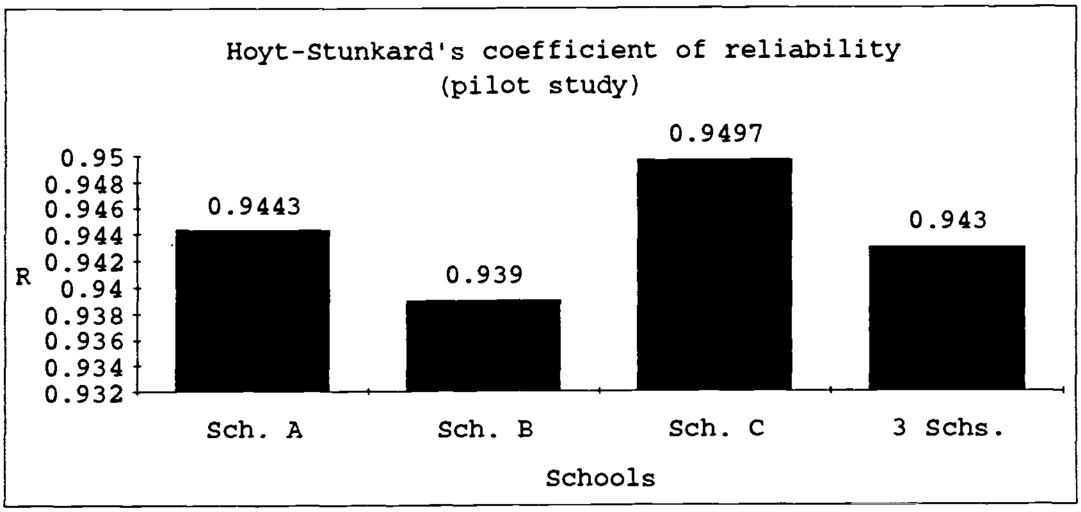
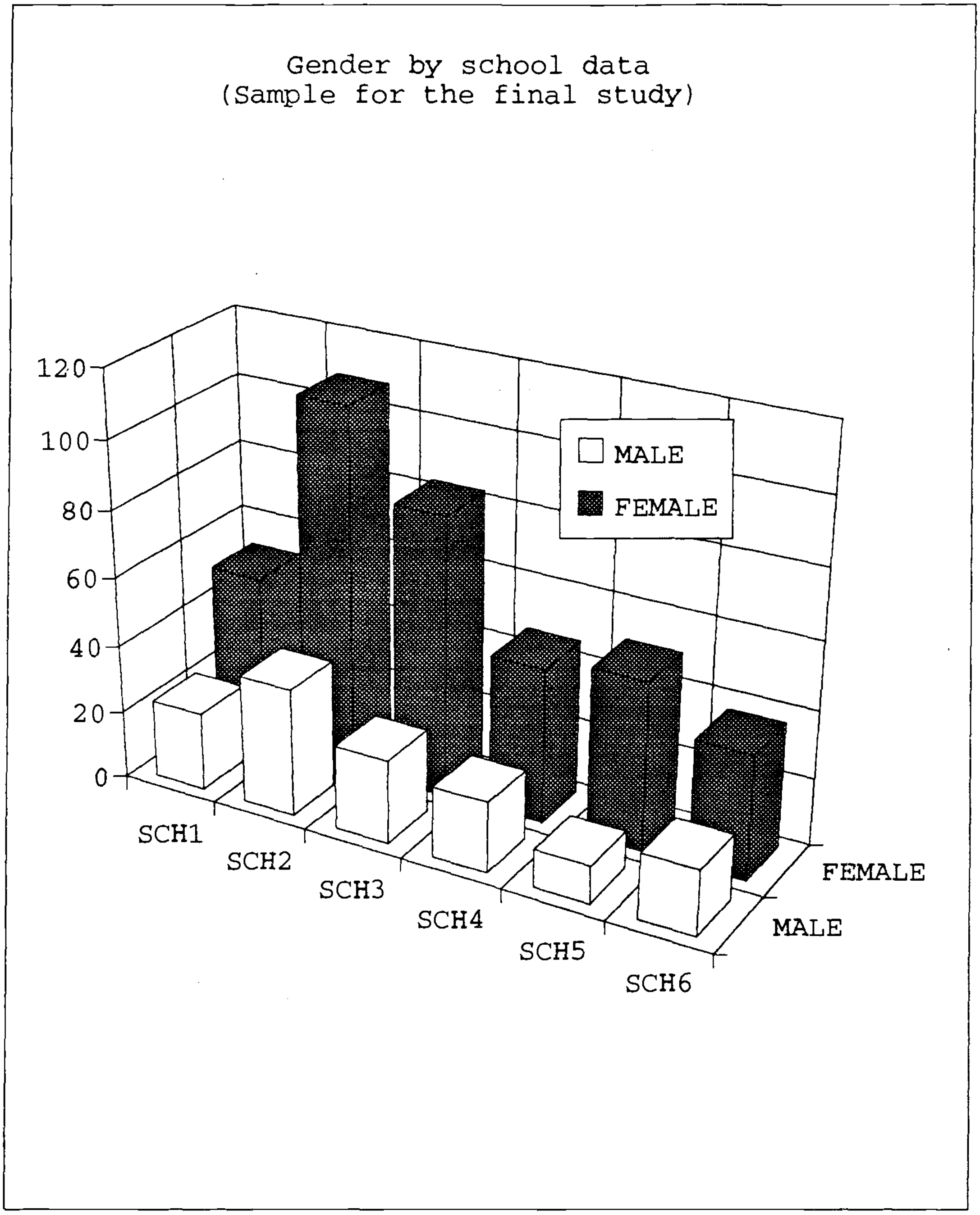
35
30
25
20
15
10
5
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41
Item number

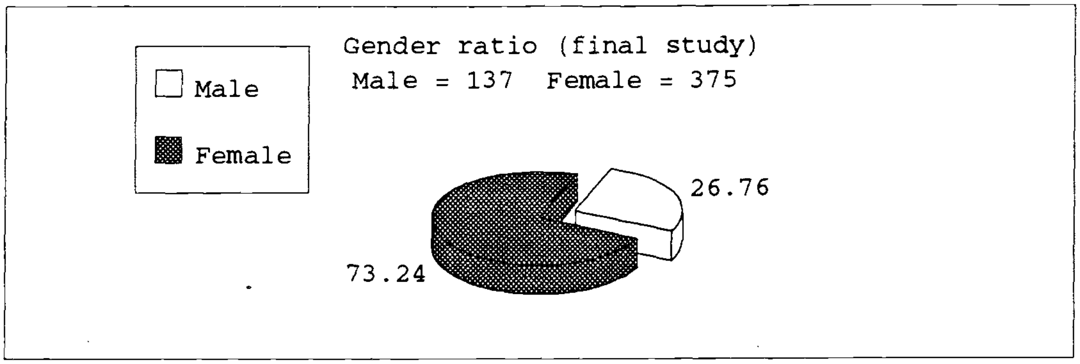

Item-total correlations (pilot study)
R
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41
Item number

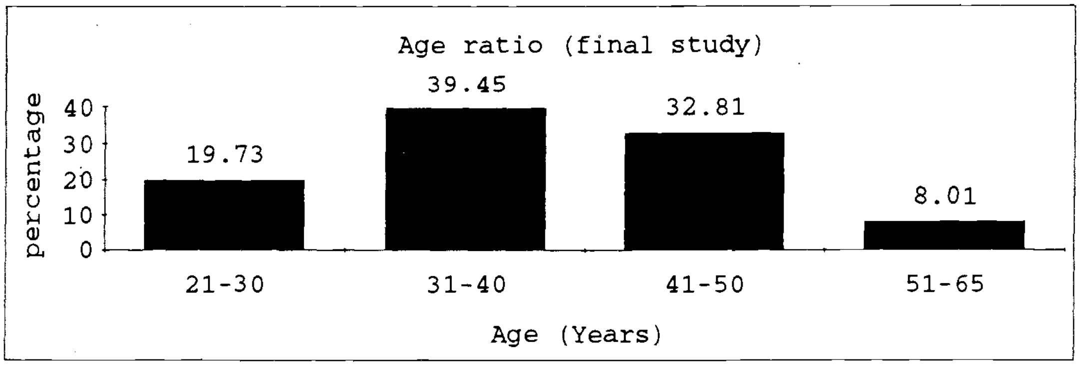

Factor loadings (pilot study)
F 1
F 2
Loading
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41
Item number

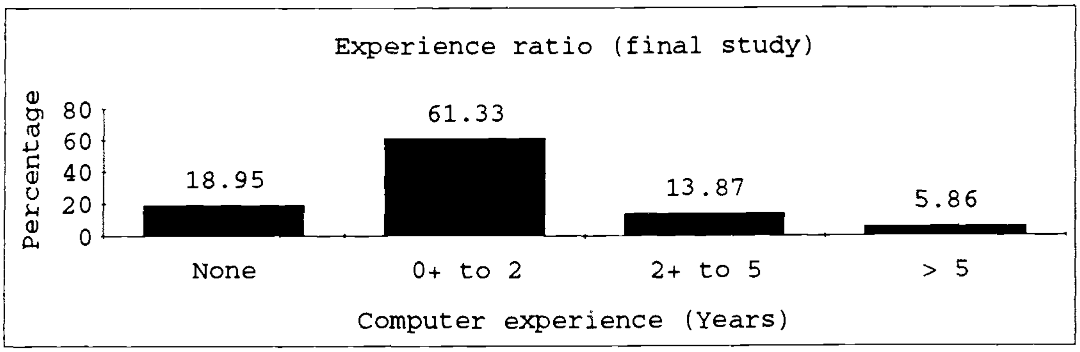

Hoyt-Stunkard's coefficient of reliability
(pilot study)
R
0.95
0.948
0.946
0.944
0.942
0.94
0.938
0.936
0.934
0.932
0.9443
0.939
0.9497
0.943
Sch. A
Sch. B
Sch. C
3 Schs.
Schools

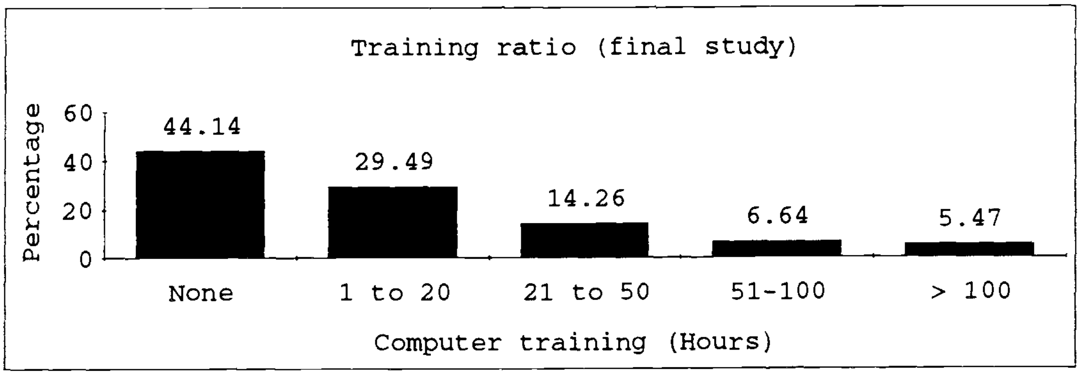


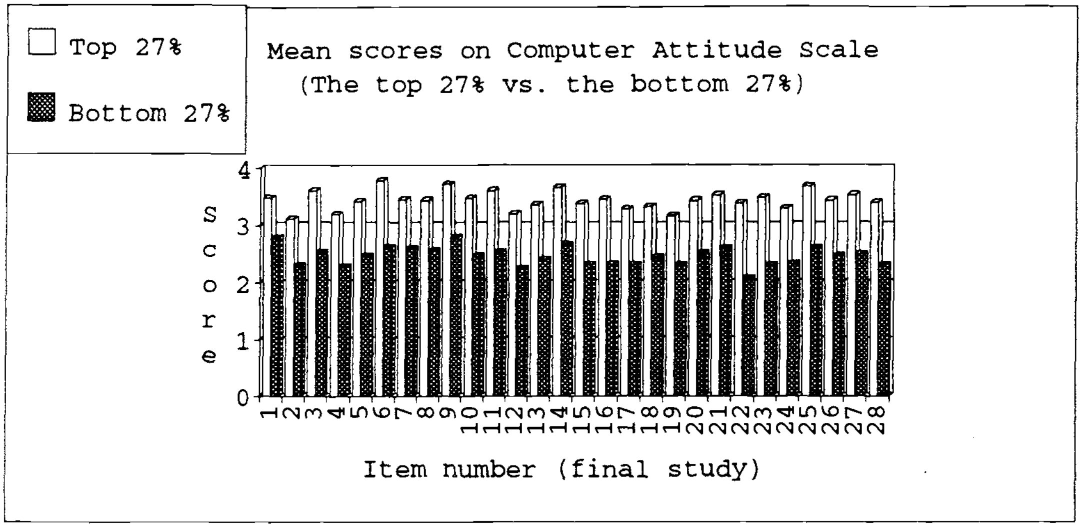
Gender by school data
(Sample for the final study)
120
100
80
60
40
20
0
MALE
FEMALE
SCH1
SCH2
SCH3
SCH4
SCH5
SCH6
FEMALE
MALE


Gender ratio (final study)
Male = 137 Female = 375
Male
Female
26.76
73.24

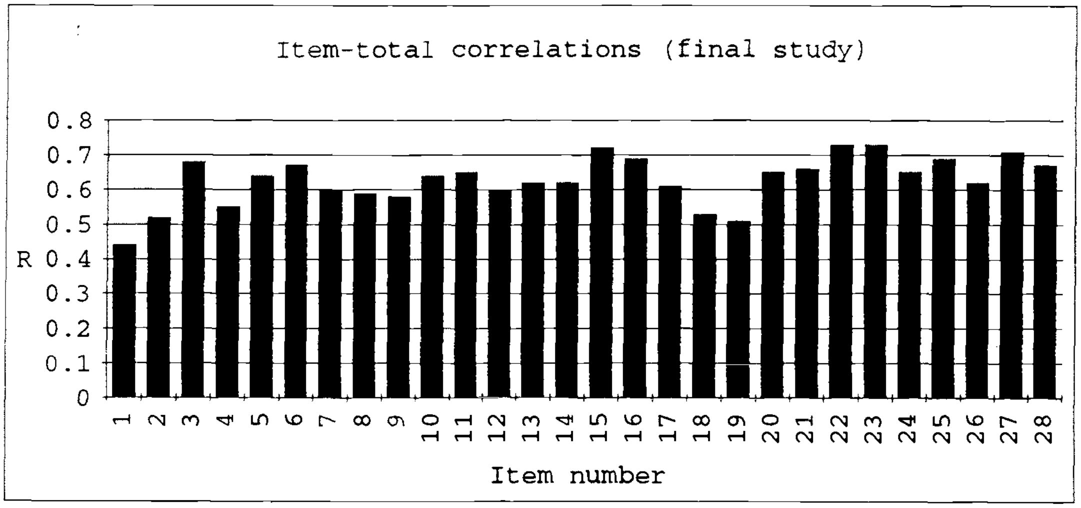

Age ratio (final study)
percentage
40
30
20
10
0
19.73
39.45
32.81
8.01
21-30
31-40
41-50
51-65
Age (Years)


Experience ratio (final study)
Percentage
80
60
40
20
0
18.95
61.33
13.87
5.86
None
0+ to 2
2+ to 5
> 5
Computer experience (Years)

