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Development and validation of an index of computer anxiety among prospective teachers

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Development and validation of an index of Computer Anxiety among prospective teachers

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STATEMENT OF PROBLEM

Computer technology has become an integral part of our daily living. Simple processes such as cashing a check or making a phone call that once relied on the services of a bank teller or an operator now are routinely handled by a computer. According to Levien (1972), "we are now experiencing the transition from an era in which the computer was an esoteric tool to one in which the computer will be an everyday necessity. (In addition), the growth of computers has exceeded the most optimistic estimates" (p. 1).

One field that has not quickly accepted the services of the computer is education (Eastwood, 1978; Finley, 1970; Roberts, 1978). Like some other forms of educational technology, computers have met with resistance to being included in the instructional process (Anastasio, 1972; Cooper, 1978; Kritek, 1976). Resistance to innovation and change has been a continual problem throughout the history of formal education. According to the Carnegie Commission (1972), there have been four revolutions in education, each meeting with less than immediate and total acceptance. The first revolution occurred when the responsibility of teaching children went to someone other than their parents. The second came with the written word. A third revolution was experienced when printing made books available on a wide scale. And today, with current technological advancements, we are in the midst of a fourth revolution (Carnegie Commission, 1972).

At each of these four major periods of change, there was considerable resistance and rejection by many parents and educators. There continues to be resistance to various components of the fourth revolution, including the computer. This resistance has been attributed to rejection through ignorance, fear of the unknown, laziness, lack of incentives, rejection through experience, etc. (Eichholz and Rogers, 1964). In the case of the computer, one reason for the resistance is what can be called, "Computer Anxiety" (CA). CA can be described as the mixture of fear, apprehension, and hope that people feel when planning to interact or when actually interacting with a computer. Because of this feeling, people who are computer anxious, when given the choice between using and not using a computer, often choose to not interact (Levien, et al., 1972; Seidel and Rubin, 1977).

According to Levien (1972), the reluctance of teachers to use the services of a computer in schools must be viewed as a serious problem for three major reasons:

1. The services of the computer are becoming very economical. What cost $10.00 for computer time in 1965 now costs less than one one-thousandth of a cent.

2. The services of the computer are applicable to almost every academic discipline and almost every walk of life.

3. The services of the computer are widely accessible. In Levien's words, "For almost everyone, the computer will be accessible, both physically, because it will be close at hand in the form of a typewriter or television-like device, and intellectually, because it will become a convenient, tireless, and reliable assistant in daily tasks, both mundane and original" (p. 3).

The problem can be summarized as follows: Computer Anxiety among teachers is one factor that is inhibiting the potential benefits of computer technology in education.

This problem needs to be attacked by educators. Currently, many school districts have invested substantial amounts of time and money into computer assisted instruction (CAI). Unfortunately, as was the case with many previous educational innovations, in many situations the computer is being placed in schools with little or no plan for its use. Teachers are left with this powerful tool but with very little training in how they can use it in the classroom. Because of this, the computer fails to support the teacher and students and becomes a source of frustration, and the target of ridicule and complaints. Without proper planning, the computer and the school fall into the "cart before the horse syndrome." The school has a dynamic product but without proper planning for its use, the product is improperly or never used.

By following the guidelines provided by the fundamentals of curriculum design, it is possible to solve the problem. No respectable superintendent would allow a new reading system to be implemented in the school district without first analyzing needs and resources, the advantages and disadvantages of the system, and support material. It would be just as intolerable to start a new program without giving teachers in-service. The same planning and preparation should be conducted for all new educational systems. Unfortunately, in the case of CAI, adequate preparation is often neglected. It seems that the leaders in some school districts and educational institutions are so excited about the prospect of what computers can do that they fail to follow the proper procedures that would insure a more positive experience.

Certainly, one way to approach this problem is to foster increased computer literacy among all teachers. But this requires much more than providing a course in computer programming for pre-service teachers as some authors have suggested (Milner, 1980). What is needed is a systematic plan to utilize the computer at all levels, from preschool through adult. To provide for this "master plan," the steps of curriculum development could be followed.

Some of the steps involved in curriculum development are assessment of needs and resources, design of the instructional system, and development of provisions for feedback and revision (Gagne and Briggs, 1979). This investigation will not try to cover the entire process of curriculum design. Rather, the researcher will complete one step that could be used for further research.

One of the first activities of instructional design focuses on the assessment of needs and resources. This investigation will contribute to the assessment of needs phase of the instructional design. The project will involve the development of a measure that will provide an index of computer anxiety in prospective teachers. With a reasonably valid instrument, teacher CA can be assessed. Based on individual and group scores, decisions can be made as to what in-service experiences would be best for each teacher or group of teachers.

To develop such a measure, the term Computer Anxiety needs to be operationally defined (Simonson, 1979; Henerson, et al., 1978). Once it is defined, valid, reliable questionnaire items need to be developed to measure that construct. Third, an index or normative reference must be established that would indicate how "computer anxious" a person is relative to the others in the group. Additionally, this study will correlate the CA index for each subject to certain subject traits (sex, academic subject area, cerebral dominance, field independence/field dependence). A strong correlation to any particular trait would suggest further study and possible in-service treatment specifically designed for individuals with that characteristic.

In summary, the purpose of this project is to follow these steps:

1. Define Computer Anxiety

2. Develop CA instrument

3. Pilot CA instrument to obtain descriptive statistics

4. Administer CA instruments to subjects

5. Obtain sex, subject area, cerebral dominance, FD/FI data from subjects

6. Correlate CA with subject traits.

Four Research Questions

The main goal of the project is to develop a reliable, valid measure of CA.

Using the CA index, the researcher, through correlation coefficients, will attempt to answer these four questions:

1. Is there a significant relationship ($p < .05$) between CA and Sex?

2. Is there a significant relationship ($p < .05$) between CA and Subject Area?

3. Is there a significant relationship ($p < .05$) between CA and

and Cerebral Dominance?

4. Is there a significant relationship ($p < .05$) between CA and FD/FI?

Definition of Terms

Computer Anxiety:

J. M. Sawrey (1959) defines anxiety as a "mixture of fear, apprehension, and hope, referred to the future." Computer Anxiety in this study will be defined as: The mixture of fear, apprehension, and hope that a teacher experiences when considering the implications of utilizing computer technology in the classroom. CA can be, but is not exclusively exhibited by the following behaviors:

- statement of apprehension:

  "I know computers can do wonderful things but won't it interfere with my students' studies?"

- statement of ignorance:

  "I don't know the first thing about computers."

- statement of indifference:

  "I'm not interested in computers."

- statement of fear:

  "I'll lose my authority when the kids find out they know more than me."

- statement of dislike:

  "The classroom is no place for these toys!"

- choice of traditional method of instruction over CAI

- failure to experiment with available computer systems

- o indifference to readings or information about CAI
- o selection of alternative non-CAI topics when CAI topics are offered as in-service, at meetings, or in informal discussion.

CA is not:

- o Math anxiety

  — it is more than a fear of computation

- o Communication anxiety

  — although it has the same abbreviation

- o Resistance to change

  — some people who have CA could be expected to welcome other innovations

- o Budget consciousness

  — some people who have CA could be expected to support expenditures for a variety of needs.

Computer Assisted Instruction (CAI):

Any educational activity presented or supported by a computer including drill and practice, tutorial instruction, simulation, games, and computer managed instruction (Baker, 1975).

Computer in the Classroom:

The physical appearance and use of a computer or computer terminal by a teacher or student in any part of a school building.

Cerebral Dominance/Hemisphericity:

The area of investigation concerned with the "possibility that individuals have a tendency to appeal to one hemisphere and its mode of thought more than the other" (Krasher, 1977, p. 121). Each subject's Cerebral Dominance will be indicated by a score attained on the Your Style of Learning and Thinking (SOLAT) Test.

Field Dependence/Field Independence (FD/FI):

According to Goodenough and Witkin (1977), "Field-dependence theory, which is still evolving, seeks to account for the ever-broadening, self-consistent patterns of psychological functioning originally identified in the course of research on the nature and basis of individual differences in perception of the upright" (p. 4). Or more simply, "'Field-dependence-independence' is our name for the...reliance on external vs. internal referents" (p. 10). Each subject's Field Dependence will be indicated by a score attained on the Group Embedded Figures Test (GEFT).

REVIEW OF LITERATURE

Innovation

For centuries the Yir Yoront people of Australia lived in a stable culture. The tools they used for food production were fashioned from stone. To have an ax was a symbol of power and dominance. Only men could own an ax. If a woman or child needed a tool, they were required to borrow one from a man. This lending-borrowing practice was a traditional, well-understood ritual. In the early 1900s, Christian missionaries discovered this "primitive culture" and brought to the Yir Yoront people the wonders of the modern world, including steel axes. Being the generous people that they were, the missionaries distributed the axes to not only the men, but to the women and children as well. With that, there was no longer a need for the women to borrow tools from the men and a long cherished (at least by the men), tradition was destroyed. Providing food with stone tools had been a full-time job for the Yir Yoront men. Suddenly, with steel tools, there was time in the day for other things. The missionaries envisioned rapid advancements in the society. But the Yir Yoront men knew only two activities, work and sleep. So when the work with the new tools was done, the rest of the day was spent in slumber (Blumenfeld, et al., 1978).

The Yir Yoront men reacted in a way not unlike some teachers' reactions to innovation. Educational innovators often act similarly to the missionaries. The literature of educational innovation speaks consistently of well-meaning "missionaries" who introduce new products or methods that will be "salvation" in the classroom. What is often found is that the innovation is so different to the classroom tradition that it is rejected, or if accepted, disrupts the familiar traditions of the classroom and is utilized improperly.

Resistance to change

There has been a multitude of suggested reasons for why our school culture is so resistant to change. Robert Finley (1970) states:

> No matter what the technological breakthrough that enters the school, there is always one deterrent to its success... the human being (p. 20).

This reluctance to accept change should not be looked upon as something to abhor or ridicule. Rather, it should be considered a condition under which we all must work. As human beings,

> we can never be fully prepared for that which is new. We have to adjust ourselves and every adjustment is a crisis in self esteem. (One would) need inordinate self confidence to face drastic change without inner trembling (Hoffer, cited in Smith, 1972, p. 11).

When considering innovation that would require change, it would be wise to consider responses that teachers have made in the past to changes that have occurred. Tobias (1966, 1969) reported that recent research "strongly confirms" a fear of automation among teachers. One-hundred-fifteen teachers were asked to rate 12 terms describing mediated instruction using semantic differential techniques. For instance, the teacher was presented with the term "filmstrip projector." The teacher then responded to the term by placing a mark on a continuum between a positive or negative descriptor such as good/bad. The mark was supposed to correspond to the teacher's "feelings" about the term. After responding to the terms, the teachers were given experience with the designated media. After exposure, they were asked to respond again. The results showed that teachers saw themselves threatened by the introduction of new media. Even after gaining experience, this feeling remained (Tobias, 1966). In a later study with 201 prospective teachers, Tobias (1969) had similar results. Additionally, it was found that the more the term suggested automation, the more fear there was expressed.

The work of O'Toole (1964) suggested that this negative attitude of teachers toward automation could have a detrimental affect on students. Students in 12 fifth and sixth grade classrooms were presented their spelling lessons on commercial teaching machines for nine days. At the end of that period their teachers expressed their feelings about the lessons on a questionnaire and during interviews. In the nine-day teaching period the students learned approximately what would have taken 20 days by traditional methods. But even when informed of the academic success of their students, teacher reaction was mixed. The majority of the teachers preferred the traditional approach to teaching spelling. The teachers unanimously rejected the machines for regular use. Reasons given for rejecting the machines were that the machines were unreliable, noisy, and took up too much space. Many teachers stated that they spent as much time helping students with mechanical problems as they would have spent if they had taught traditionally. Female teachers were particularly disturbed by the mechanical unreliability of the machines. In addition, the staff was pessimistic about the length of time it takes to get new instructional techniques implemented. Analysis of student scores showed that the students of those teachers whose attitudes were strongly against the teaching machines scored significantly lower than the rest of the group. This finding was quite important because the students worked independently, without the direct supervision of their teacher. However, despite the negative feelings expressed, the teachers in this study saw a bright future for this type of instruction and agreed that educators should be moving toward innovation at a faster rate.

Because of findings similar to O'Toole's, other researchers have attempted to isolate reasons for the negative attitudes of teachers toward new teaching techniques. Just as there are many reasons to like traditional methods of teaching, there have been many reasons suggested to dislike innovation. It is not the intent of this researcher to analyze each suggested reason, however, it is important to recognize that there are a variety of opinions. Below are some of the reasons suggested for teacher resistance to innovation.

1. Eastwood (1978) and Finley (1970) suggested that teachers fear they will lose their jobs. This fear stemmed from the concern that a machine would be able to teach more efficiently and that teaching staffs would be cut.

2. The lack of rewards for innovation was a barrier to change (Cooper, 1978; Eastwood, 1978).

3. The general need of teachers for independence and the need to be in the "spotlight" was reported to inhibit any new product or program that might reduce either one (Levien, 1972).

4. The fact that teachers need to assume new roles with each innovation has caused role overload. A person can only assume a finite number of roles ... as new roles were acquired, old roles were

modified (Kritek, 1976; Roberts, 1978).

5. Pincus (1974) suggested that many new teachers simply would not accept the responsibility to make appropriate changes in behavior patterns needed to accept innovation.

6. Eastwood (1978) stated that teachers feel that new technology would have a dehumanizing affect on students and teachers. While the academic portion of the curriculum might be enhanced, the importance of the teacher as a role model, counselor, or friend might be neglected. Teachers resisted even the experimenting with innovation in the schools because they thought it may have a detrimental effect on students.

7. Even if teachers accepted an innovation, resources in the form of manpower and software were often found to be insufficient or totally lacking (Eastwood, 1978; Roberts, 1978).

8. Kritek (1976), in a review of forty-four case studies, observed that in many situations where innovative instructional systems were supposedly implemented, the system, in practice, was very different from what was originally adopted. It appeared that innovation was almost never adopted as a whole, but "transformed" as it was incorporated. Kritek referred to this as the "natural law of program survival." The parts of the new system that were consistent with the status quo were emphasized and the parts that challenged tradition were ignored. Eastwood (1978) supported this finding by reporting a quote credited to the Association for Supervision and Curriculum Development (ASCD). According to ASCD, the educational system has a tremendous ability to absorb change while not changing at all.

In summary, there are a multitude of barriers to innovation in the classroom, educational, economic, institutional, and legal, but they are "... no more critical than barriers due to the attitudes and traditions that have grown up about education" (Eastwood, 1978, p. 20).

Facilitators to change

The previous section discussed inhibitors to change in education. This section will review facilitators to educational innovation. One of the first educational innovations in U.S. Education was in 1642 when the "Massachusetts Law" provided the basic concept leading to the establishment of public schools. Another early innovation was the "Deluder Satan Act" of 1647 that required towns to financially support their schools. Some authors were so convinced that innovation was a constant process in the United States that they agreed that American Education has a "penchant for change" (Orlich, 1978). Orlich stated that one facilitator to change was having a "critical mass of advocates" who could then promote the cause of innovation among their colleagues.

Roberts (1978) maintained that to facilitate change teachers must have a ready understanding and perceived relevance of the possible innovation. The environment of the '80s is what McCluhan has called the "electronic surround." As a result, teachers must understand that they cannot deal with first graders as though they had never seen "Sesame Street" or with high schoolers as though they had not seen space flights (Platt, 1977). Today's students must be recognized as people who learn in ways different from students of the past.

Many studies have indicated that teachers were generally in favor of many new teaching techniques or devices, but they often disagreed on how to implement the innovation. The desire for change was found to exist, but the process for change was often unclear (Eichholz and Rogers, 1964; George and Rutherford, 1978; O'Toole, 1964; Vandenberghe and Pottie, 1978).

Models of change

Innovative teachers realize that some of the "lock-step, outmoded" systems of education must change for innovation to be implemented smoothly. These teachers generally preferred the "ripple effect" where the enthusiasm of a few teachers spreads throughout a school like a stone dropped in a pond (Schlesser, et al., 1971).

Havelock (1973) has suggested five steps to the "adoption of innovation" phase of educational change:

1. Awareness

   — teacher receives factual information

2. Interest

   — teacher seeks out additional information

3. Trial

   — teacher actually uses innovation

4. Adoption

   — innovation is incorporated into curriculum

5. Integration

   — innovation becomes acceptable, useful, valuable part of the educational program.

When following the above steps, it is important that individuals must be allowed to progress through all the steps. Rejection can occur at any step. Hazards occur when steps are skipped or the order of steps is changed. For example, putting the trial step ahead of the interest step would create barriers that could be prevented. Hurrying steps to meet a schedule is equally hazardous, as is ignoring individual differences. Some people will take longer on certain steps than others. Individuals should be allowed to make personal commitments toward the innovation during the process and the individual should feel free to discuss doubts about an innovation's value. In addition, participants should be provided with resources and help, particularly when the trial step begins.

Eichholz and Rogers (1964) developed a model similar to the five steps proposed by Havelock. In addition, however, Eichholz suggested five stages of rejection:

1. Awareness

   — information

2. Indifference

   — no opinion, pro or con

3. Denial

   — teacher sees no value in innovation

4. Trial

   — teacher reluctantly makes use of the innovation

5. Rejection

   — innovation is rejected.

This model suggests that rejection of an innovation often occurs before the trial period begins. Using forty-five teachers, Eichholz found evidence that potential adopters and potential rejectors approach innovations with preestablished adopter or rejector "sets." The implications for innovation implementation of people possessing these "sets" are clear. In many cases it would make no difference whether an innovation was good or bad. The innovation would be accepted or rejected based on the sets in the minds of the recipients.