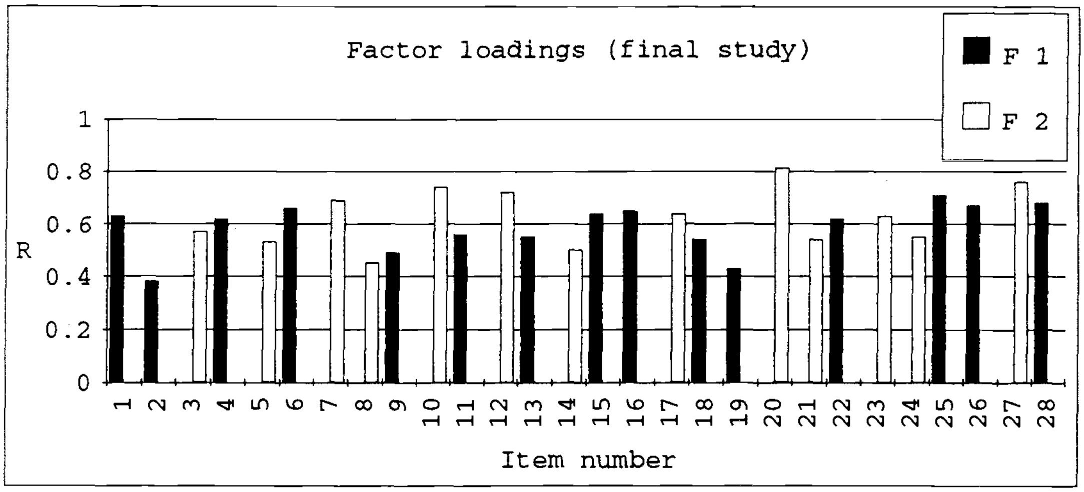

Training ratio (final study)
Percentage
60
40
20
0
44.14
29.49
14.26
6.64
5.47
None
1 to 20
21 to 50
51-100
> 100
Computer training (Hours)



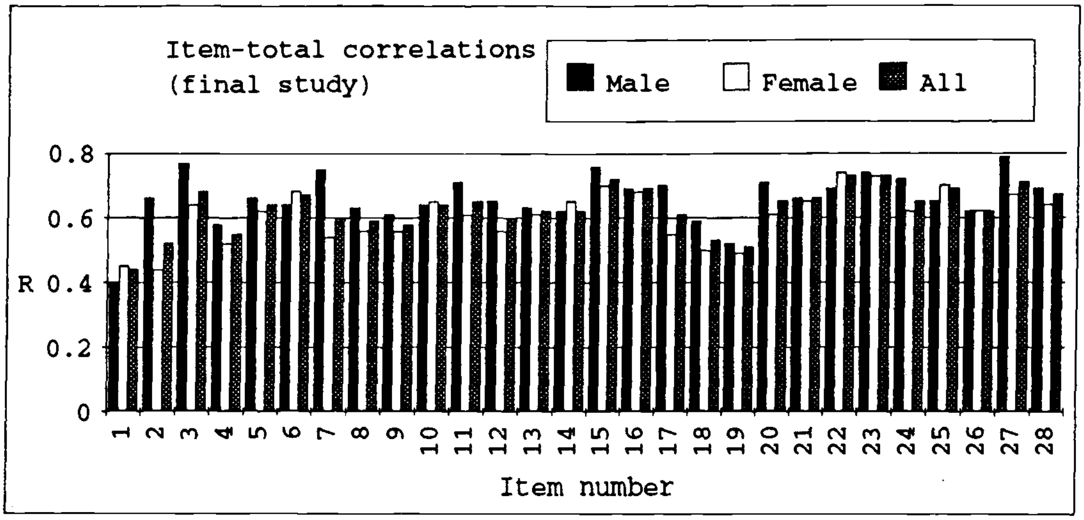
Top 27%
Bottom 27%
Mean scores on Computer Attitude Scale
(The top 27% vs. the bottom 27%)
Score
0
1
2
3
4
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Item number (final study)

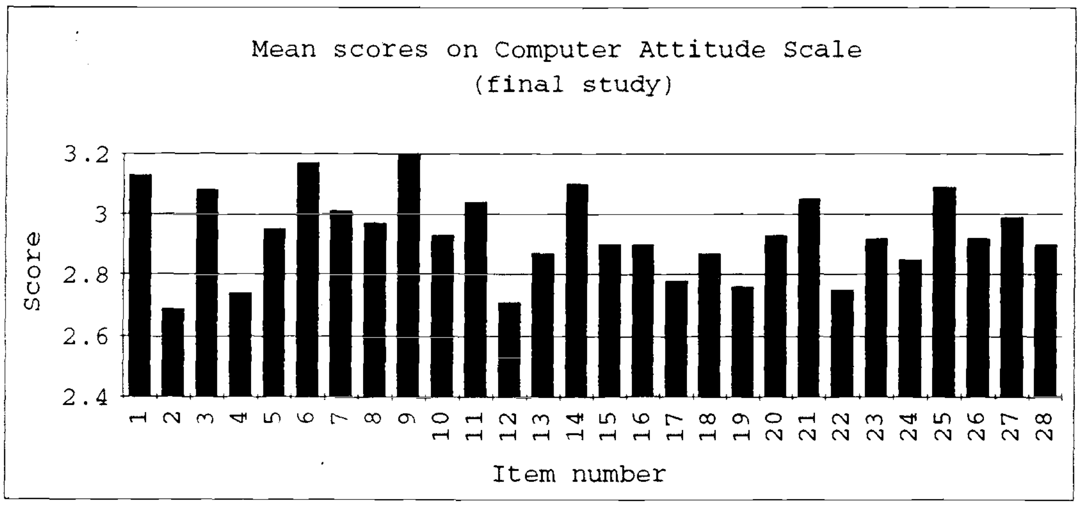


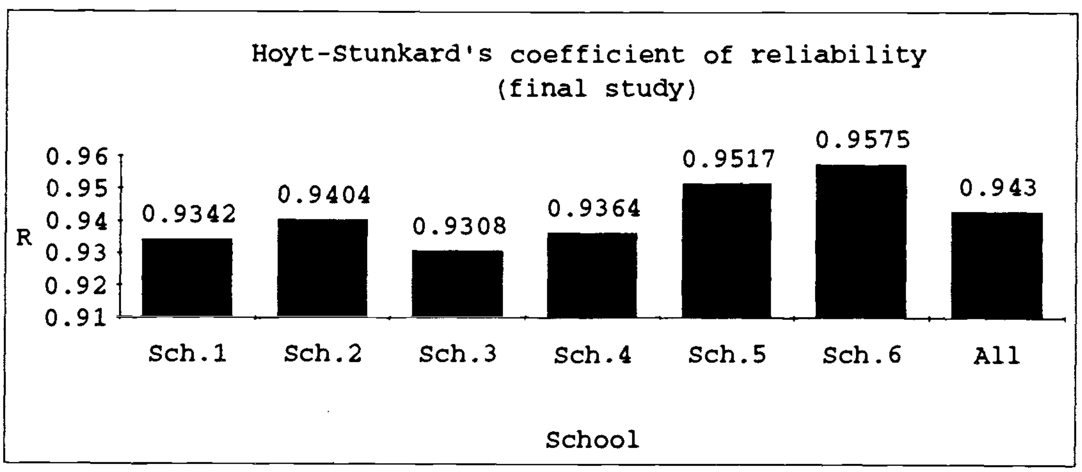
Item-total correlations (final study)
R
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Item number

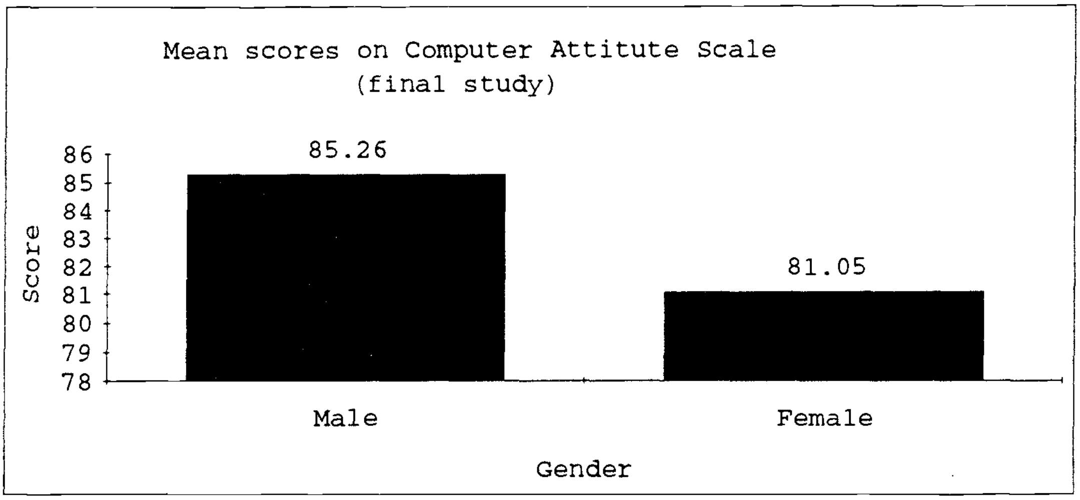


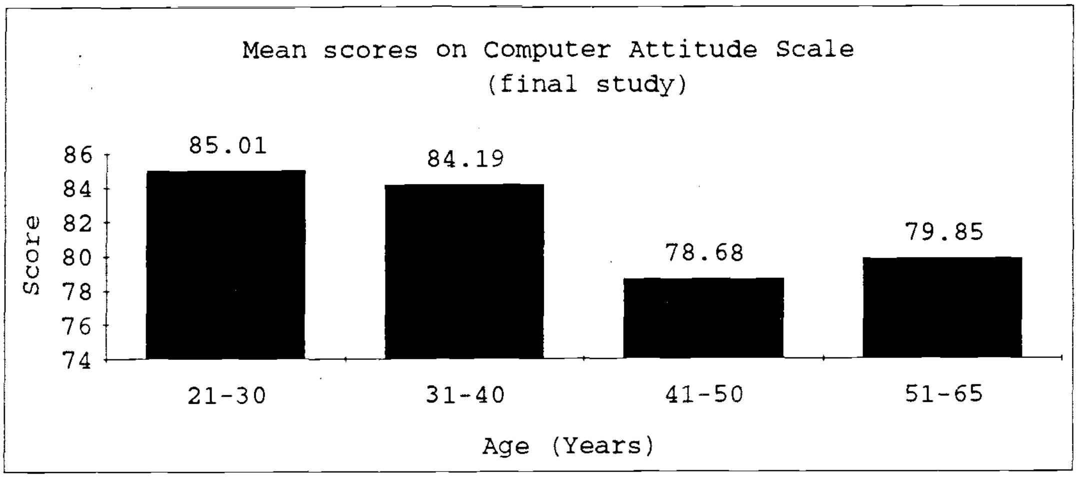
Factor loadings (final study)
F 1
F 2
R
0
0.2
0.4
0.6
0.8
1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Item number

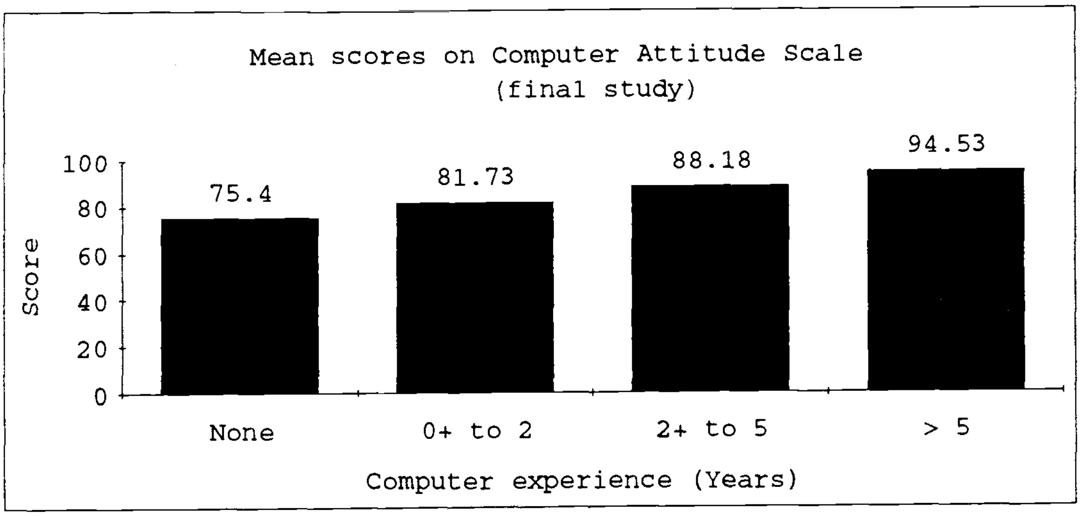

Item-total correlations
(final study)
Male
Female
All
0.8
0.6
R 0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Item number

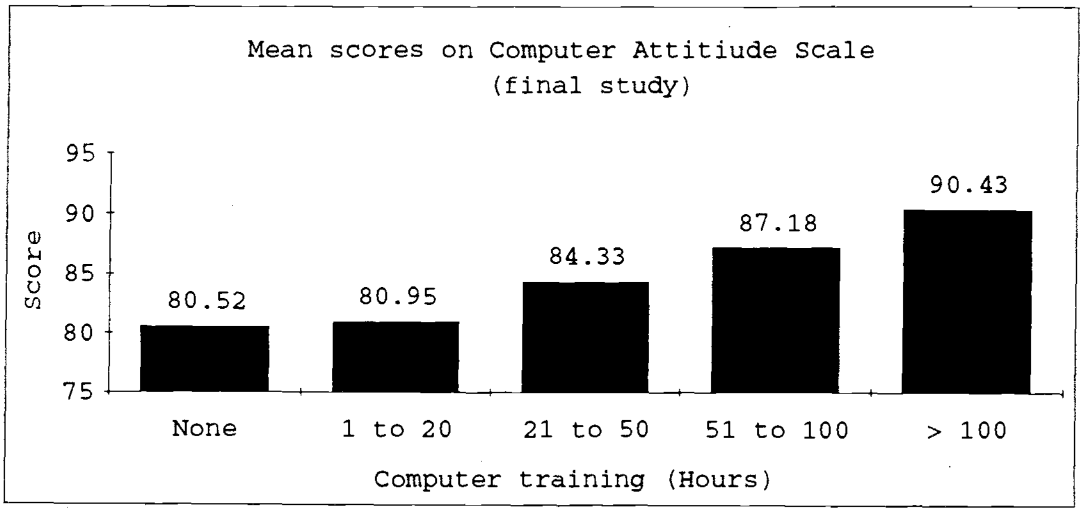

Mean scores on Computer Attitude Scale
(final study)
3.2
3
2.8
2.6
2.4
Score
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Item number

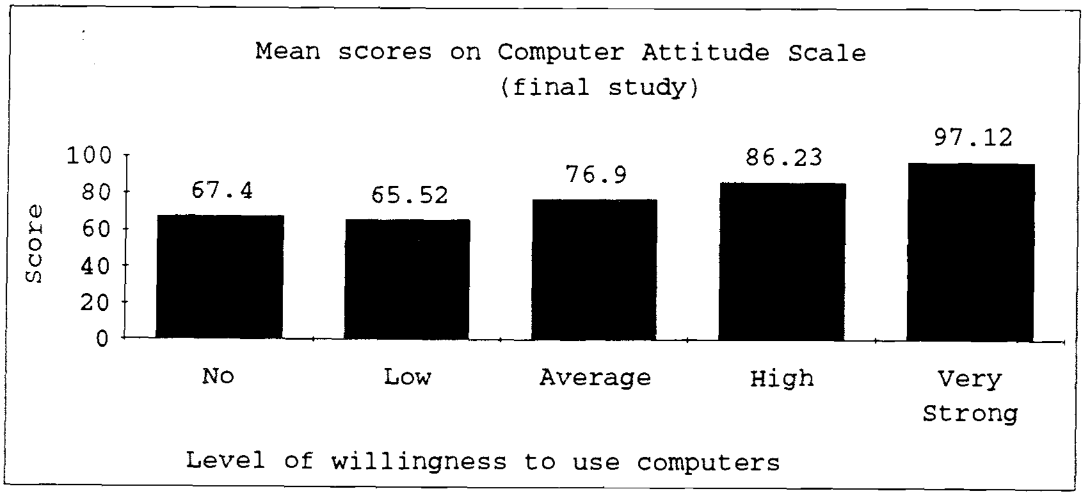

Hoyt-Stunkard's coefficient of reliability
(final study)
0.96
0.95
0.94
0.93
0.92
0.91
R
0.9342
0.9404
0.9308
0.9364
0.9517
0.9575
0.943
Sch.1
Sch.2
Sch.3
Sch.4
Sch.5
Sch.6
All
School