Research conducted by George (1978) also investigated the problem of the rejection of many innovations. This research was based on the assumption that implementation was up to the individual. Those who did innovate decided on what degree they would innovate. George used the Concerns-Based Adoption Model (CBAM). One major component of CBAM was the affective dimension titled "Stages of Concern" (SOC). SOC consisted of seven steps from awareness (getting basic information), to refocusing (exploring additional benefits of the adopted innovation). A second major part of CBAM was the "Levels of Use" (LOU) or behavioral dimension. LOU also had seven steps from nonuse to renewal (seeking modification of an innovation for increased impact). Figures 1 and 2 list the steps of SOC and LOU, respectively.

George's two-year study used 146 teachers in 39 schools in 3 states and 117 professors in 9 universities in 6 states. Characteristic differences between users and nonusers were found. There was a definite relationship between scores on SOC and LOU. Nonusers were at the lower end of the SOC scale. Users at the lower end of SOC declined in LOU over the two years. Those high on SOC increased in LOU. One major conclusion of this research that has been widely supported by anxiety research was that before the use of anything new, a teacher's concerns were very self-centered, perhaps because of worry about performance. After experience, teachers' concerns were transferred from self to the affects the innovation had on students (Poole and Gaudry, 1974; Thompson, 1963;

0. Awareness
   — Little concern about or involvement with the innovation.

1. Informational
   — General awareness of the innovation, interested general characteristics, effects and requirements for use.

2. Personal
   — Uncertain about the demands of the innovation and personal role with the innovation.

3. Management
   — Attention focused on tasks of using innovation and the best use of information and resources.

4. Consequence
   — Attention focused on the impact of the innovation on students.

5. Collaboration
   — Attention focused on coordination and cooperation with others regarding use of innovation.

6. Refocusing
   — Attention focused on exploration and more universal benefits from the innovation.

Figure 1. Stages of Concern (SOC) (George and Rutherford, 1978)

0. Nonuse
   — User has little or no knowledge of innovation, and no involvement with it.

1. Orientation
   — User recently acquired information about innovation and is exploring its value.

2. Preparation
   — User preparing for first use of innovation.

3. Mechanical Use
   — User focuses on short-term day-to-day use of innovation with little time for reflection.

4. Routine and Refinement
   — Innovation is being stabilized and varied to increase its impact.

5. Integration
   — User is combining efforts to use innovation with related activities to achieve collective impact on clients.

6. Renewal
   — User reevaluates the quality of use of innovation and seeks major modifications to improve it.

Figure 2. Levels of Use (LOU) (George and Rutherford, 1978)

Travers, et al., 1952).

The steps of adoption suggested above share characteristics with more general models of instructional design. Both groups agree that there are steps to both processes that should not be ignored, hurried, or altered. Each step is critical to the successful adoption of that innovation (Gagne and Briggs, 1979).

The literature documents several theories about the resistance to innovation. The general consensus is that the attitude of the user of the innovation is critical to the subsequent success of the innovation. Negative attitudes very often develop because innovations are introduced without much planning. The change agents attempting to implement the new program fail to facilitate the change properly. Models of change have been developed to facilitate the implementation of change. No one model is universally accepted. Rather, almost any model can be useful if the model takes a systematic approach to this traditionally difficult task. Without this organization, the potential adopters of change become like stone age men disrupted and confused by their new steel axes.

Computers in the classroom

Current usage of computers for instruction can be summed up in one word — inconsistent. Touring the school districts of Iowa, one can find districts at each level of LOU for computer assisted instruction (CAI). One could witness a school system at level 6 with teachers probing the capacities of the computer for use in their teaching. Within a few miles, a school system could be found at level 0, with no computer resources available. In those districts that are using the computer, it would be hard to find two that utilize CAI in the same way. The inconsistency of the use of CAI is not unique to Iowa. It is a national phenomenon (Area, Note 1).

The problems and successes of other educational innovations relate directly to computer technology in schools. Before computers, most classroom methods encouraged independence, self-sufficiency, and autonomy. But with this new technology, teachers must rely on programmers, technicians, program sharing, etc. To successfully use the computer for instruction, teachers will have to "... exchange their old technology ... for a new method" (Blumenfeld, et al., 1978, p. 5). However, as reported previously, for systematic change to occur, teachers must feel a need, see benefit, and have a say in the development of their computer utilization program. Some teachers are uncomfortable when students learn without their help. These teachers will probably be unwilling to give up control of the teaching process to a computer program (Blumenfeld, et al., 1978). To reach all teachers, the process of change must be systematic, logical, and individualized.

According to Anastasio (1972), the two most highly rated statements by 35 "computer experts" concerning the factors inhibiting the use of computers in instruction were:

> Reluctance of school personnel to go through reorganization and training that a broad use of CAI (computer assisted instruction), would entail.

and

> Cautiousness and uncertainty on the part of educators as to the effectiveness of CAI in comparison with traditional methods (p. 8).

Very recently several authors have called for new theories of instruction to include computers and demands for the education of teachers in "computer literacy." Magin (1976) describes interactive computing as "the most dramatic and significant of technological innovations." Fennell, et al.'s (1977) research concluded that it is "inevitable" that the computer will be in our schools. Kearsley (1979) called for a new level of theory that not only includes how to "fully take advantage of new instructional capabilities" of the computer, but also when <u>not</u> to use it. Along with the discussion of how to implement the computer in K-12 classrooms, comes the demand for teaching prospective teachers about computers at the university (Milner, 1980; Mocciola, 1979).

There have been many exciting reports of success with CAI (Bell and Droegemueller, 1979; Cheves and Parks, 1979; Chiang, 1978; Piece, 1979; Sandals, 1979). But along with this excitement must come the objectivity and understanding presented in the literature that states that lasting change does not occur overnight and that following logical steps facilitates success.

Anxiety

Teacher anxiety has long been a topic of concern for educators. In 1933, 11% of the teachers responding to a nationwide questionnaire had suffered nervous breakdowns. An additional 17% reported being "unusually nervous." In 1938, the National Education Association reported that 37.5% of 5,150 teachers studied saw themselves as being "seriously worried and nervous." By 1967, the percentage of those teachers who felt they were under "moderate or considerable strain" had climbed to 78% (Coates, 1976). As reported previously, and expanded upon below, the emotional state of teachers can affect the performance of students. Thus, this growing problem could have serious affects on the welfare of the students of these teachers under strain, as well as the welfare of the teachers themselves (Doyal and Forsyth, 1973).

There are three main forms of anxiety response. The first reaction form is a somatic response such as sweating palms or increased pulse. The second form of response to anxiety involves thoughts about the inability to cope with a threatening situation. A third anxiety response form makes use of coping styles, generally involving patterns of response that were previously successful (Keavney and Sinclair, 1978). The second form of anxiety response, thoughts, is by far the most studied, primarily by correlating anxiety to other teacher traits, or to student traits.

The teaching situation and teacher imagination most often seem to be the cause of teacher anxiety. In a study of 120 elementary student teachers, Travers, et al. (1952) concluded that situations that produce anxiety were "characterized by vagueness and uncertainty concerning both the situation and the adequacy of the responses that may be made to it." In other words, when teachers did not know "where they stood," anxiety often developed. Thompson (1963) found that when 125 student teachers reported sources of their preteaching anxieties, almost 50% of their anxieties were caused by imagination. Another 25% of their anxieties were attributed to "hear-say." In other words, almost one-half of the situations that produced anxiety were imagined by the student teachers and did not actually occur (e.g., teacher walks into class with zipper down). Another one-fourth of the situations that produced anxiety originated through discussion with other student teachers and had no reliable foundation (e.g., "Joe said that when Marvin's sister was student teaching, she knew someone who was locked in the closet by the kids").

The responses of highly anxious teachers have been correlated with many undesirable classroom situations. Youngs (1978) reported that highly anxious teachers were less likely to administer positive reinforcement and had more disruptive students than nonanxious teachers. Anxious teachers had a strong desire to remove themselves from an uncomfortable situation and any future risk-taking situations. While in stressful situations, anxious teachers reported negative emotions (inferiority, uselessness, loneliness, betrayal), which lead to increased anxiety. In an extensive review of anxiety research, Keavney and Sinclair (1978) concluded that teacher anxiety was consistently correlated with low rapport with students, less verbal support, more hostile speech and behavior, increased dogmatism, and pupil anxiety. Teacher anxiety was negatively correlated with teacher warmth and pupil achievement.

The relationships suggested by Keavney involving teacher anxiety positively correlating with pupil anxiety and negatively correlating with pupil achievement have been the focus of relatively little research. What research that has been conducted has indicated that a cause and effect relationship between teacher anxiety and low pupil achievement may very well exist. Observing 234 third grade students and their 10 teachers, Doyal and Forsyth (1973) concluded that it was "possible" that the influence of teacher anxiety was passed on to students. Kracht and Casey (1968) administered the Minnesota Teacher Attitude Inventory (MTAI) and the Institute for Personality and Ability Testing Anxiety Scale (IPAT) to 318 college seniors prior to their student teaching experience. At the end of student teaching, each subject received a score based on their student teaching "effectiveness" using the Student Teacher Evaluation (STE). Kracht and Casey found that the MTAI and the STE scores were positively correlated and concluded that "social adjustment and successful teaching may go together." The IPAT and STE were not related. However, the MTAI and IPAT scores were negatively correlated meaning that a low score on MTAI correlated with a score of high anxiety. This led Kracht and Casey to suggest that since MTAI was successfully correlated with both IPAT and STE, a more sensitive measure of teaching performance than STE might indicate that anxiety and effectiveness are connected.

Certain character traits have been associated with teacher anxiety. Females appeared to be more anxious than males, particularly toward mechanical devices (Finley, 1970; O'Toole, 1964; Thompson, 1963). This conclusion must be cautiously interpreted, particularly because of the dates when the research was conducted. Social conditions and biases at the time may have contributed to those results. The grade level at which a teacher works may also be associated with anxiety. In a study of 125 student teachers, elementary student teachers were found to be more anxious than secondary student teachers (Thompson, 1963).

Still another characteristic, "hemisphericity," has been associated with anxiety. Tucker, et al. (1978) studied the effects of stress on the processing capacity of the brain's right and left hemispheres in 80 college students. Tucker asked his subjects to perform tasks using visual information that was presented to them. The information that was presented to the left visual field and interpreted by the right hemisphere was processed equally well by the anxious and the control groups. However, highly anxious subjects made more errors when the information was presented to the right visual field and processed by the left hemisphere. It appeared that anxiety overloaded the processing capacity of the left hemisphere under high task demanding situations. The following section in this chapter will review hemisphericity literature.

As previously reported, there has been research conducted on the possible cause of anxiety. There also have been studies conducted on the reduction of anxiety. Two strategies are reported here. It seems that one simple way to reduce anxiety is to give teachers experience in the situations causing negative feelings. In studies of student teachers, there have been several reports of a "statistically significant change (in) ... an overall drop in anxiety about facing the teaching situation" after experience (Keavney and Sinclair, 1978; Poole and Gaudry, 1974; Thompson, 1963; Travers, et al., 1952).

A second strategy for coping with anxiety is to create situations where teachers know what to expect and know what their expected behaviors are to be. With 120 student teachers, Travers, et al. (1952) found that when interns became accustomed to the routine of their classes and expectations of their cooperating teachers, and found acceptable behaviors to fit their situations, their anxieties were significantly reduced.

Summary

In the preceding discussion of teacher anxiety, TA, many studies were cited that reported correlations between TA and various undesirable classroom situations including, fewer positive reinforcements, disruptive students, teacher desire to escape, teacher feeling of inferiority, uselessness, loneliness, and betrayal, increased teacher dogmatism, hostile speech and behavior, low rapport with students, less verbal support by teacher, and pupil anxiety. The cause and effect relationship between TA and these variables has not been strongly validated but researchers and logic suggest that there is some sort of a relationship. Various characteristics such as the teacher's sex, grade level taught, and hemisphericity were correlated to TA. Because of the possible detrimental consequences of a cause and effect relationship, and the connection of other subject traits, anxiety would appear to be a topic of great concern and in need of immediate attention by researchers in education.

Cognitive Styles

As reported above, anxiety and cognitive style may be related. In this section, two cognitive style theories will be discussed: Hemisphericity and Field Dependence/Field Independence (FD/FI).

Hemisphericity

Hemisphericity, or Cerebral Dominance, research is rooted in the study of subjects with brain damage or subjects whose corpus callosum (the connecting fibers between the two cerebral hemispheres) was severed to control epilepsy. What was found in this early research was that the way a subject responded was dependent on which hemisphere processed the information that was received. Based on these observations, researchers theorized that the left and right hemispheres of the cerebrum were specialized to process certain kinds of stimuli, and in certain ways. Through research, some generalizations about hemisphericity have been formulated and generally accepted.

The left hemisphere   The left hemisphere is specialized to process information analytically and sequentially (Ornstein, 1977, 1978; Tucker, et al., 1978). In the study of individuals with left cerebral damage, loss of speech is one of the most commonly observed results (Krasher, 1977). According to Krasher, the study of brain wave patterns indicates there is a pronounced increase in electrical activity of the left hemisphere while a subject is performing verbal tasks. When considering the activities of students in the average classroom, it becomes apparent that the "scientific and technological aspects of our civilization are products of the left ... (and it is) especially true that schools pander to the left" (Nebes, 1977, p. 104).

The right hemisphere   According to Nebes (1977), persons with right brain damage suffer quite different problems compared with those with damage to the left. Damage to the right hemisphere causes difficulty in "perceiving, manipulating, and remembering visual, tactile, and auditory stimuli that are hard to label and describe verbally." Ornstein (1978) concurred that spatial awareness and recognition of others is inhibited with right brain damage and added that musical ability is affected. He also reported that several right brain damaged subjects who had normal capacities for speech and reason had lost the ability to dress themselves. Through these experiences with brain damaged and normal subjects, the right hemisphere has been recognized as being a wholistic, intuitive processor (Ornstein, 1978). Some of the right hemisphere's specialized functions deal with crafts, body image, orientation in space, and mystical and humanistic aspects of life.

Right vs. left According to Ornstein (1978), humans do not have a "split brain." The brain is a whole with specialized parts. Very often, information processing is integrated between the two hemispheres. At times, the right hemisphere will process verbal information and the left, nonsequential stimuli (Krasher, 1977). Each side has the capabilities to perform tasks generally referred to the opposite side. It is apparently more efficient for the brain to specialize, and this is what is normally found.

In a study of lawyers and ceramists, brain wave readings were recorded during various activities such as writing a letter, setting blocks in a pattern, reading, and tracing a pattern seen through a mirror. It was found that alpha waves are generated by the hemisphere that is not stimulated by the activity. It, in effect, sleeps. For instance, when reading technical material, the right hemisphere was producing alpha (sleep) waves. When the task was changed to reading a story, the right side "woke up" and electrical activity increased (Ornstein, 1978).

Another study whose results suggested the integration of the two specialized parts of the brain involved giving brain damaged patients pictures to draw. Those patients with damage to the right side drew pictures with great detail (attributed to the well-functioning left hemisphere) but with no organization. Those with damage to the left hemisphere drew pictures that, in general, looked like the desired objects (right side functioning normally) but had very little detail (Nebes, 1977).

Current thought on hemisphericity states that people's perceptions of the world are dominated by one side of the brain. Those who are right brain dominant process most information in a wholistic, intuitive way. Those who are left brain dominant process information in an analytical, sequential way (Lutz, 1978; Torrance, et al., 1977). The differences in information processing can be illustrated by two descriptions of sand made by two different third grade students. One definition stated, "Sand is made of silica, which is Silicon Dioxide, SiO_2." The second definition stated,

> Big rocks into pebbles,
> Pebbles into sand.
> I really hold a million,
> million rocks here in my hand (Lutz, 1978, p. 4).

A test of hemisphericity E. Paul Torrance, and others have developed a paper and pencil measurement of hemisphericity. Alternate form reliabilities, reported in 1977, were:

Right hemisphere specialization = .84

Left hemisphere specialization = .74

Integrative style = .85

Test-retest reliability = .84

To determine the first three figures, alternate forms of the test were administered to each subject. For each subject, the score on Form A was correlated with the score on Form B. For the subjects who were considered right hemispheric dominant, the scores yielded a correlation coefficient of .84. The same was done for left hemispheric dominant subjects and those who integrated both hemispheres. The test-retest reliability was determined by twice administering the same form of the test to subjects with a time interval between. Each subject then had two scores that were correlated. An example of the questions in this test entitled "Your Style of Learning and Thinking" can be found in Appendix 1.

Field dependence/field independence (FD/FI)

According to Koppleman (1979), FD/FI research began during World War II when it was observed that some fighter pilots, while flying through clouds, became disoriented and could not keep their planes upright. Herman Witkin, a noted psychologist, was contacted to find a way to identify people who would be prone to experience this problem. From Witkin's work, and the work of others, the theory of FD/FI cognitive style was developed.

Field dependence Field dependence is characterized by the importance that is given to the context in which information is presented (Nelson, 1977; Witkin, et al., 1962). A field dependent person would be one who enjoys social functions. One would expect a teacher with this cognitive style to interact frequently with his/her students (Stone, 1976). This person would also place importance on interacting with surroundings and, like the right hemispheric dominant person, would experience the environment in a global fashion (Nelson, 1977; Witkin, et al., 1962). To a field dependent person, context is very important.

Field independence Field independence is characterized by the perception of oneself and objects as distinct from the environment (Nelson, 1977; Stone, 1976; Witkin, et al., 1962). Field independence, like left hemispheric dominance, is exhibited by analytical and technical thought processes. Relying on internal referrents is very important to the field independent person. The following is an example of internal vs. external referrents. Consider a person standing at a railroad crossing as a train is going by. To the person, each railroad car is huge. The person used his/her body as a point of reference to judge the size of the railroad car. The person's body was an internal referrent. When comparing the railroad car to the entire train of 100 cars, it suddenly becomes small, only 1/100 of the train. The person used the train as an external referrent.