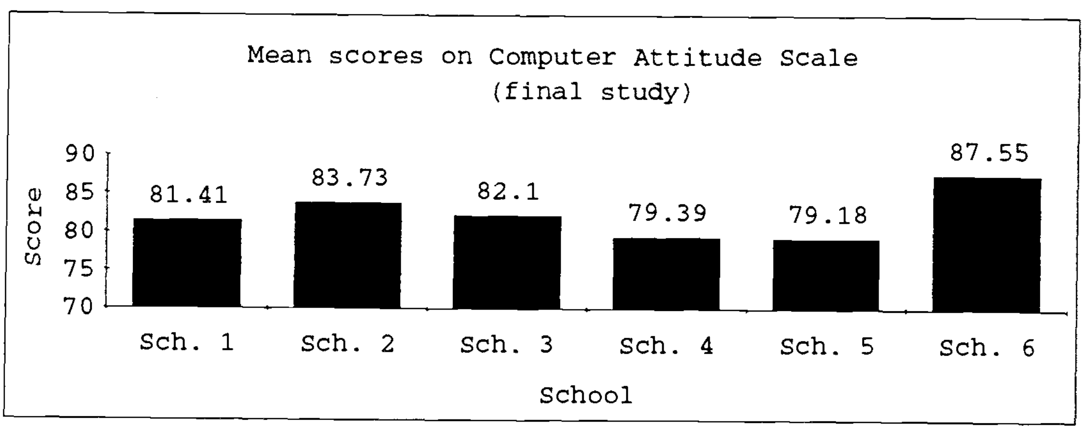

Mean scores on Computer Attitute Scale
(final study)
Score
86
85
84
83
82
81
80
79
78
85.26
81.05
Male
Female
Gender

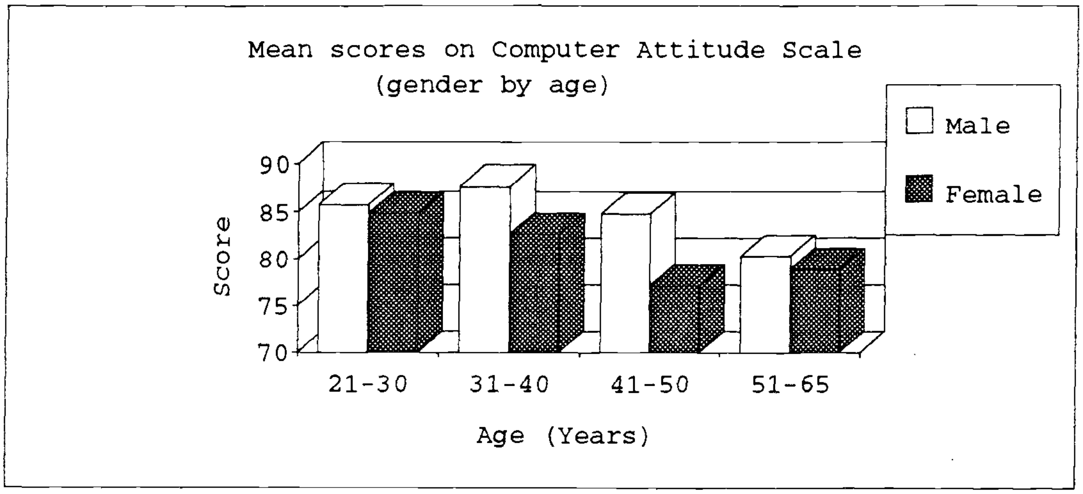

Mean scores on Computer Attitude Scale
(final study)
Score
86
84
82
80
78
76
74
85.01
84.19
78.68
79.85
21-30
31-40
41-50
51-65
Age (Years)

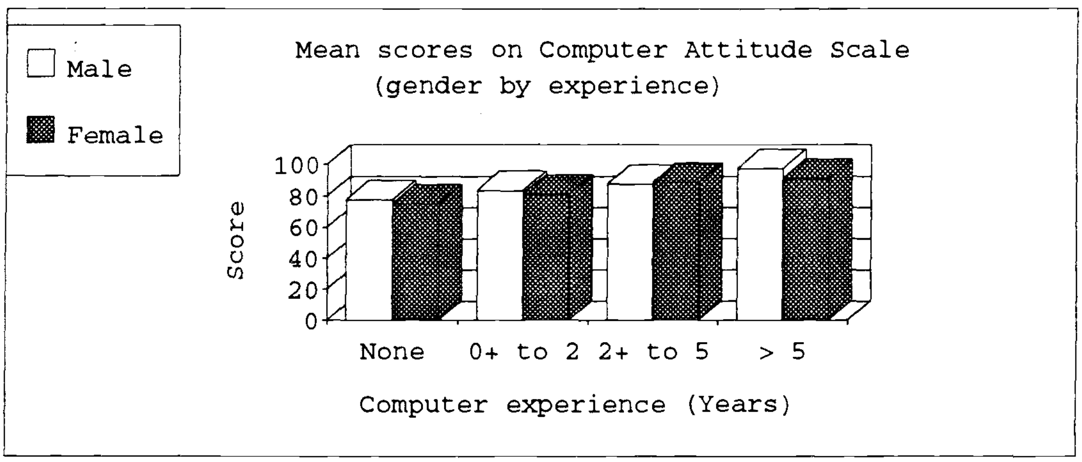

Mean scores on Computer Attitude Scale
(final study)
Score
100
80
60
40
20
0
75.4
81.73
88.18
94.53
None
0+ to 2
2+ to 5
> 5
Computer experience (Years)

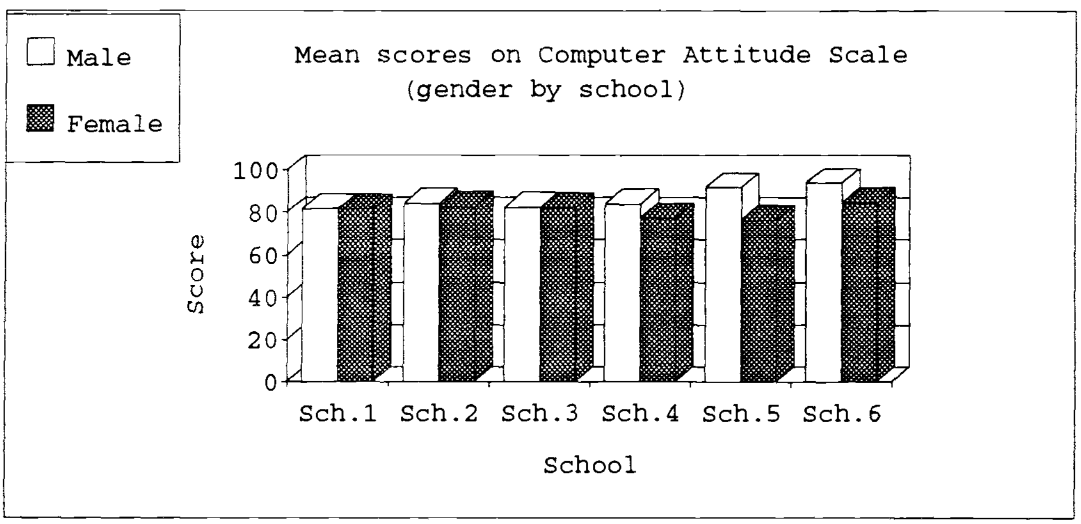

Mean scores on Computer Attitiude Scale
(final study)
Score
95
90
85
80
75
80.52
80.95
84.33
87.18
90.43
None
1 to 20
21 to 50
51 to 100
> 100
Computer training (Hours)

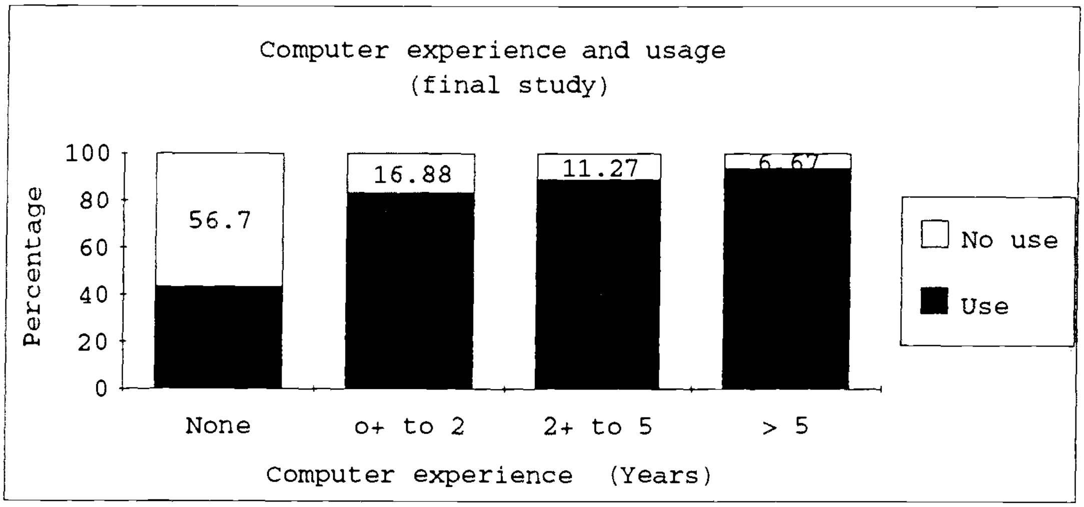

Mean scores on Computer Attitude Scale
(final study)
Score
100
80
60
40
20
0
67.4
65.52
76.9
86.23
97.12
No
Low
Average
High
Very Strong
Level of willingness to use computers


Mean scores on Computer Attitude Scale
(final study)
Score
90
85
80
75
70
81.41
83.73
82.1
79.39
79.18
87.55
Sch. 1
Sch. 2
Sch. 3
Sch. 4
Sch. 5
Sch. 6
School

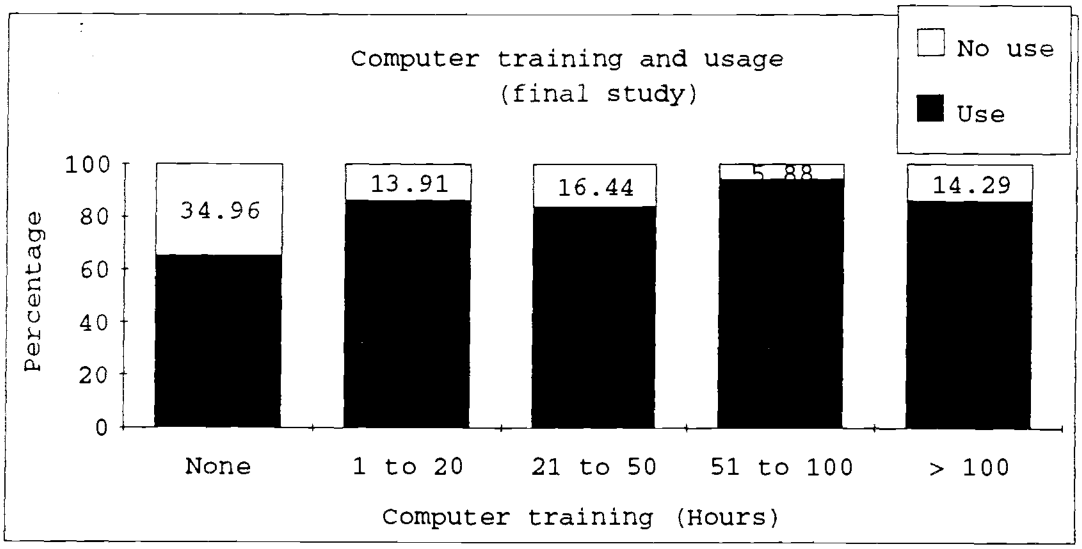

Mean scores on Computer Attitude Scale
(gender by age)
Male
Female
90
85
80
75
70
Score
21-30
31-40
41-50
51-65
Age (Years)


Male
Female
Mean scores on Computer Attitude Scale
(gender by experience)
100
80
60
40
20
0
Score
None
0+ to 2
2+ to 5
> 5
Computer experience (Years)

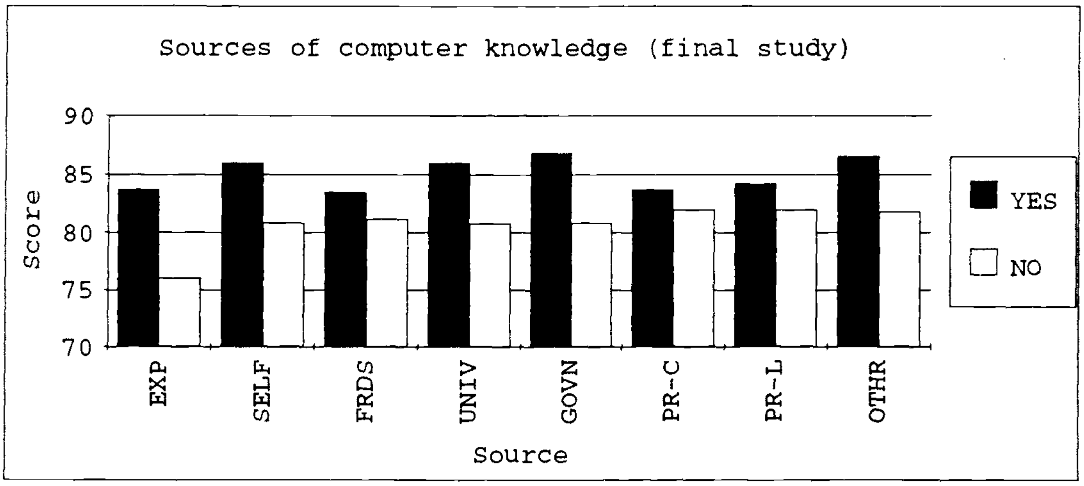

Male
Female
Mean scores on Computer Attitude Scale
(gender by school)
100
80
60
40
20
0
Score
Sch.1
Sch.2
Sch.3
Sch.4
Sch.5
Sch.6
School



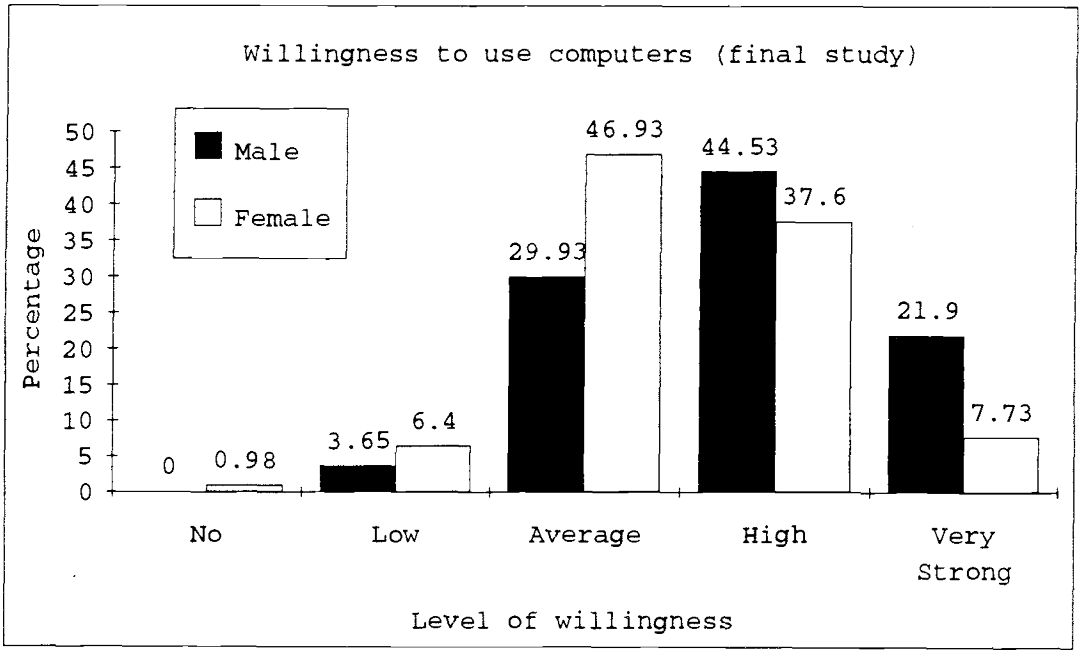
Computer experience and usage
(final study)
Percentage
100
80
60
40
20
0
56.7
16.88
11.27
6.67
No use
Use
None
o+ to 2
2+ to 5
> 5
Computer experience (Years)

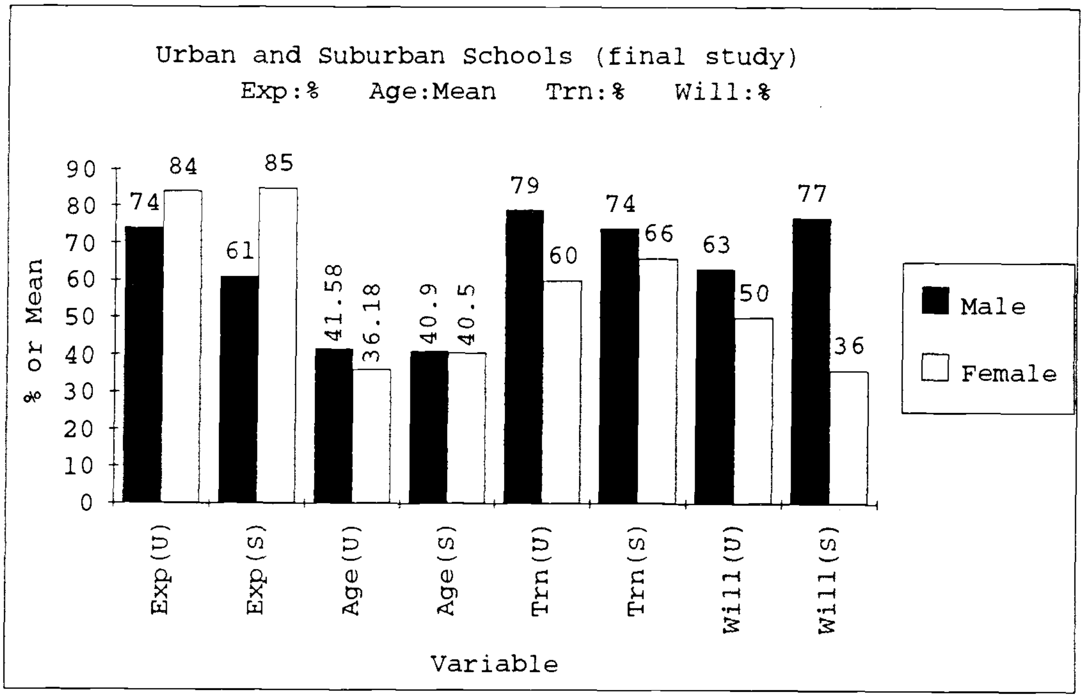


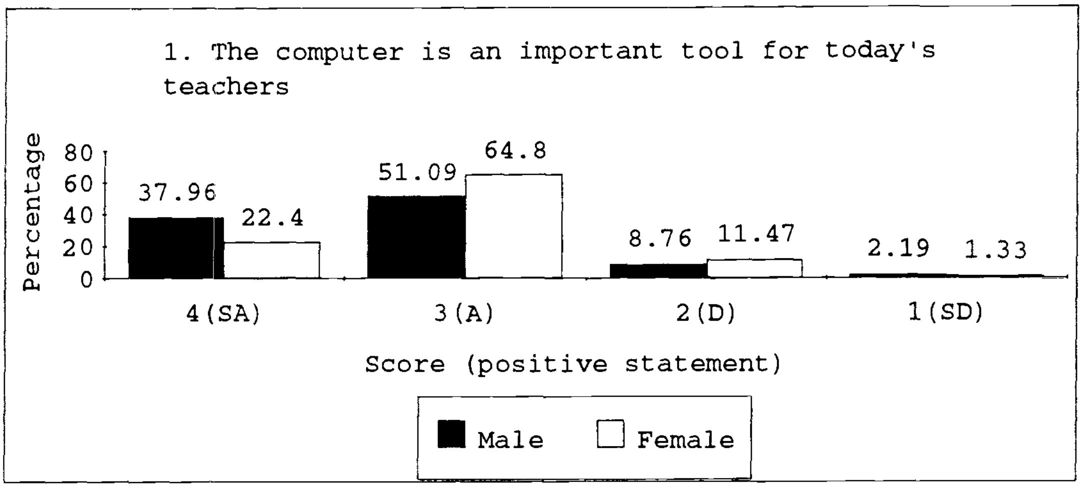
Computer training and usage
(final study)
No use
Use
Percentage
100
80
60
40
20
0
34.96
13.91
16.44
5.88
14.29
None
1 to 20
21 to 50
51 to 100
> 100
Computer training (Hours)

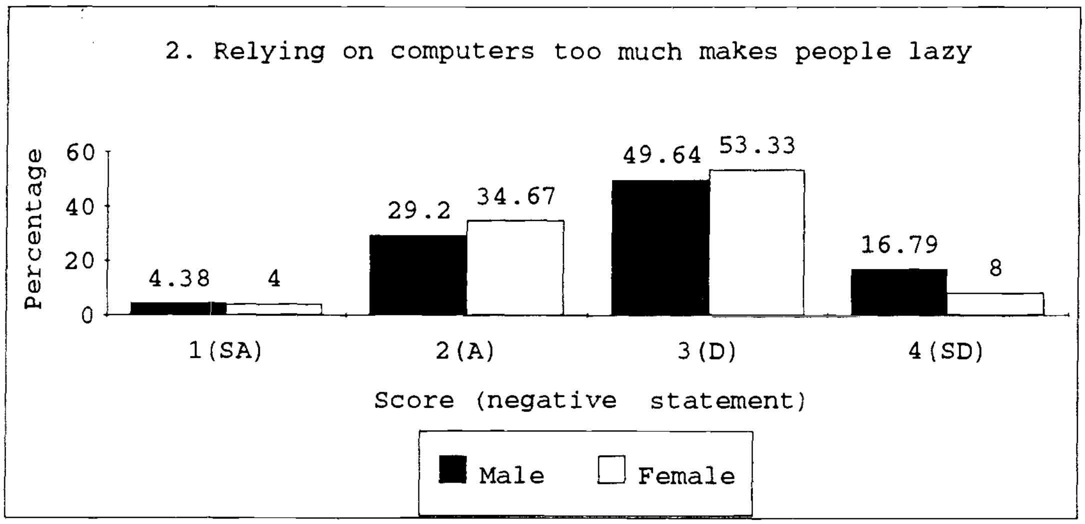


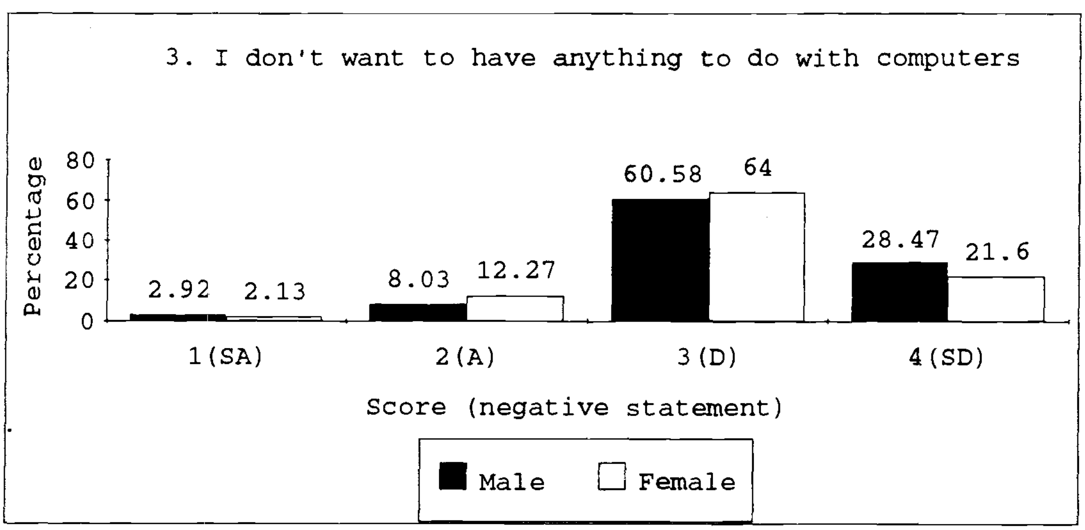
Sources of computer knowledge (final study)
Score
90
85
80
75
70
YES
NO
EXP
SELF
FRDS
UNIV
GOVN
PR-C
PR-L
OTHR
Source

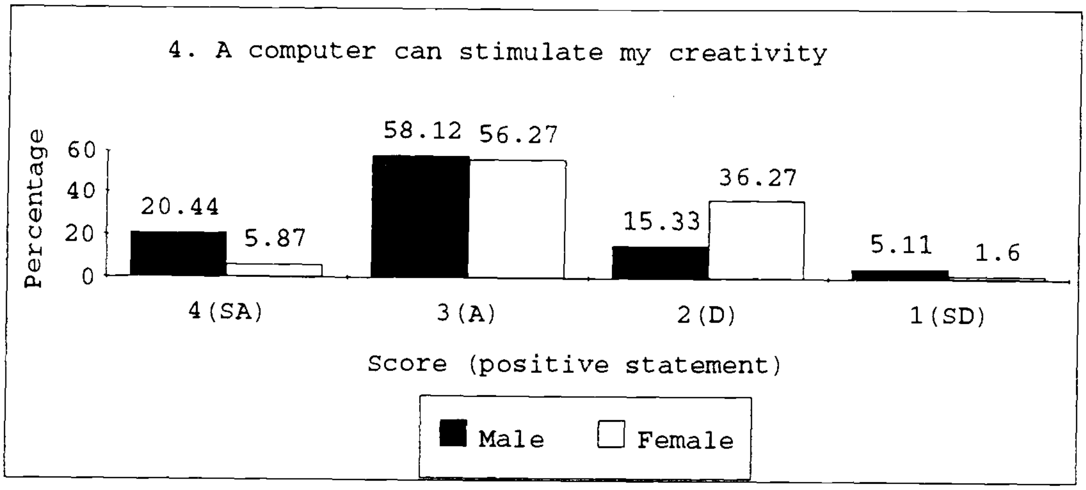

Willingness to use computers (final study)
Male
Female
Percentage
50
45
40
35
30
25
20
15
10
5
0
0
0.98
3.65
6.4
29.93
46.93
44.53
37.6
21.9
7.73
No
Low
Average
High
Very Strong
Level of willingness

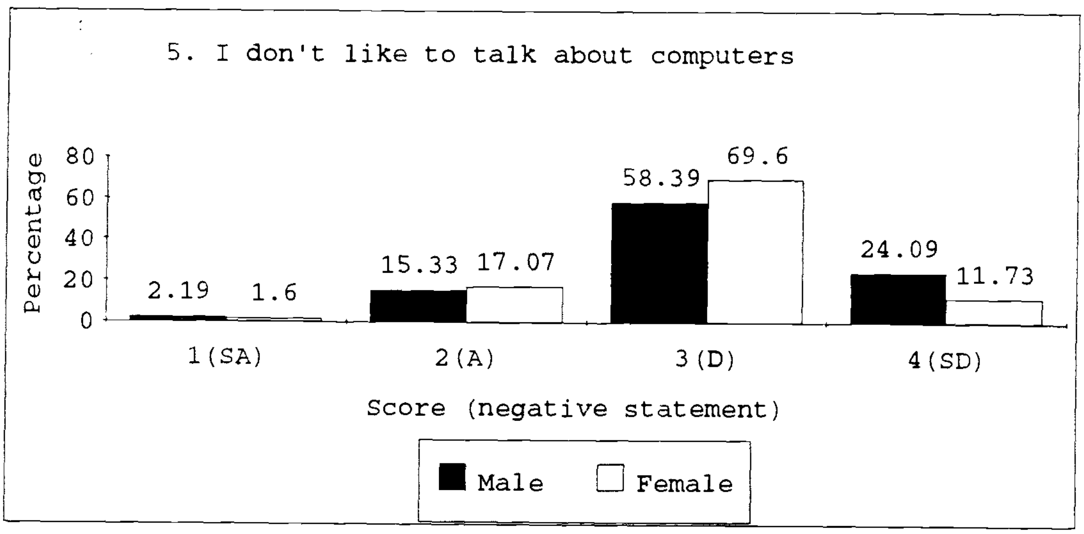

Urban and Suburban Schools (final study)
Exp:% Age:Mean Trn:% Will:%
% or Mean
90
80
70
60
50
40
30
20
10
0
74
84
61
85
41.58
36.18
40.9
40.5
79
60
74
66
63
50
77
36
Male
Female
Exp(U)
Exp(S)
Age(U)
Age(S)
Trn(U)
Trn(S)
Will(U)
Will(S)
Variable

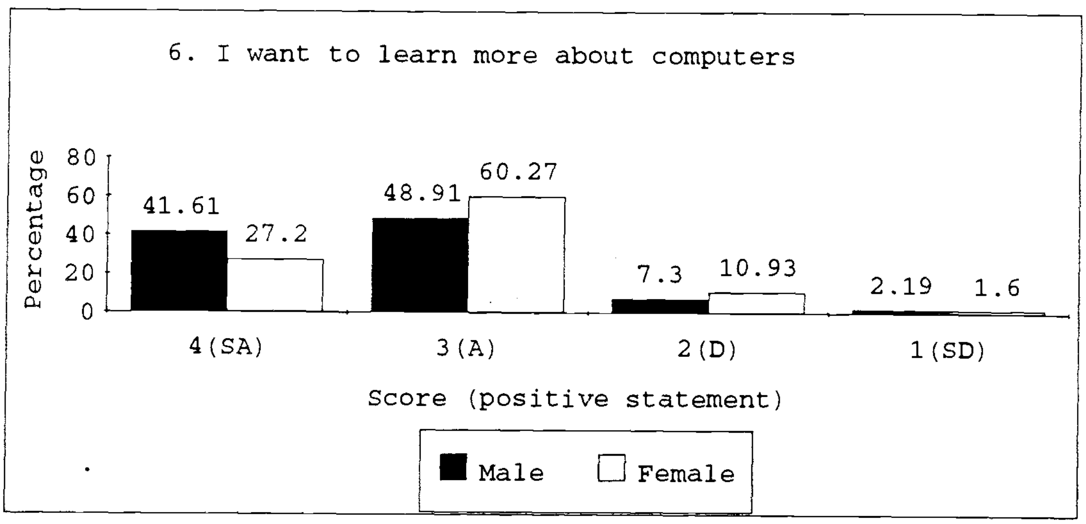

1. The computer is an important tool for today's teachers
Percentage
80
60
40
20
0
37.96
22.4
51.09
64.8
8.76
11.47
2.19
1.33
4(SA)
3(A)
2(D)
1(SD)
Score (positive statement)
Male
Female

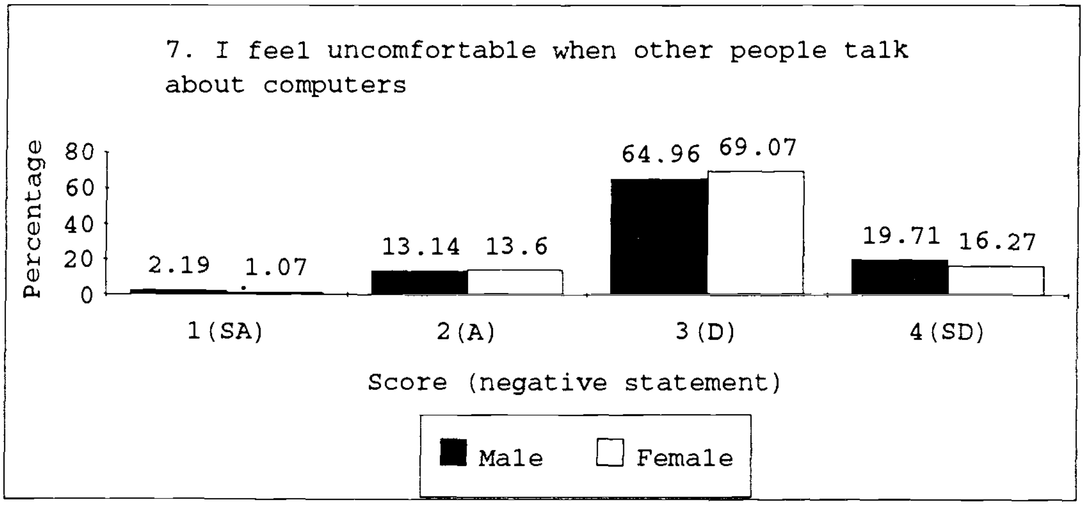

2. Relying on computers too much makes people lazy
Percentage
60
40
20
0
4.38
4
29.2
34.67
49.64
53.33
16.79
8
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