Tests of FD/FI Early measurements of FD/FI involved tasks of righting oneself in a tilted room or standing a rod upright in a tilted frame. The Rod and Frame Test made use of a luminous rod suspended in a luminous tilted frame. The subject was placed in a dark room (so the walls would not be visible) and asked to place the rod upright. Those who placed the rod upright using their bodies as the point of reference would be labelled field independent. Those who placed the rod upright using the frame as the reference point would be considered field dependent (Goodenough and Witkin, 1977). In another FD/FI test, the Body Adjustment Test, subjects were placed in a tilted room and asked to make themselves upright. Again, based on internal or external referrents used by the subjects, the corresponding cognitive style was assigned (Goodenough and Witkin, 1977).

In the late 1940s, Witkin designed a measure that could be completed with paper and pencil. He chose figures that were developed by the German psychologist, Gottschaldt. With the figures, he constructed the Embedded Figures Test (EFT). In this test, the subjects were shown a complex figure for fifteen seconds. Then a simple figure that was "embedded" in the complex one was presented for ten seconds. The subject was then asked to trace the simple figure's lines on the complex one. Those who were successful at drawing the figures were described as field independent. Those who had difficulty or failed to find the embedded figures were designated as field dependent (Witkin, 1950). Research with these tests indicated that, in general, women were more field dependent than men (Nelson, 1977; Witkin, 1950). Cautions were given concerning the value judgments that have been made in the past as a result of this finding (e.g., FI smarter than FD). FD/FI has little, if any, relationship to learning ability or memory. It is, rather, a continuum on which a style of learning, not ability, exists (Nelson, 1977).

An extension of the EFT is the Group Embedded Figures Test (GEFT). This test was also developed by Witkin and has the following reliability estimate:

Test-Retest reliability for both males and females = .82.

Validity statistics between EFT and GEFT suggest that "the GEFT may prove to be a useful substitute for the EFT" (Witkin, et al., 1971). An example of the questions used on the GEFT is located in Appendix 2.

Constructing an Attitude Measurement

The term "attitude" has a variety of meanings for a variety of people. Simonson (1979) states that attitudes are "predispositions to respond (and that) while attitudes are latent and not directly observable in themselves, they do act to organize, or to provide direction to, actions and behaviors that are observable" (p. 35). An attitude has three components: affective (liking or disliking), cognitive (how much knowledge one has of the subject), and behavioral (what action one has taken toward the subject). In a bibliography of 25 years of research on attitudes, Simonson, et al. (1979) observed that most research has dealt with the affective component of attitudes. From this review, the authors concluded that there appears to be a positive link between learner attitudes and achievement.

To measure a particular attitude, very often a measure must be developed. This section will deal with the steps used to develop an attitude measure. Before these steps are described, some precautions must be stated:

- Attitudes are measured through inference, they cannot be measured directly.
- Affect, cognition, and behavior may not always be consistent with each other. It is dangerous to measure only one

component of an attitude.

- Attitudes can fluctuate with time, thus the results of today's attitude measurement may not be valid in the future.

- Certain attitudes have various definitions in various situations (Henerson, et al., 1978).

These precautions should be considered whenever attitudes are measured.

Henerson, et al. (1978) in the book, How to Measure Attitudes, succinctly list and explain the procedures for constructing an attitude measuring instrument. While the steps listed for construction are credited to Simonson, unless otherwise cited, the following information is gleaned from the Henerson book.

Attitude measures should be valid, reliable, replicable, and simple to administer, explain and understand (Simonson, et al., 1979). To create a measure with those characteristics, the following six steps should be followed:

1. Identify the construct to be measured.
2. Find an existing measure of the construct.
3. Design a measure.
4. Conduct a pilot study.
5. Revise tests for use in major investigation.
6. Summarize, analyze, and display results (Simonson, 1979).

Each of these steps will be briefly discussed below.

1. Identify the construct to be measured.

The attitude, since it cannot be directly measured must be operationally defined (Simonson, et al., 1979). Once it is defined, behaviors can be observed as indicators of the attitude.

The objectives of the measure must be clear and described in detail. The audience should agree about the major objectives of the measure, what evidence will show the objectives were reached, and what the priorities of the objectives are.

2. Find an existing measure of the construct.

There are two major advantages to finding an existing measure. First, it is difficult and time-consuming to develop an original measure. Second, an existing measure will have reliability and validity estimates available to give an idea of how consistent and appropriate the test would be. One disadvantage of an existing measure is that it may not measure exactly what the investigator wants to measure. Buros' two volumes, Mental Measurements Yearbook and Tests in Print, are very authoritative and comprehensive. They list most measures that are available.

3. Construct an Attitude Measure.

When no measure can be found, it is necessary to construct a new one. There are five basic steps to follow in creating an original instrument.

1. Determine what the specific objectives of the measurement are and what information is needed. A good measure focuses on a few basic objectives.

2. Choose a response format. There are a variety of response formats. The Likert type scale is very common and easy to quantify. The semantic differential is even simpler and is good to use when the subjects' opinions may not be well thought out. Projective techniques require the respondent to finish a story. Sentence completion requires the finishing of a sentence with one or a few words. The critical incident asks subjects to write a description about a recent incident and judge it good or bad. Rating sheets have the subject place responses in a hierarchy. Checklists ask the subject to check off desired activities or experiences. Each format has its advantages and disadvantages (Poetker, 1979).

3. Determine the respondents' (frame of reference) by collecting information about previous skills and experience.

4. Write questions based on steps 1, 2, and 3. They can often be generated by revising questions used in other instruments (Bellamy, 1978; Crowley, 1976; Henerson, et al., 1978; Westley and Jacobson, 1962; Yee and Fruchter, 1971). Critique each question by asking: Does it relate to one idea? Is this a simple way to ask the question? Are there unclear or confusing words? Are there words that might arouse a certain emotion? Is the question asked negatively? Does the question suggest a certain response? Does the question allow a response of "no opinion?"

5. Construct a data summary sheet that will be easy to understand and transfer data to and from.

4. Conduct Pilot Study.

At this time validity and reliability statistics should be generated. The first item of concern is construct (validity.) Through opinions of "those who should know," content experts, or people whom are known to possess the desired attitude, one can determine whether the questions actually measure the desired construct described in the title of the instrument (Simonson, 1979).

Content validity: To determine content validity, the questions must actually measure the attitudes and behaviors used to describe the construct. A sample of the statements should reflect the behaviors of the construct. In addition, the statements should be in the same proportion as the importance of the behaviors they measure. Some threats to validity include the weak link between attitudes and behavior, response bias, inaccurate responses, lack of objectivity in administration, and too few items. All of these points must be considered in the determination of the validity statement.

Reliability means consistency: A reliable instrument is one that will give essentially the same results when administered more than once to the same group of people. One method to determine reliability is through the "Cronbach Alpha" formula. The formula, appearing in Figure 3, estimates reliability through the comparison of the total variance of a test with the sum of the variances of each item on the test. The reliability score is reported by a decimal between 0.00 and

$$\frac{n}{n - 1} [1 - \frac{\Sigma IV}{TV}]$$

n = number of items

IV = item variance

TV = total variance

Figure 3. Cronbach Alpha formula

1.00. A reliability of .70 is considered respectable for an attitude test.

To increase both reliability and validity, a pilot test and a subsequent item analysis should be conducted. To do this, a set of possible questions for the instrument should be submitted to the "pilot group." Once scores are obtained for the individuals, they can be placed in a high, middle, or low group. Each question can then be analyzed against the groupings. If the question that was intended to have a favorable response from the high group did, it would probably be included in the final instrument. However, further checks should be made to see if the low group gave negative responses. In short, the questions that were answered in the expected way that discriminated between the groups should make up the final instrument. Statements that did not discriminate, but tended to bring the groups together, should be discarded.

5. Revise test for use in major investigation.

Once the specific items have been selected, the instrument should be revised and polished. The questionnaire should look well-planned and easy to fill out. There should be as few questions as possible. A balance should be struck between too much writing on the page and too many pages. The researcher should look at the questionnaire as if he/she was going to fill it out. Once the above steps are completed, the instrument is ready to be administered.

6. Summarize, analyze, and display results.

Thought should be given to this step in the beginning stages of development of the instrument. If the data summary sheet was developed during the questionnaire development, it should be a simple task to transfer data from the questionnaire to the sheet. The statistical treatment will depend on the goals of the questionnaire, but again, if sufficient thought was given during development, calculating the statistics should be relatively easy. Results would be displayed in a manner to make them easy to read and understand while also being informative and easy to report.

Summary

In this chapter, literature was reviewed in four areas: Innovation, Anxiety, Cognitive Style, and Attitude Measurement Construction. The following is a summary of that review.