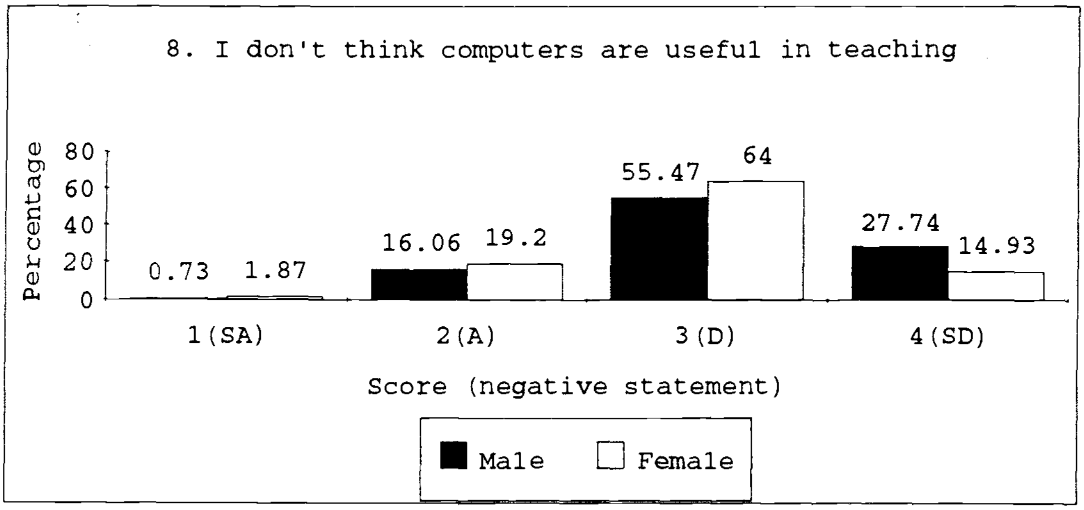

3. I don't want to have anything to do with computers
Percentage
80
60
40
20
0
2.92
2.13
8.03
12.27
60.58
64
28.47
21.6
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

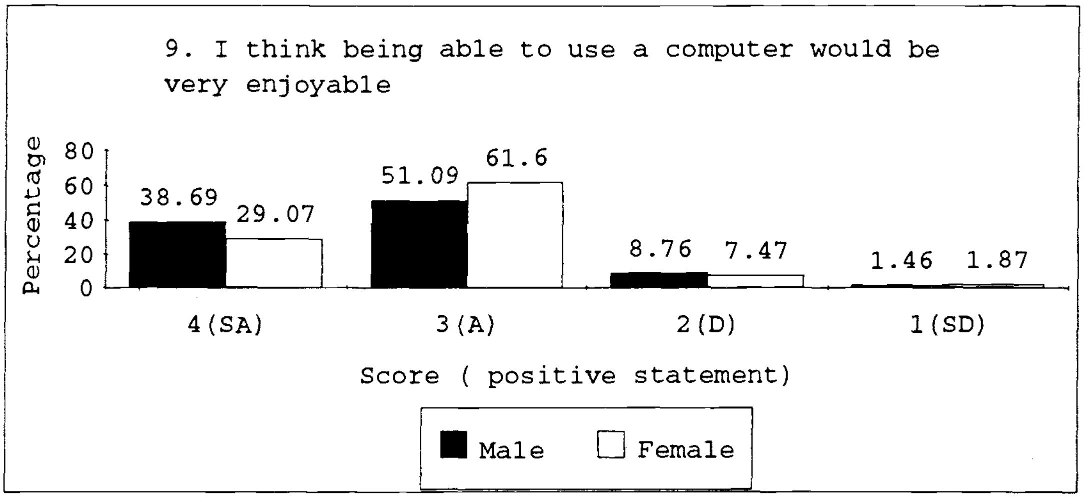

4. A computer can stimulate my creativity
Percentage
60
40
20
0
20.44
5.87
58.12
56.27
15.33
36.27
5.11
1.6
4(SA)
3(A)
2(D)
1(SD)
Score (positive statement)
Male
Female

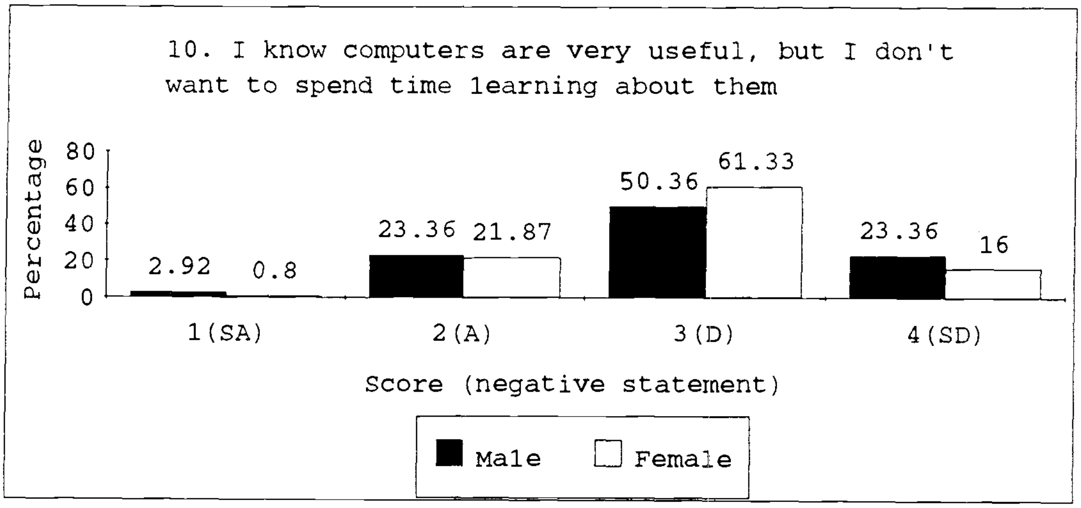

5. I don't like to talk about computers
Percentage
80
60
40
20
0
2.19
1.6
15.33
17.07
58.39
69.6
24.09
11.73
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

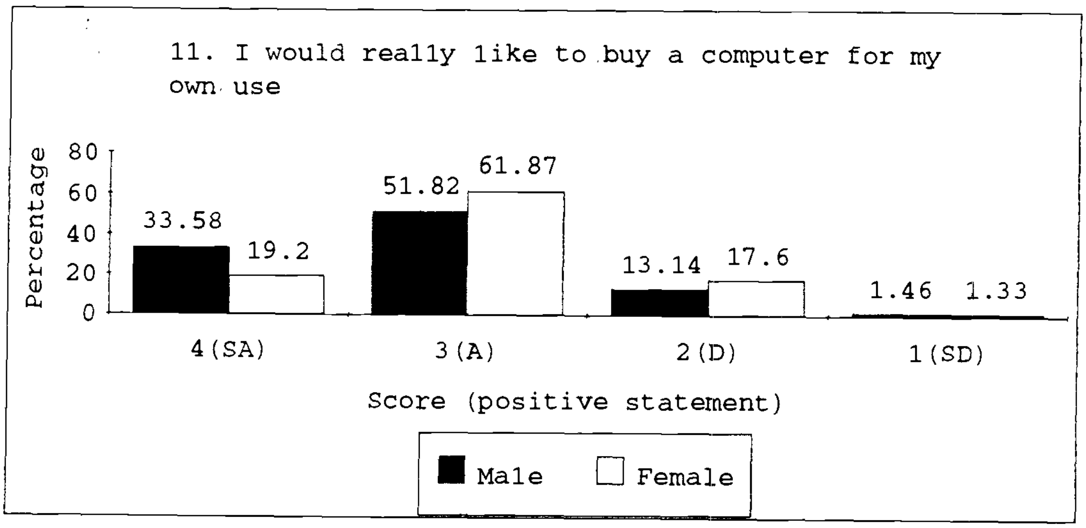

6. I want to learn more about computers
Percentage
80
60
40
20
0
41.61
27.2
48.91
60.27
7.3
10.93
2.19
1.6
4(SA)
3(A)
2(D)
1(SD)
Score (positive statement)
Male
Female

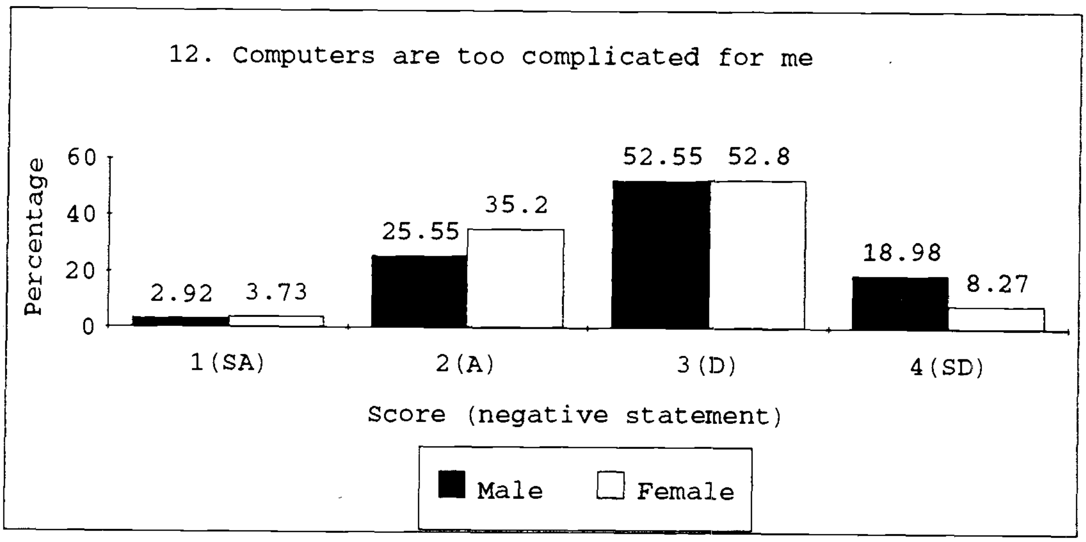

7. I feel uncomfortable when other people talk about computers
Percentage
80
60
40
20
0
2.19
1.07
13.14
13.6
64.96
69.07
19.71
16.27
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

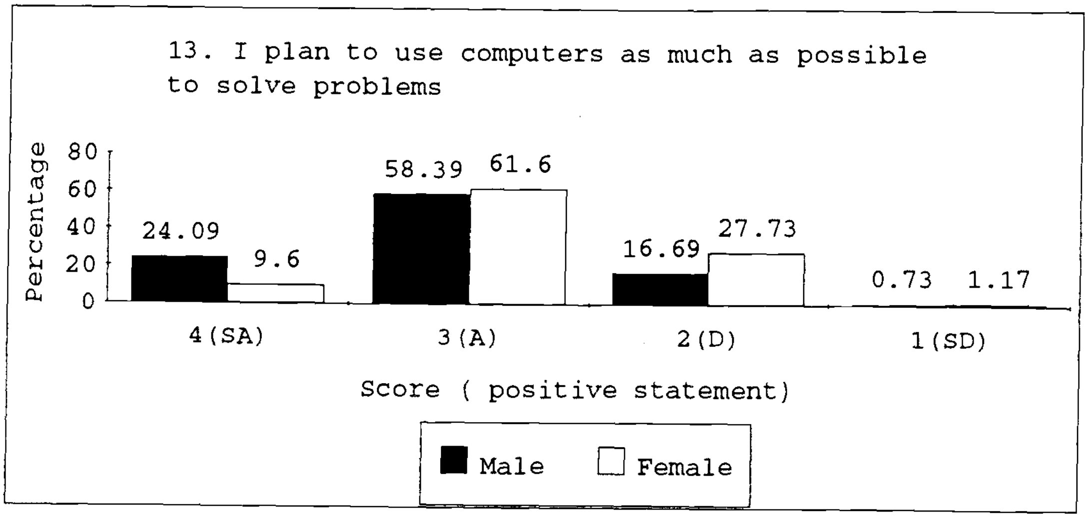

8. I don't think computers are useful in teaching
Percentage
80
60
40
20
0
0.73
1.87
16.06
19.2
55.47
64
27.74
14.93
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

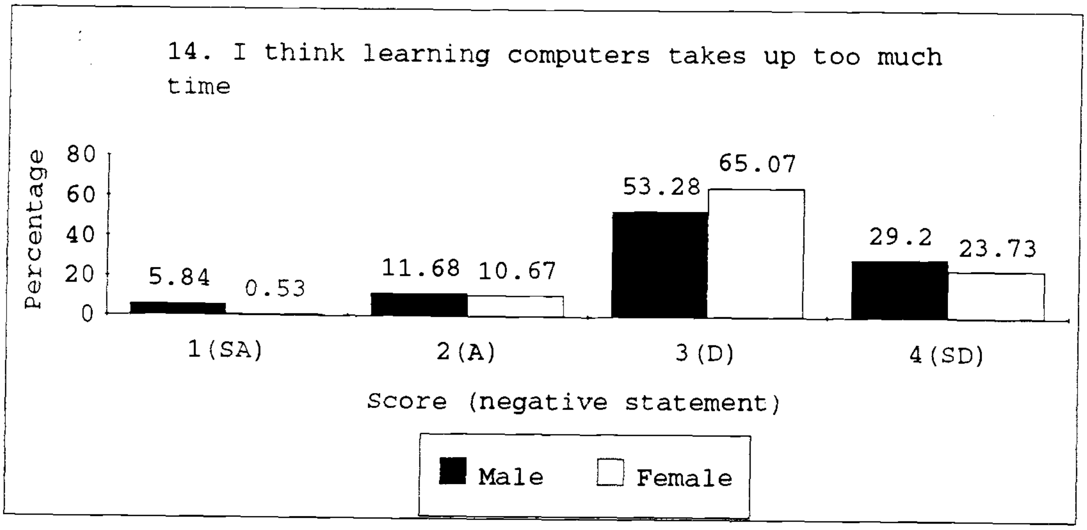

9. I think being able to use a computer would be very enjoyable
Percentage
80
60
40
20
0
38.69
29.07
51.09
61.6
8.76
7.47
1.46
1.87
4(SA)
3(A)
2(D)
1(SD)
Score (positive statement)
Male
Female

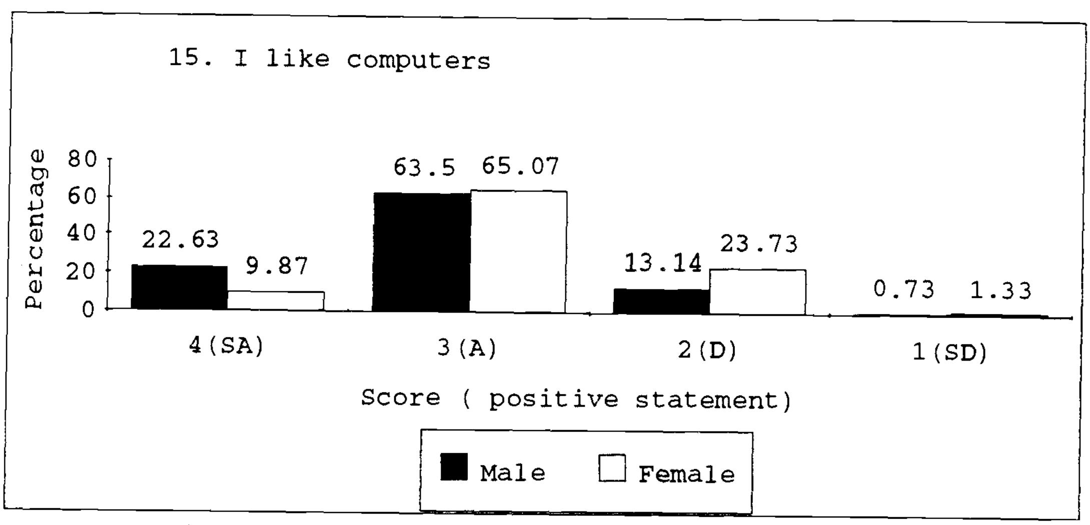

10. I know computers are very useful, but I don't want to spend time learning about them
Percentage
80
60
40
20
0
2.92
0.8
23.36
21.87
50.36
61.33
23.36
16
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

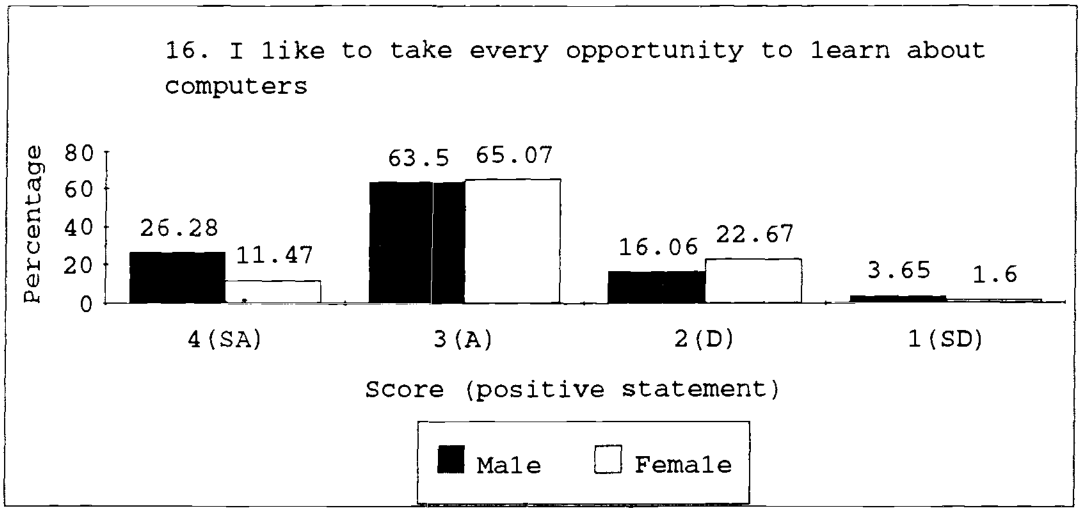

11. I would really like to buy a computer for my own use
Percentage
80
60
40
20
0
33.58
19.2
51.82
61.87
13.14
17.6
1.46
1.33
4(SA)
3(A)
2(D)
1(SD)
Score (positive statement)
Male
Female

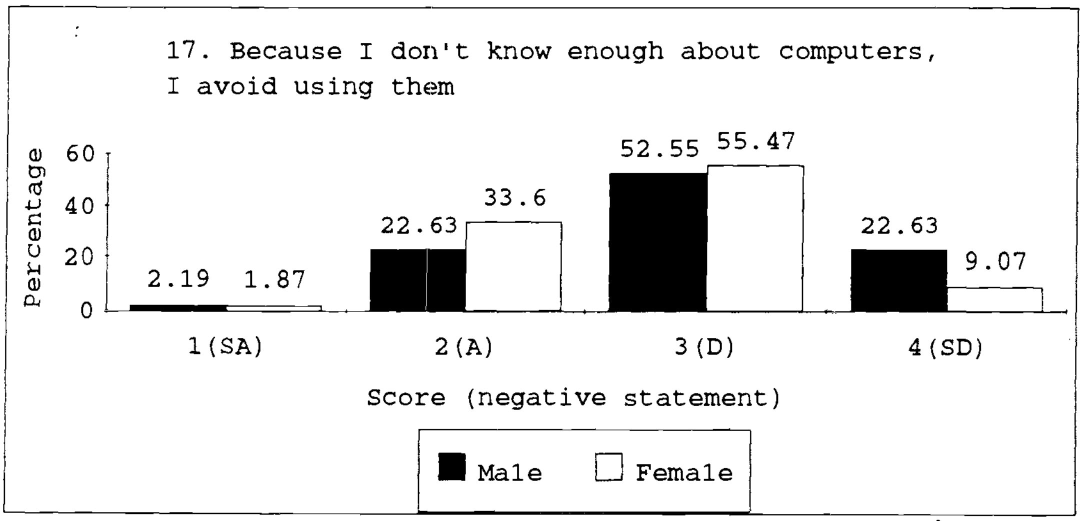

12. Computers are too complicated for me
Percentage
60
40
20
0
2.92
3.73
25.55
35.2
52.55
52.8
18.98
8.27
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

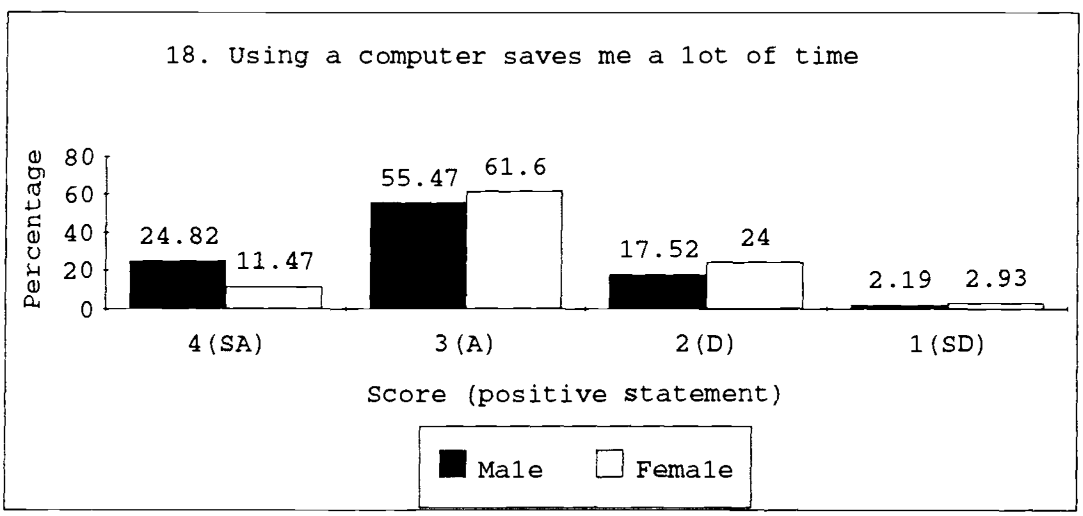

13. I plan to use computers as much as possible to solve problems
Percentage
80
60
40
20
0
24.09
9.6
58.39
61.6
16.69
27.73
0.73
1.17
4(SA)
3(A)
2(D)
1(SD)
Score (positive statement)
Male
Female

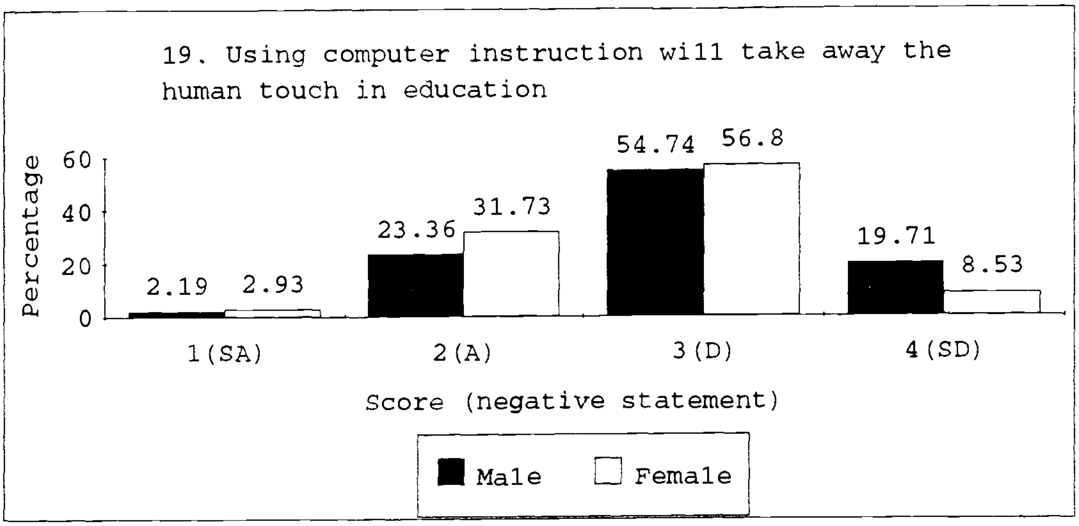

14. I think learning computers takes up too much time
Percentage
80
60
40
20
0
5.84
0.53
11.68
10.67
53.28
65.07
29.2
23.73
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

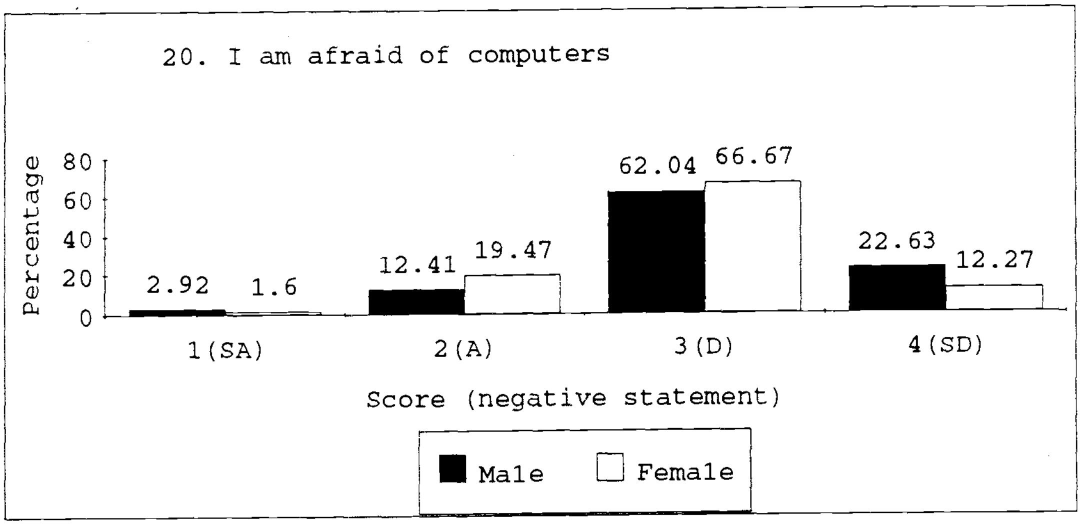

15. I like computers
Percentage
80
60
40
20
0
22.63
9.87
63.5
65.07
13.14
23.73
0.73
1.33
4(SA)
3(A)
2(D)
1(SD)
Score (positive statement)
Male
Female

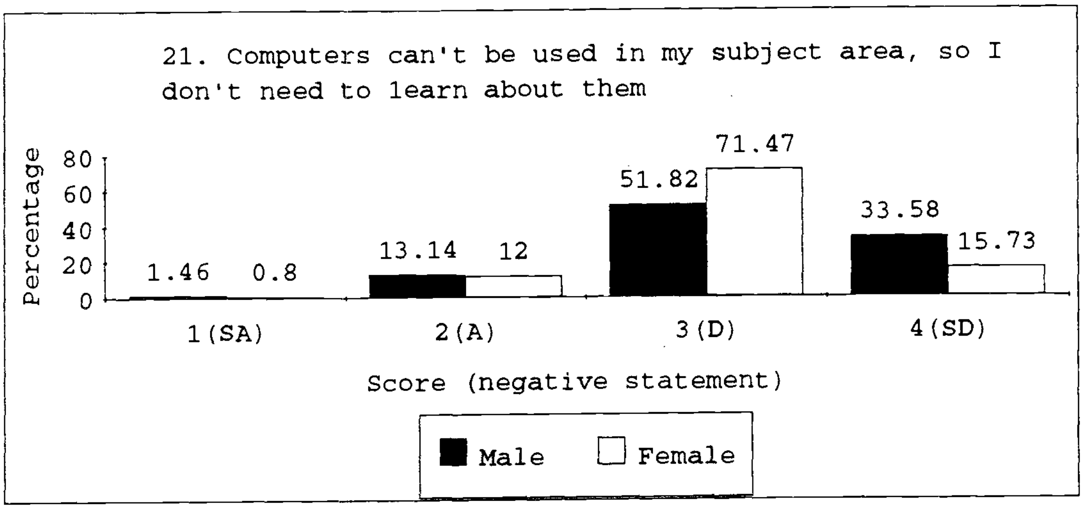

16. I like to take every opportunity to learn about computers
Percentage
80
60
40
20
0
26.28
11.47
63.5
65.07
16.06
22.67
3.65
1.6
4(SA)
3(A)
2(D)
1(SD)
Score (positive statement)
Male
Female

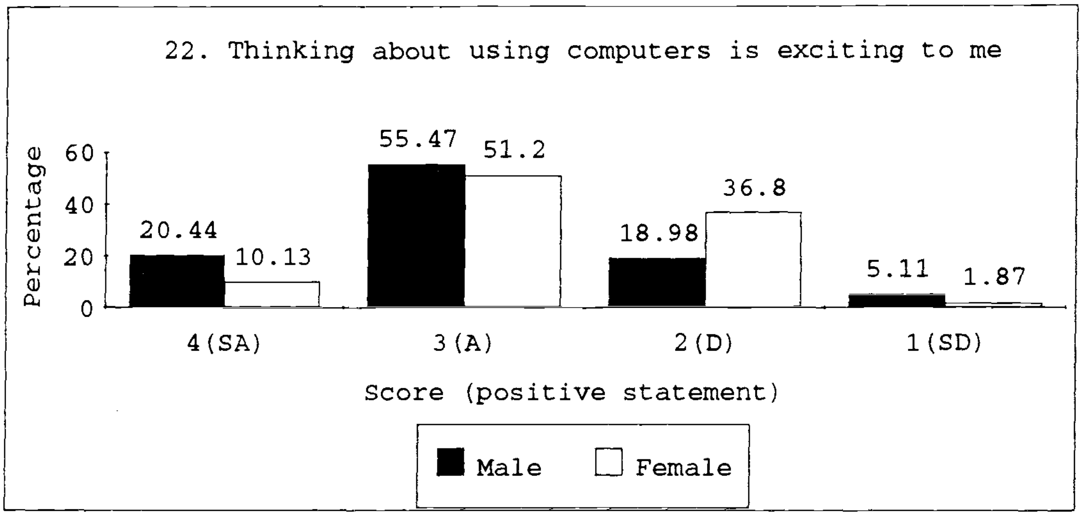

17. Because I don't know enough about computers, I avoid using them
Percentage
60
40
20
0
2.19
1.87
22.63
33.6
52.55
55.47
22.63
9.07
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

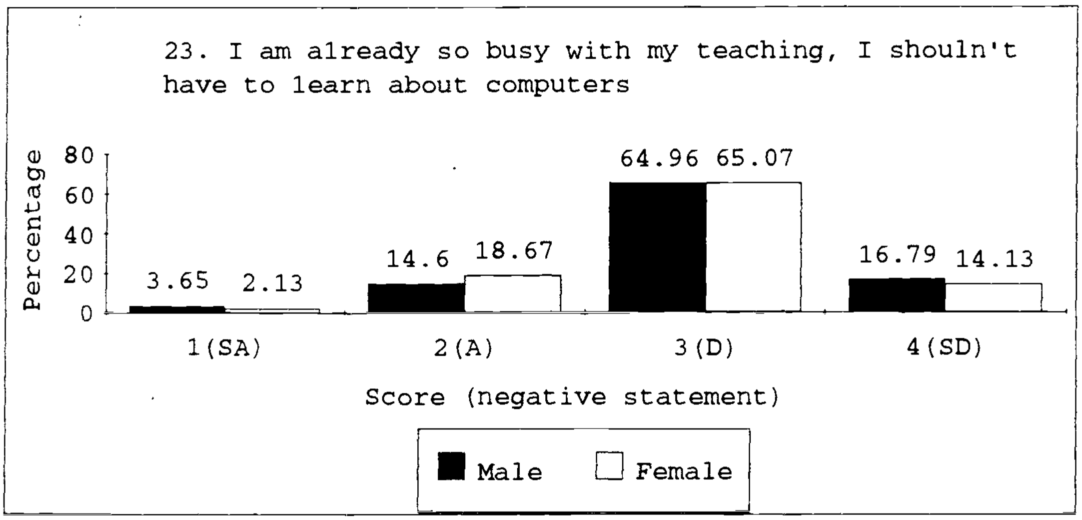

18. Using a computer saves me a lot of time
Percentage
80
60
40
20
0
24.82
11.47
55.47
61.6
17.52
24
2.19
2.93
4(SA)
3(A)
2(D)
1(SD)
Score (positive statement)
Male
Female