Innovation in education is seldom totally and immediately accepted. Resistance to change is attributed to a variety of reasons including fear of automation, fear for job security, need for independence, role overload, laziness, the dehumanizing effect of technology, lack of supporting resources, and tradition.

Teacher Anxiety (TA) has been associated with the introduction and resistance of innovations. Many variables such as the classroom situation, teacher style of reinforcement, student achievement, student behavior, and teacher behavior have been successfully correlated with TA. While not strongly corroborated, there appears to be some indication that innovation can lead to TA which can lead to undesirable classroom situations. Learner characteristics including sex, teacher grade level, cerebral dominance, and field dependence have also been correlated with TA.

While there are various forms of resistance to educational innovation, there are also facilitators to change. Ready understanding of, perceived relevance of, and gathering a critical mass of advocates for a particular innovation will facilitate its implementation. Following general models of change also encourage the acceptance of new techniques. The computer is one form of educational innovation that has experienced the resistance described above. But while the computer has met with resistance in some areas, in other areas it has been accepted through the use of facilitators and models of change.

Hemisphericity, Field Dependence, sex, and teacher subject area can be collected. In addition, a newly identified construct, Computer Anxiety (CA) can be measured through the use of an instrument developed according to the following steps:

1. Identify the construct
2. Find a measure
3. Design a measure
4. Conduct pilot study
5. Revise pilot study
6. Summarize and display results.

Because of the possible relationship between TA, computers, subject characteristics, and various classroom situations, it would be wise to investigate these relationships.

METHODOLOGY

The Sample

The prospective teachers used in this investigation were enrolled in Secondary Education 301 (SECED 301), the introductory media course for undergraduate education majors at Iowa State University. The class is designed for juniors, but it is not uncommon to find sophomores, seniors, and sometimes, freshmen also enrolled. The course requires that students have taken a fundamentals of education course prior to enrolling in SECED 301.

The course meets for two hours once a week for ten weeks. During the first seven sessions, media production skills are discussed, demonstrated, and practiced. The topics covered include visual literacy, dry mounting, spirit duplication, scripting, still and motion photography, videotaping, audiotaping, and transparency production. In the eighth week an "equipment practicum" is conducted. During the final two weeks of the course, students present to their peers a 5-8 minute lesson in their subject area using the mediated materials they produced during the previous weeks. The classes generally consist of more women than men. The students were assumed to be a representative sample of prospective teachers at ISU because every teacher education student is required to pass SECED 301 to graduate. Figure 4 is a summary of the distribution of the sample.

Sex

Number of subjects:	175
Males	47
Females	121
Missing data	7
	175

Subject area

Number of subjects: 175	
Child Development and Elementary Education	66
Home Economics (other than CD)	22
Sciences & Humanities	34
Education (other than El Ed)	17
Agriculture	19
Missing data	17
	175

Figure 4. Demographics of the sample

Procedures

The main purpose of this study was to produce a valid and reliable index of Computer Anxiety (CA). Since one did not already exist, the researcher was forced to construct one. The literature on attitude test construction was reviewed and the suggestions of Henerson, et al. (1978) for attitude test development were followed.

The first step was to decide what kind of a measure the CA instrument would be. It was decided that the agreement scale (Likert type) format would be used because of its familiarity to subjects and ease of manipulating the resulting data. At the same time it was decided to calculate an index from subject responses in order to have one score of CA that could be correlated to other subject characteristics.

The second step involved finding or generating statements to be used in the CA instrument. First, the researcher searched for existing measures dealing with innovation in education to find any test items that might pertain to CA that could be adapted to be used in the instrument. Four applicable studies were found and some items from these instruments were considered and adapted for use in the CA measure (Bellamy, 1978; Crowley, 1976; Westley and Jacobson, 1962; Yee and Fruchter, 1971). Additional items were generated from positive and negative statements that the researcher compiled through general readings, presentations on computer assisted instruction (CAI), and personal experiences. Each item made a statement related to at least one part of the definition of CA detailed in the opening chapter.

Since attitudes have three components, affect, cognition, and behavior, the statements were arranged according to which component they referred. Of the initial 63 statements generated concerning computers in the classroom, 21 dealt with the cognitive component, 22 referred to the affective component, and 20 were related to behavior. The 63 statements were presented to (an attitude research expert) who testified to their face validity, that is, they appeared to make statements about a person's knowledge, feeling, or behavior toward computers in an educational environment.

A pilot test was then conducted using 32 subjects in two summer classes of SECED 301. These subjects were asked to respond on a scale from 1 to 5 their agreement or disagreement to each statement. A score of "1" given to a statement meant "strongly agree." Responding with a "5" meant "strongly disagree." Circling "3" meant "no opinion," "undecided," or "don't know." Thirty statements were considered positive statements — ones that supported CAI. Thirty-three statements were negative, or expressed fear, or nonsupport of CAI. To quantify the scores, the responses to the negative statements were reversed. (A response of "5" was considered a "1," a "4" became a "2," etc.) Once the reversal was complete, each person's responses for all 63 statements were summed to obtain a total score. Thus, a person that agreed with the positive statements and disagreed with the negative statements would have a low score. A person who disagreed with the positive statements and agreed with the negative statements would have a high score. The lowest possible score would be 63. The highest score would be 315. A person who answered "3," no opinion, to all 63 items would score 189.

After the scores were calculated, the students with the lowest five scores were selected as the "positive" group. Their scores ranged from 119 to 155 with a mean of 136. The students with the five highest scores were selected as the "negative" group. Their scores ranged from 203 to 237 with a mean of 215. The two groups were then compared in an item analysis to determine which statements had the most influence in causing the scores in the "positive" group to be low and the scores of the "negative" group to be high. From the item analysis, ten statements were selected as ones that tended to separate the two groups. Those ten statements were selected to compose the subsequent Computer Anxiety Index. The item analysis identified those statements that tend to make the negative responders "more" negative, and the positive responders "more" positive (Henerson, et al., 1978).

To discourage the subjects from establishing a "computer set" while responding to the ten statements about computers, 20 "distractor statements" were generated and randomly included with the ten "target statements" on the final questionnaire. To further protect against the respondents establishing a response set, the instrument was entitled "Educational Innovation Survey." The distractor statements referred to other recent forms of educational innovation such as new teaching methods and video tape. The intent was to convince the subjects they were responding to 30 statements on various innovations, not statements about computers. To obtain a reliability estimate for the CA index, the Cronbach Alpha method was used both during the pilot test and the main study. From the pilot test, the 10 target items yielded a reliability estimate of .88. The reliability estimate for the CA index in the main study was .86. Additional normative data for both the pilot test and the CA index in the main study are as follows:

	Pilot study	CA index in main study
# of subjects	31	175
Mean	31.9	31.8
Standard deviation	7.0	6.5
# not responding or missing data	1	3

A second goal of the study was to compare the CA index to four respondent characteristics: sex, subject area in which the respondent was planning to teach, Field Dependence, and Hemisphericity. Data on the first two characteristics were obtained from class lists. The hemisphericity information was obtained from each subject through Form A of the Your Style of Learning and Thinking test (SOLAT) developed by E. Paul Torrance at the University of Georgia. Form A of SOLAT consists of 36 sets of three statements about memory and other mental processes. The respondent selects the statement of the three that most closely describes him/herself. In the triplets one statement describes a left cerebral process, one describes a right cerebral process, and the third describes a person who integrates the two hemispheres. After compiling each subject's responses, he/she was placed on a continuum that indicated subjects as being more right or left dominant according to where he/she was in relation to his/her peers. In other words, each subject received a "hemisphericity score" that would be correlated with CA. A low score (e.g., 56) meant that a student tended to be left hemispheric dominant. A higher score (e.g., 88) meant that a student tended to be right hemispheric dominant.

Next, 50 subjects were randomly selected to complete another measure one week after completing the CA and SOLAT instruments. These fifty subjects were administered the Group Embedded Figures Test (GEFT) as a measure of field dependence. The ideal situation would have had all subjects in the sample completing the GEFT. But because the GEFT was expensive and could not be reproduced, only 50 copies were purchased.

The GEFT requires the subject to locate and trace a simple figure embedded within a larger, more complex figure. Two sections of nine problems each are scored. One seven-problem section precedes the two scored sections and was used for practice. Based on the results of this test, subjects were again placed on a continuum according to how well they "disembedded" the simple figures. Each subject was given a score in order to make the correlation of FD/FI with CA. A low score (e.g., 3) meant that the subject tended to be field dependent. A high score (e.g., 18) meant that the subject tended to be field independent.

The CA index and SOLAT were administered during the first class session of SECED 301. All 175 students were requested to respond to the 30 CA index statements and 36 SOLAT items. The subjects also put their social security numbers on the answer sheets so that scores could be compared. A computer was used to randomly select subjects to complete the GEFT. Once the subjects for GEFT were obtained and scores were correlated, the social security number records were destroyed.