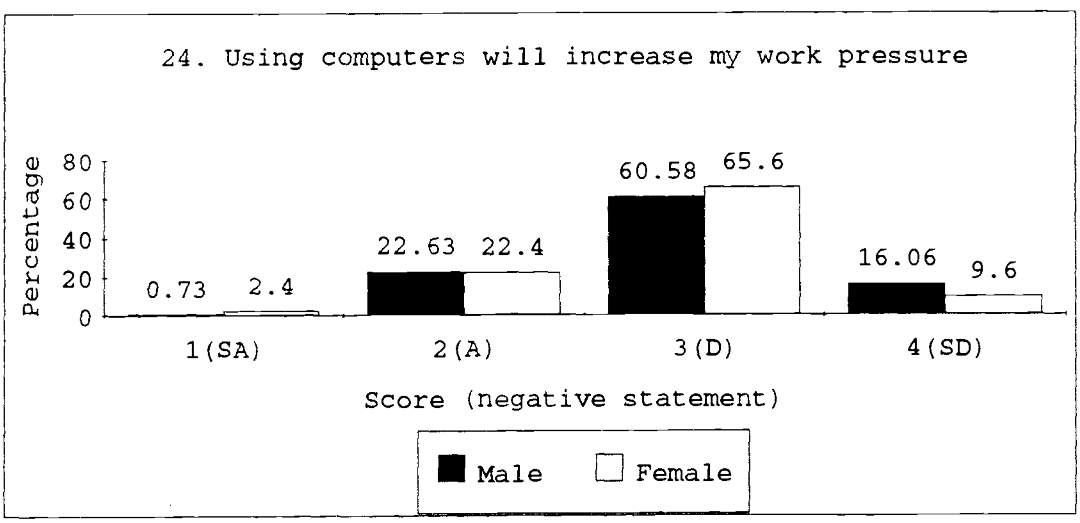

19. Using computer instruction will take away the human touch in education
Percentage
60
40
20
0
2.19
2.93
23.36
31.73
54.74
56.8
19.71
8.53
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

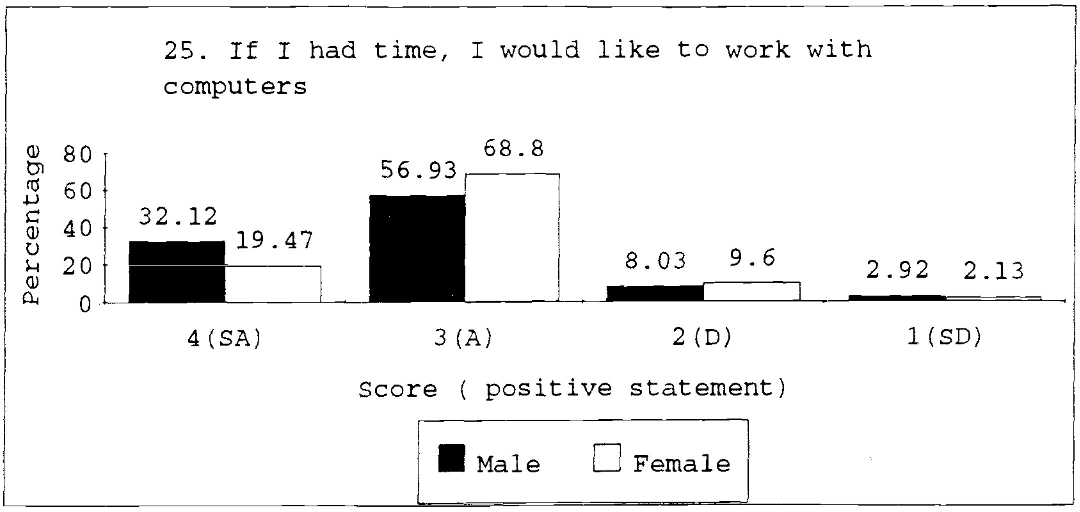

20. I am afraid of computers
Percentage
80
60
40
20
0
2.92
1.6
12.41
19.47
62.04
66.67
22.63
12.27
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

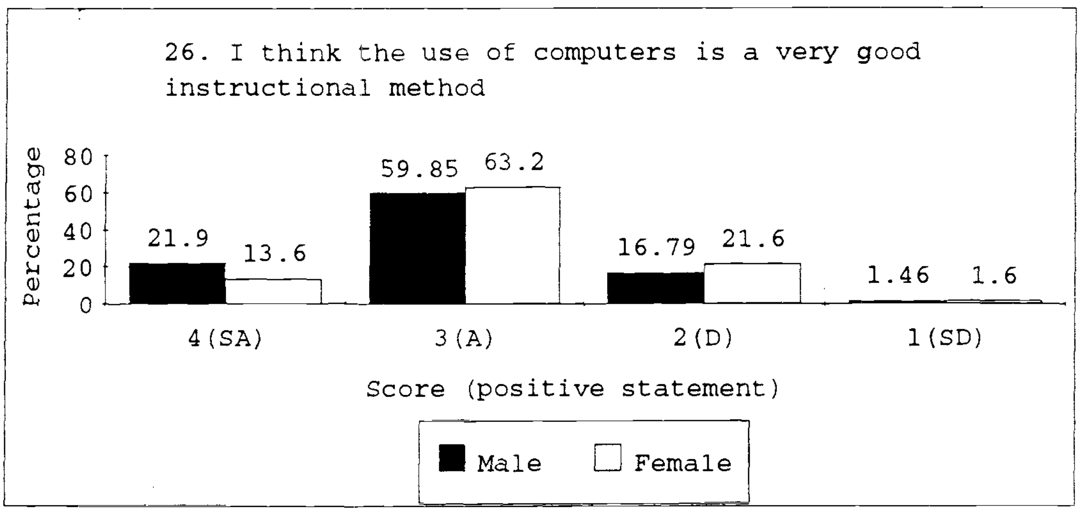

21. Computers can't be used in my subject area, so I don't need to learn about them
Percentage
80
60
40
20
0
1.46
0.8
13.14
12
51.82
71.47
33.58
15.73
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

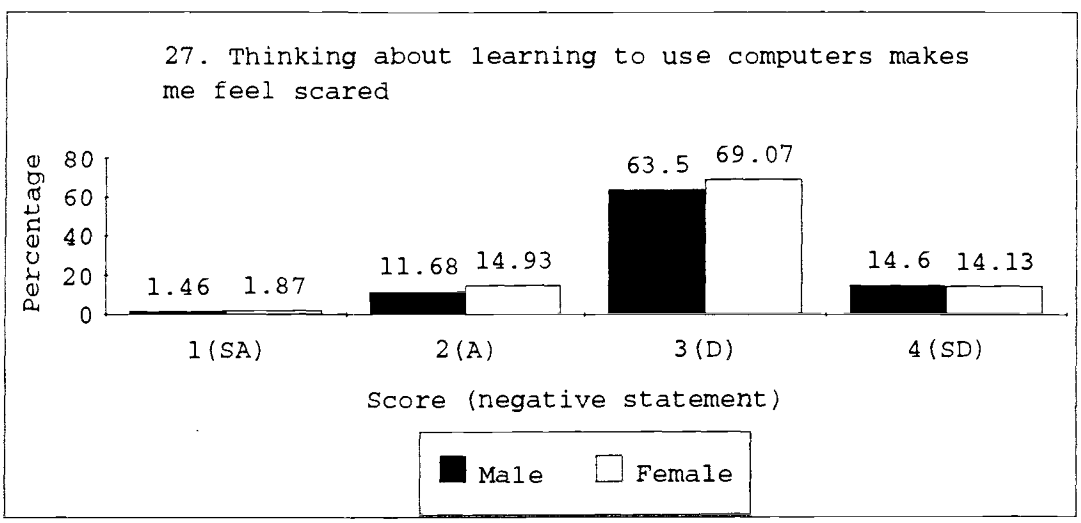

22. Thinking about using computers is exciting to me
Percentage
0
20
40
60
20.44
10.13
55.47
51.2
18.98
36.8
5.11
1.87
4(SA)
3(A)
2(D)
1(SD)
Score (positive statement)
Male
Female

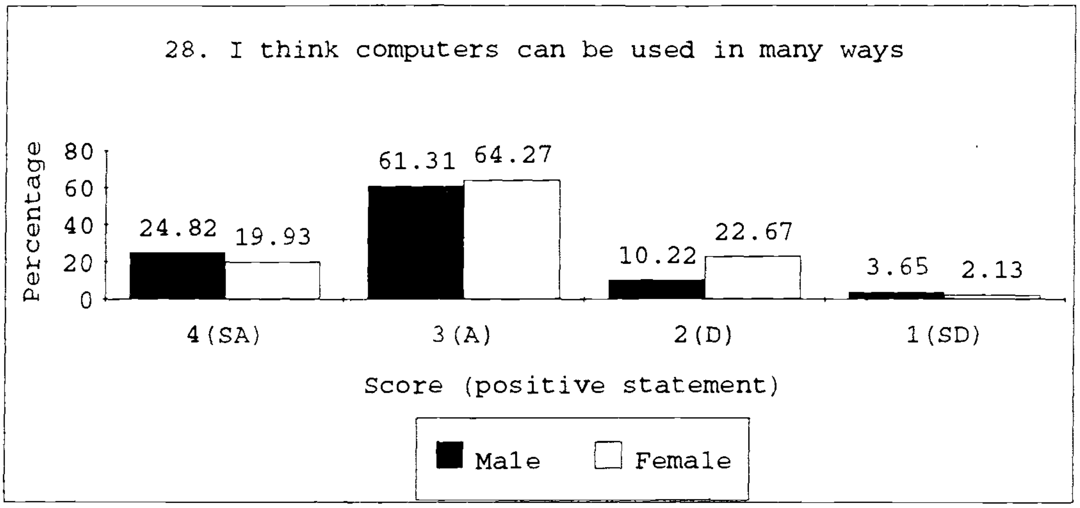

23. I am already so busy with my teaching, I shouln't have to learn about computers
Percentage
0
20
40
60
80
3.65
2.13
14.6
18.67
64.96
65.07
16.79
14.13
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

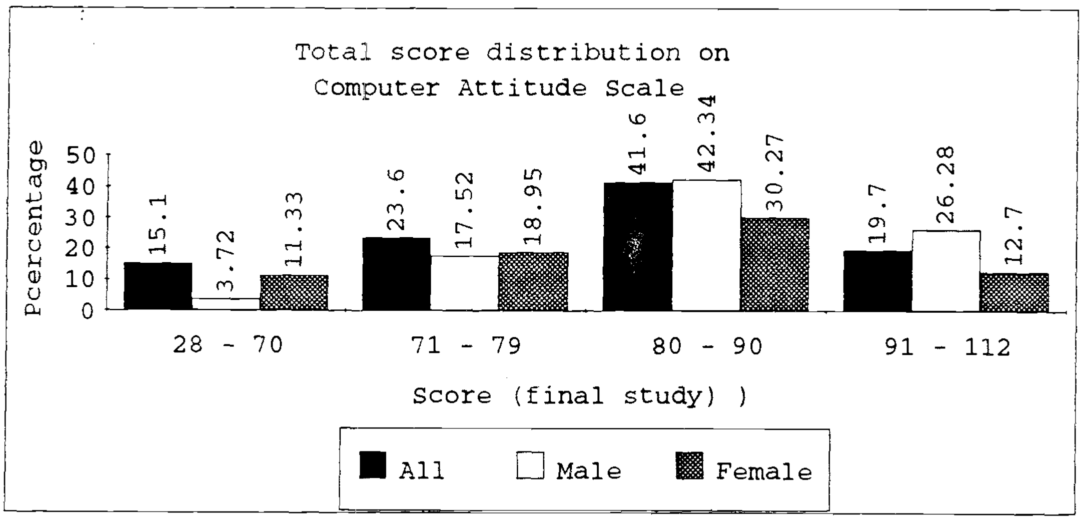

24. Using computers will increase my work pressure
Percentage
0
20
40
60
80
0.73
2.4
22.63
22.4
60.58
65.6
16.06
9.6
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

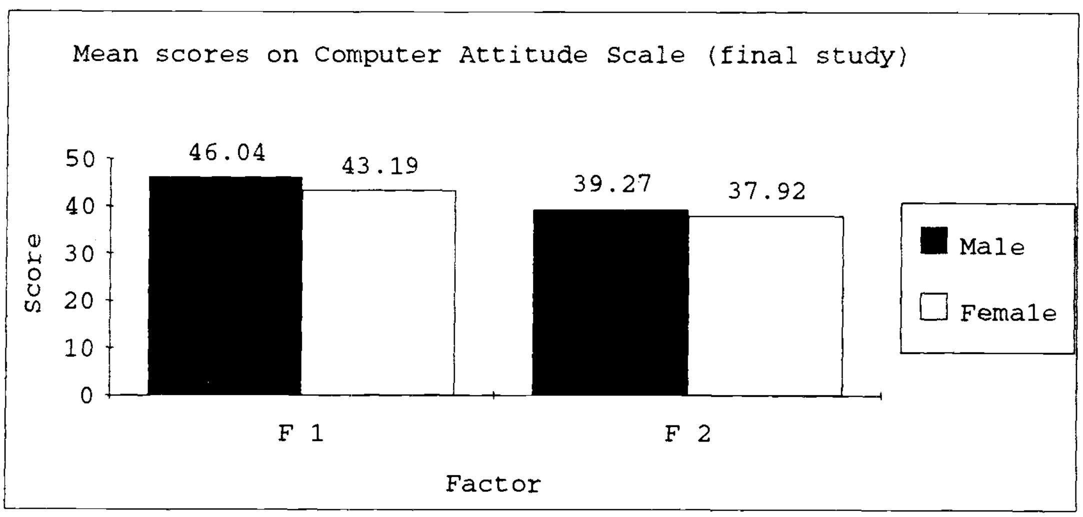

25. If I had time, I would like to work with computers
Percentage
80
60
40
20
0
32.12
19.47
56.93
68.8
8.03
9.6
2.92
2.13
4(SA)
3(A)
2(D)
1(SD)
Score (positive statement)
Male
Female

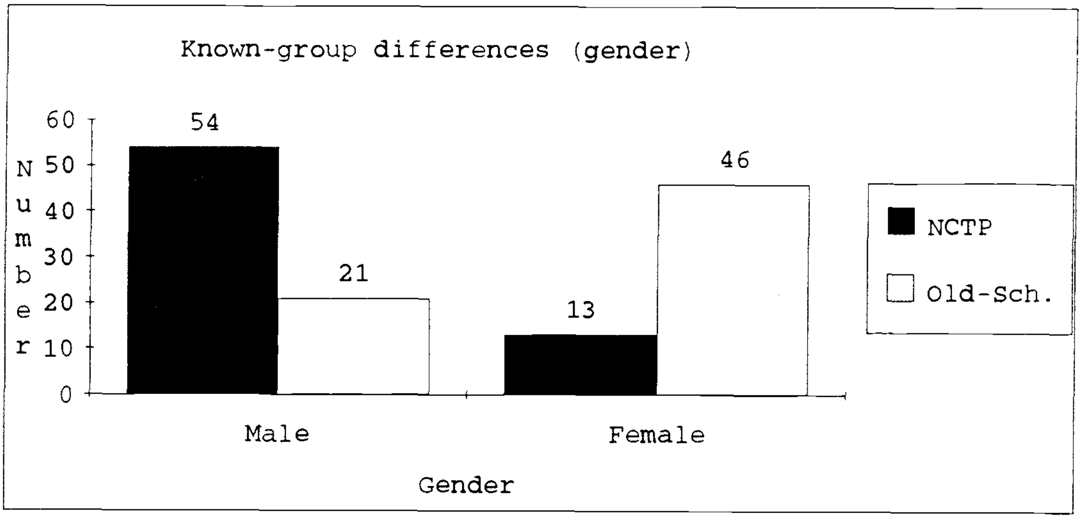

26. I think the use of computers is a very good instructional method
Percentage
80
60
40
20
0
21.9
13.6
59.85
63.2
16.79
21.6
1.46
1.6
4(SA)
3(A)
2(D)
1(SD)
Score (positive statement)
Male
Female

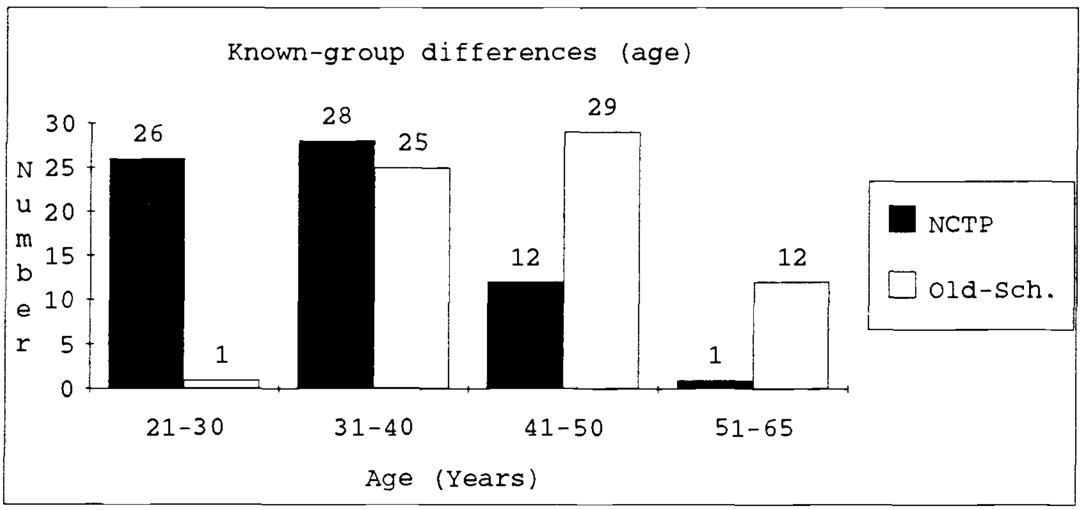

27. Thinking about learning to use computers makes me feel scared
Percentage
80
60
40
20
0
1.46
1.87
11.68
14.93
63.5
69.07
14.6
14.13
1(SA)
2(A)
3(D)
4(SD)
Score (negative statement)
Male
Female

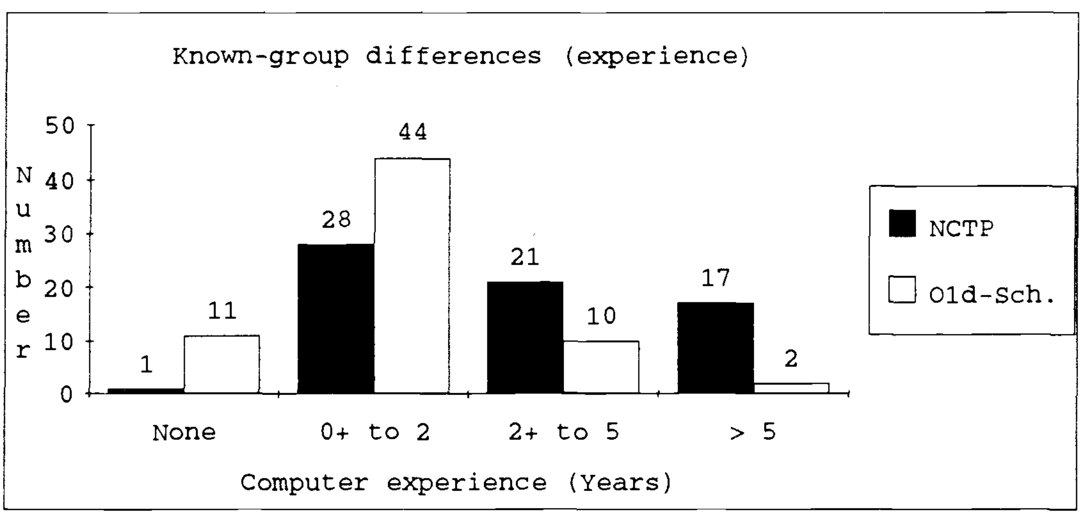

28. I think computers can be used in many ways
Percentage
80
60
40
20
0
24.82
19.93
61.31
64.27
10.22
22.67
3.65
2.13
4(SA)
3(A)
2(D)
1(SD)
Score (positive statement)
Male
Female

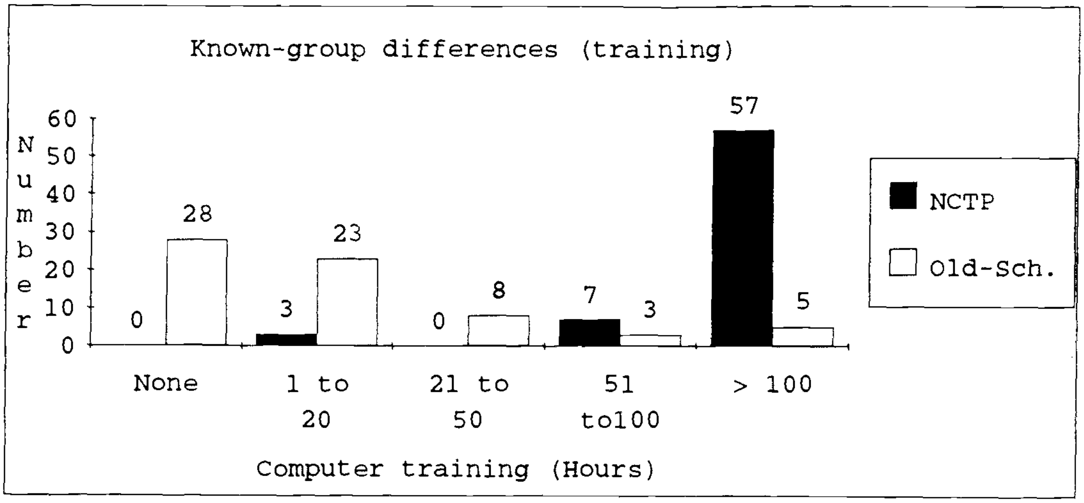

Total score distribution on
Computer Attitude Scale
Pcercentage
50
40
30
20
10
0
15.1
3.72
11.33
23.6
17.52
18.95
41.6
42.34
30.27
19.7
26.28
12.7
28 - 70
71 - 79
80 - 90
91 - 112
Score (final study))
All
Male
Female

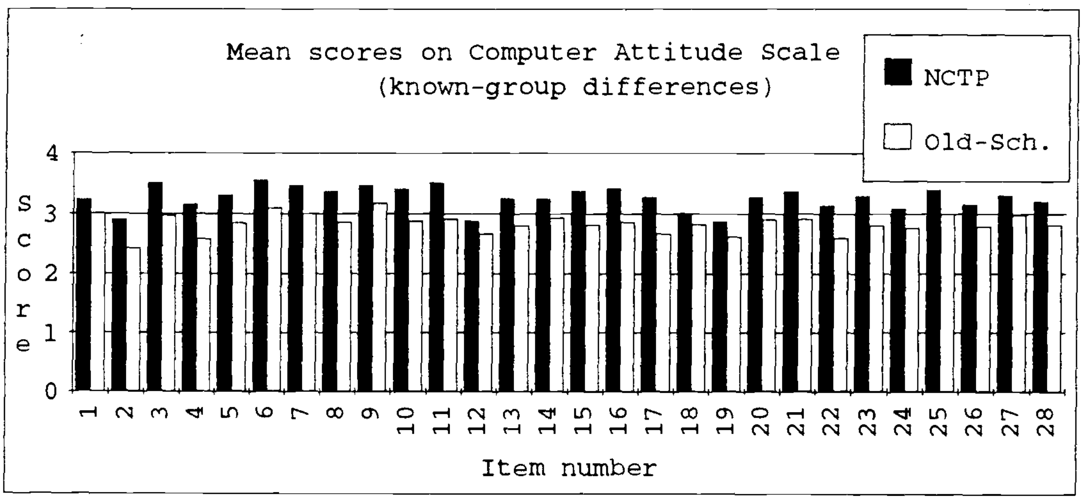

Mean scores on Computer Attitude Scale (final study)
Score
50
40
30
20
10
0
46.04
43.19
39.27
37.92
F 1
F 2
Factor
Male
Female

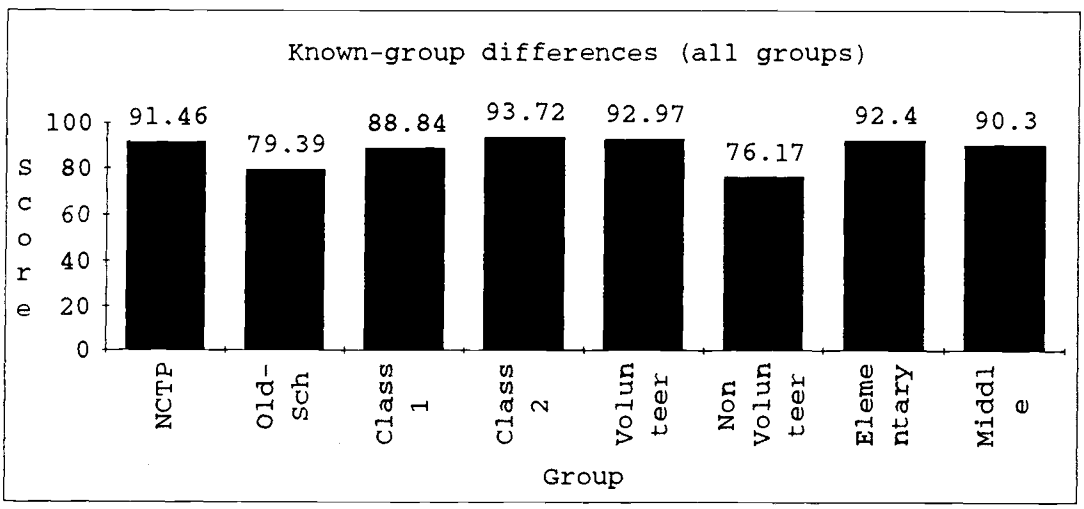

Known-group differences (gender)
Number
0
10
20
30
40
50
60
54
21
13
46
Male
Female
Gender
NCTP
Old-Sch.


Known-group differences (age)
Number
0
5
10
15
20
25
30
26
1
28
25
12
29
1
12
21-30
31-40
41-50
51-65
Age (Years)
NCTP
Old-Sch.


Known-group differences (experience)
Number
0
10
20
30
40
50
1
11
28
44
21
10
17
2
None
0+ to 2
2+ to 5
> 5
Computer experience (Years)
NCTP
Old-Sch.


Known-group differences (training)
Number
60
50
40
30
20
10
0
0
28
3
23
0
8
7
3
57
5
None
1 to 20
21 to 50
51 to100
> 100
Computer training (Hours)
NCTP
Old-Sch.


Mean scores on Computer Attitude Scale (known-group differences)
NCTP
Old-Sch.
Score
4
3
2
1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
Item number


Known-group differences (all groups)
Score
100
80
60
40
20
0
91.46
79.39
88.84
93.72
92.97
76.17
92.4
90.3
NCTP
Old-Sch
Class 1
Class 2
Volunteer
Non Volunteer
Elementary
Middle
Group

Appendix P

Instrument for the Final Study of Computer Attitudes (Chinese Version)

中華民國國中國小教師對電腦的態度
問　卷

敬愛的老師：

近幾年來爲了電腦教育的發展，政府在各級學校投下了不少的人力和物力。國中國小老師在我國發展資訊教育的過程中佔有舉足輕重的地位。爲了瞭解國中國小教師對電腦的態度，敝人在有關單位的協助下做了一系列的研究。本次研究的目的在於希望透過本問卷來瞭解您對電腦所持的態度，進而瞭解現階段我國國中國小教師對電腦的態度。因此，您提供的意見對我國資訊教育的發展方向將有重要的貢獻。　　謝謝您的協助 ！

謹祝　　教　安

研究主持人　劉弘煌 敬上

八十二 年 六 月 十五日

請依照下列說明完成您的問卷：

一、答案並無對錯，純粹按照您個人的眞實情況回答。

二、每題請按照您個人對該問項贊成或不贊成的程度回答。

三、圈選答案時請不必考慮太多，直覺反應往往最能反映出您眞實的態度。

四、請務必回答每一問題。

範 例:

	非常同意	同意	不同意	非常不同意
23. 電腦是教育上非常有用的工具	□	☑	□	□

這句問項依照您個人贊同的程度，如果：

您非常贊同就在　"非常同意"　的空格裡打 "✓"

您非常不贊同就在 "非常不同意" 的空格裡打 "✓"

若您不能確定，請在 "同意" 和 "不同意" 兩者中選擇與您的意見較接近者！

註：請不要遺漏任何一題(否則此問卷將無法作進一步的統計分析)

第一部份：電腦態度問卷

	非常同意	同意	不同意	非常不同意
1. 電腦是現今教師的重要工具	☐	☐	☐	☐
2. 過度使用電腦會使人產生惰性	☐	☐	☐	☐
3. 我對電腦有排斥感	☐	☐	☐	☐
4. 電腦能激發我的創造力	☐	☐	☐	☐
5. 我不喜歡與人談及電腦	☐	☐	☐	☐
6. 我想學更多有關電腦方面的知識	☐	☐	☐	☐
7. 當別人談到電腦時我會覺得很不自在	☐	☐	☐	☐
8. 我不認爲電腦可以用在我的教學上	☐	☐	☐	☐
9. 我想會用電腦是一件很愉快的事	☐	☐	☐	☐
10. 我知道電腦的好處但不願意花時間去學	☐	☐	☐	☐
11. 我很願意買部電腦來使用	☐	☐	☐	☐
12. 對我來說電腦太複雜了	☐	☐	☐	☐
13. 我會多利用電腦來幫我解決問題	☐	☐	☐	☐
14. 我覺得學習電腦是一件浪費時間的事	☐	☐	☐	☐
15. 我喜歡電腦	☐	☐	☐	☐
16. 我會隨時隨地把握學習電腦的機會	☐	☐	☐	☐
17. 因爲對電腦不熟悉所以我儘量避免使用電腦	☐	☐	☐	☐
18. 使用電腦可以幫助我節省很多工作時間	☐	☐	☐	☐
19. 電腦教學會剝奪人性化教育的機會	☐	☐	☐	☐
20. 我對電腦懷有恐懼感	☐	☐	☐	☐
21. 我教的科目用不上電腦所以我也不想學	☐	☐	☐	☐

— 續下頁 —

	非常同意	同意	不同意	非常不同意
22. 一想到要學電腦我就興致勃勃	☐	☐	☐	☐
23. 我的教學工作已經夠忙了還學什麼電腦	☐	☐	☐	☐
24. 使用電腦會增加我的工作壓力	☐	☐	☐	☐
25. 有時間的話我想多接觸電腦	☐	☐	☐	☐
26. 我想使用電腦於教學會是一種很好的教學方式	☐	☐	☐	☐
27. 一想到要學電腦我心裡就害怕	☐	☐	☐	☐
28. 在很多方面我想我會利用到電腦	☐	☐	☐	☐

第二部份: 基本資料

1. 您的任教科目是: ____________
2. 您的年齡是: _____ 歲
3. 您的性別是: 男☐ 女☐
4. 您學習及使用電腦的經驗累積已有_____年_____個月 (請約略估計)
5. 您在職期間受過的電腦訓練大約累計有_____小時
6. 您在學校是否使用過電腦?(是☐ 否☐)
7. 您個人家裡是否擁有電腦?(是☐ 否☐)
8. 您學習電腦的經驗來源爲何?(此題爲多選，請在適合您的部份打√)

☐ 沒有經驗 ☐ 自己摸索 ☐ 朋友或同事

☐ 求學期間 ☐ 政府單位主辦的電腦訓練

☐ 私人公司或單位主辦的電腦訓練 ☐ 電腦補習班

☐ 其他

續下頁

9. 您的工作是否需要使用電腦？(是☐　否☐)

10. 您學習及使用的意願如何？

☐很強烈　☐高　☐普通　☐很低　☐不願意

11. 此題請自由作答：

(1) 請您說明目前在學校推廣電腦使用及教學的問題有那些？

(2) 對增進老師學習及使用電腦的意願您有何建議？

— 謝謝您寶貴的意見！—