The subjects who were chosen to complete the GEFT and agreed to do so, received released time from their 301 classes to complete the instrument. Completion of the GEFT brought the information gathering phase of the study to an end. Information for all subjects in the sample included sex, subject area, CA index, and Hemisphericity score. The fifty subjects that completed the GEFT test had an additional score for that measure.

As mentioned, the CA index was of greatest concern. For each subject, the CA index was compared to his/her sex, subject area, and SOLAT scores. The 50 subjects who had a GEFT score also had that score correlated with CA. From these correlations, conclusions were drawn and recommendations made as to the relationship between CA and those variables. Those results and conclusions are found in the following chapter.

Summary of procedural steps

1. Operationally define Computer Anxiety
2. Select type of measure
3. Generate possible test items
4. Determine face validity of items selected
5. Conduct pilot study
6. Complete item analysis of pilot study
7. Calculate reliability estimate of pilot study
8. Select items for final instrument
9. Generate distractor statements
10. Obtain SOLAT and GEFT
11. Obtain information on subjects' sex and academic subject area
12. Administer final CA instrument
13. Administer SOLAT
14. Randomly select subjects for GEFT
15. Administer GEFT
16. Score and compile normative data for CA index, SOLAT and GEFT
17. Compare normative data for SOLAT and GEFT to standardized data available from the test publishers
18. Calculate reliability estimate of CA index
19. Correlate CA index with sex, subject area, Hemisphericity and Field Dependence
20. Draw conclusions

21. Make recommendations

22. End.

RESULTS

The opening chapter outlined the purpose of this project, to successfully measure Computer Anxiety. The next chapter reviewed literature on innovation, teacher anxiety, cognitive style, and the methods of constructing an attitude measurement. Following that, the methods of this investigation were described. The methods included gathering data on sex, college major, hemisphericity, and field dependence. That information was then correlated with Computer Anxiety. This chapter will report the results obtained from those procedures. This chapter will include these data:

1. Results for the Computer Anxiety Index
2. Results for the hemisphericity test
3. Results for the field dependence test
4. Pearson Correlations between variables
5. Analysis of variance with college major
6. T-test of Computer Anxiety on hemisphericity.

Results for Computer Anxiety Index (CAIN)

In the undergraduate media (SECED 301) classes, 178 subjects responded to the Computer Anxiety (CA) instrument. Three subjects failed to complete the entire instrument. Those three subjects' scores were discarded before the results were compiled. As reported previously, Computer Anxiety and scores on the CA Index are directly related. That is, one would expect subjects with high scores to have a great deal of Computer Anxiety while those who score low would also be low in CA.

Figure 5 summarizes the descriptive statistics for the CA Index. Figures 6 and 7 illustrate the results of cross tabulations of the CA Index with sex and college major.

An estimate of reliability of CAIN was calculated through the Cronbach Alpha formula (see Figure 3). A reliability estimate of r = .86 was obtained.

Results for Your Style of Learning and Thinking (SOLAT)

The Your Style of Learning and Thinking (SOLAT) test was completed by 168 of the possible 175 subjects who correctly completed the CAIN. SOLAT was a measure of hemisphericity. A low score on the test indicated left hemispheric dominance. A high score indicated right hemispheric dominance. Two of those 168 subjects' scores were discarded because of missing data in the responses. One-hundred sixty-six valid scores remained for SOLAT. The scores for SOLAT in this study were tabulated somewhat differently than the scores used for the normative data. Rather than reporting total scores for individuals, mean scores were given for the number of questions that were answered with a right hemispheric response, an integrated response, and a left hemispheric response. For example, in the norm group, each individual, on the average answered 9.2 questions with a right hemispheric response, 8.4 questions that would be attributed to the left hemisphere, and 18.4 questions with an integrated response. Based on the points given to each response in this study (left = 1, integrated = 2, right = 3), the average score from the normative data would be 71.2. Because of

N	175
Lowest Possible Score	10
Lowest Actual Score	12
Highest Possible Score	50
Highest Actual Score	49
Range	37
Mean	31.8
Median	31.3
Mode	31
Standard Deviation	6.5

Note: Low Score = Low Computer Anxiety

High Score = Higher Computer Anxiety

Figure 5. Computer Anxiety Index (CAIN) descriptive statistics

	Male	Female
N	47	121
Minimum Score	20	12
Maximum Score	49	45
Range	29	33
Mean	31.7	31.8
Standard Deviation	7.1	6.2

Number Missing (not on class list so sex could not be determined) = 7

Figure 6. Tabulation of Computer Anxiety Index by sex

	ElEd CD	HEC w/o CD	Sci & Hum	Ed w/o ElEd	Ag
N	66	22	34	17	19
Minimum Score	17	24	12	22	22
Maximum Score	41	45	43	45	44
Range	24	21	31	23	22
Mean	31.4	32.5	32.2	34.2	29.2
Standard Deviation	5.8	5.5	8.1	6.3	6.1

Number Missing (not on class list so subject area could not be determined) = 17

Key:

ElEd/CD = Elementary Education, Child Development

HEC w/o CD = College of Home Economics without Child Development majors

Sci & Hum = College of Sciences and Humanities

Ed w/o ElEd = College of Education without Elementary Education majors

Ag = College of Agriculture

Figure 7. Tabulation of Computer Anxiety Index by college major of subject

the way the points were assigned, a low score would indicate a tendency for left hemispheric dominance and a high score would indicate a tendency for right hemispheric dominance.

Figure 8 displays the descriptive statistics for SOLAT while Figures 9 and 10 show the cross tabulation data for sex and subject area.

Since normative data available for SOLAT from Torrance, et al. (1977) did not compare males to females, nor analyze the results by subject area, comparisons with the sample data on those variables could not be made. What could be compared were the group average scores and standard deviation. The average scores were quite similar, differing by 1.8 points. The average standard deviations, however, differed by approximately the same amount, 1.9. The norm group was somewhat more homogeneous than the experimental group. This could be attributed to the fact that the norm group was less than 1/3 the size of the experimental group for this study.

Results for Group Embedded Figures Test (GEFT)

Forty-nine students completed the Group Embedded Figures Test (GEFT). The GEFT was a measure to determine field dependence. A low score on the test indicated field dependence. A high score indicated field independence. The subjects were asked to find simple figures that were embedded within larger, more complex figures. For each figure that was successfuly "disembedded," the subject scored one point. As a result, those students whose scores were low were considered to be

	Sample	Norms*
N	166	50
Lowest Possible Score	36	
Lowest Actual Score	56	
Highest Possible Score	108	
Highest Actual Score	88	
Range	32	
Mean	73	71.2
Median	72	
Mode	71	
Standard Deviation	6.2	4.3

Note: Low Score = Left hemispheric dominance

High Score = Right hemispheric dominance

*Norm group consisted of undergraduate Education majors at the University of Georgia.

Figure 8. Your Style of Learning and Thinking (SOLAT) (a measure of hemisphericity) descriptive statistics

	Male	Female
N	42	117
Minimum Score	61	56
Maximum Score	81	88
Range	20	32
Mean	72.3	72.7
Standard Deviation	5.7	6.2

Number Missing (not on class list so sex could not be determined) = 7

Figure 9. Tabulation of SOLAT (hemisphericity) by sex

	ElEd CD	HEC w/o CD	Sci & Hum	Ed w/o ElEd	Ag
N	63	22	34	16	16
Minimum Score	56	62	61	67	64
Maximum Score	85	83	88	81	88
Range	29	21	27	14	24
Mean	72.1	71.2	73.0	74.6	74.5
Standard Deviation	5.6	5.7	7.1	5.2	6.0

Number Missing (not on class list so subject area could not be determined) = 15

Key:

EdEd/CD = Elementary Education, Child Development

HEC w/o CD = College of Home Economics without Child Development majors

Sci & Hum = College of Sciences and Humanities

Ed w/o ElEd = College of Education without Elementary Education majors

Ag = College of Agriculture

Figure 10. Tabulation of SOLAT (hemisphericity) by college major of subjects

more field dependent than those whose point totals were higher. Two subjects' scores were discarded for the following reasons. One subject had completed the GEFT test for a previous study. The second subject did not complete the CAIN and had no score with which to compare the GEFT score. Descriptive data for the results of the GEFT appear in Figure 11. Figures 12 and 13 summarize results on the GEFT by sex and subject area.

The GEFT scores from the sample were compared to the normative scores in the GEFT manual (Witkin, et al., 1971). The norms were obtained from undergraduates at an Eastern United States liberal arts college. The mean score of the 13 males in this sample compared favorably to the normative score. However, for female subjects, the sample mean of 11.8 was a full point higher than the group norm. This can be possibly attributed to the colleges from which the groups were drawn. Iowa State University is recognized as an institution of excellence in engineering, mathematics, and the natural sciences. Based on this emphasis, students at Iowa State may have a more technical background than students majoring in the same subjects at a liberal arts college. Females who have more experience in subjects that require precision may have an advantage over others on a test like the GEFT.

	Sample	Norms*
N	47	397
Lowest Possible Score	0	
Lowest Actual Score	3	
Highest Possible Score	18	
Highest Actual Score	18	
Range	15	
Mean	11.8	11.2
Median	12.4	
Mode	12	
Standard Deviation	4.5	4.2

Note: Low Score = Field Dependence

High Score = Field Independence

*Norm group consisted of undergraduates at an Eastern liberal arts college.

Figure 11. Group Embedded Figures Test (GEFT) (a measure of field dependence) descriptive statistics

	Males		Females	
	Sample	Norms*	Sample	Norms*
N	13	155	34	242
Minimum Score	3		3	
Maximum Score	17		18	
Range	14		15	
Mean	11.6	12.0	11.8	10.8
Standard Deviation	4.8	4.1	4.4	4.2

*Norm group consisted of undergraduates at an Eastern liberal arts college.

Figure 12. Tabulation of GEFT (field dependence) by sex

	ElEd CD	HEC w/o CD	Sci & Hum	Ed w/o ElEd	Ag
N	14	8	9	7	4
Minimum Score	3	7	4	4	7
Maximum Score	17	18	17	17	14
Range	14	11	13	13	7
Mean	10.4	12.4	13.8	11.6	10.3
Standard Deviation	4.8	3.3	4.2	4.9	2.9

Number Missing (information not available on class lists) = 5

Key:

ElEd/CD = Elementary Education, Child Development

HEC w/o CD = College of Home Economics without Child Development majors

Sci & Hum = College of Sciences and Humanities

Ed w/o ElEd = College of Education without Elementary Education majors

Ag = College of Agriculture

Figure 13. Tabulation of GEFT (field dependence) by college major of subjects

Pearson Correlations between Variables

Pearson Correlation Coefficients were generated between the Computer Anxiety Index (CAIN) and Sex, SOLAT, and GEFT. These coefficients, sample sizes, and level of significance are reported in Figure 14.

Computer Anxiety and College Major

A one-way analysis of variance was completed to compare the CA Index with college major. Figure 15 summarizes these data. The results showed no significant difference between the mean scores of any of the groups of subjects.

T-Test of Computer Anxiety on SOLAT

The table of correlation coefficients did not reveal any relationship at the .05 level of significance. It did indicate that there may be a possible relationship between CA and hemisphericity. The correlation coefficient was calculated as -.1215 with a probability level of .059. To study this further, the CA scores of subjects were placed into 5 groups. Scores that were greater than one standard deviation below the mean were placed in the low (low computer anxiety) group. Scores that were greater than one standard deviation above the mean were placed in the high (high computer anxiety) group. The other scores were placed in three groups of

Computer Anxiety correlated with:	Correlation coefficient	Number of cases	Level of significance
Sex	.009	168	.454
SOLAT (hemisphericity)	-.122	166	.059
GEFT (field dependence)	-.100	47	.251

Figure 14. Pearson Correlation Coefficients

	Degrees of freedom	Sum of squares	Mean square	F ratio	F probability
Between groups	4	257.13	64.628		
Within groups	153	6244.76	40.82	1.58	.18
Total	157	6501.89			

Figure 15. Analysis of variance — Computer Anxiety Index by college major

1/2 to 1 standard deviation below the mean, within 1/2 standard deviation of the mean, and 1/2 to 1 standard deviation above the mean.

A t-test was calculated between the low CA group and the high CA group on the SOLAT variable. Figure 16 summarizes this calculation. The t-test between high and low Computer Anxiety failed to demonstrate a significant difference between the two groups for the hemisphericity variable.

Summary

The results of this study reveal a fairly normal distribution for the variables of Computer Anxiety, hemisphericity, and field dependence. No statistically significant relationship was found between Computer Anxiety and sex, college major, hemisphericity, or field dependence.

A possible trend was revealed between Computer Anxiety and hemisphericity. The negative correlation suggested that right hemispheric dominant subjects are slightly more computer anxious than left hemispheric dominant subjects. (A post hoc analysis) failed to reveal a significant relationship between these two variables.

The Computer Anxiety Index appeared to be a reliable measurement. Using the standard of r = .70 as being a respectable reliability estimate for an attitude measurement, the reliability estimates of r = .88 for the pilot test and r = .86 for the main study are quite encouraging.

	N	Mean	Standard deviation	t-value
Low CA	22	74.1	5.3	0.89
High CA	30	72.6	6.6	

Figure 16. T-test — low/high Computer Anxiety on SOLAT

DISCUSSION OF RESULTS

The idea for this study originated with the researcher's past experiences with teachers who exhibited resistance to educational innovations. New techniques or devices have almost always met some level of resistance from educators. The computer is one example of a powerful instructional tool that has met this resistance (Anastasio, 1972; Blumenfeld, et al., 1978). There are a variety of reasons to explain why the computer has not been widely accepted. Computer Anxiety (CA) may be one source of resistance. In order to facilitate the acceptance of computers in the classroom, the researcher applied the principles of instructional design (Gagne and Briggs, 1979). One of the first steps in any well-designed instructional system is the assessment of needs. The intent of this research was to assess the needs of prospective teachers by creating a measure of Computer Anxiety that could be used to determine the extent of this problem.

Anxiety seems to be logically associated with resistance. Research has indicated that there is a great deal of anxiety among teachers from preservice to the most experienced (Coates and Thoresen, 1976; Keavney and Sinclair, 1978; Travers, et al., 1952; Youngs, 1978). The research cited in the Review of Literature of this study related anxiety to sex (Finley, 1970; O'Toole, 1964; Thompson, 1963), teacher grade level (Thompson, 1963), and cognitive style (Tucker, et al., 1978). Because of these relationships, for this study, data on these characteristics were gathered from prospective teachers and compared to CA scores. None of these characteristics had a statistically significant relation to any other variable.

Sex Relationship to Computer Anxiety

The literature review suggested that females tended to have greater levels of anxiety than males (Finley, 1970; O'Toole, 1964; Thompson, 1963). In the results of this study, the correlation coefficient between sex and Computer Anxiety was almost 0.00 indicating no relationship whatsoever. The tabulation of CA scores by sex in Figure 6 revealed almost identical mean scores (.1 difference) for males and females. In fact, the most "computer anxious" subject in the entire study was male. In addition, several females showed less computer anxiety than the least computer anxious male. The conclusion was reached that the males and females scores on the CAIN were not significantly different. Even though the research cited reported that female teachers exhibit higher levels of anxiety than males, this research did not. The conclusion from this study is that females as a group have no more nor less Computer Anxiety than males.

College Major Relationship to Computer Anxiety

In the literature, there was evidence reported that teachers of young children tended to have more anxiety toward innovation than teachers of older children (Thompson, 1963). To investigate this, the subjects were grouped according to the college (Home Economics, Sciences and Humanities, Education, and Agriculture) in which they were classified. An additional group was identified that consisted of students enrolled in Child Development (CD) and Elementary Education (ElEd). It was assumed that if there was a significant relationship between

Computer Anxiety and college major, it would be found in this group. A single classification analysis of variance was used to compare groups and it was found that "no two groups were significantly different at the .05 level." Tabulations of the Computer Anxiety Index by college major also revealed that the ElEd/CD group had the 2nd lowest mean score of the 5 groups. This group also had the 2nd lowest minimum score and the lowest maximum score of the five groups. This was quite different from what was expected, since it indicated that as a group, these subjects tended to have lower CA than most other college students. Based on these results, it was concluded that Computer Anxiety does not discriminate significantly between subjects in different major curricula. In other words, a student enrolled in Elementary Education cannot be expected to have a higher level of Computer Anxiety than a student enrolled in English, or any other major subject area.

Hemisphericity Relationship to Computer Anxiety

Another relationship suggested by the literature was the one between anxiety and hemisphericity. It was reported that those subjects who were left hemispheric dominant tended to be more adversely affected by anxiety than other subjects (Tucker, et al., 1978). The hemisphericity variable as measured by the Your Style of Learning and Thinking (SOLAT) test (Torrance, et al., 1977) was correlated with the score from the Computer Anxiety Index. The SOLAT scores were also tabulated by sex and college major.

The tabulation of SOLAT by sex revealed a slightly lower mean for males than females. While the relationship is not statistically significant, it is consistent with the general agreement that more males tend to be left hemispheric dominant than females. An analysis of variance of SOLAT by college major found no statistically significant difference between the groups. This was also expected.

The correlation of SOLAT with CAIN prompted some additional analysis. The correlation of -.1215 at the .059 level of significance suggested that there was a tendency for the left hemispheric dominant subjects to have more computer anxiety than right hemispheric dominant subjects. The most highly computer anxious subjects were compared to the subjects with the lowest CA scores on the hemisphericity variable. The post hoc t-test for the high and low groups failed to show a statistically significant difference. However, the correlations between these two variables indicated that there might be a trend between CA and hemisphericity. Because of this possible trend, the conclusion drawn about these two variables was that while this study did not consistently show a strong relationship between CA and hemisphericity, there was sufficient evidence to warrant additional study of that possible relationship in the future.

The literature suggested that females were generally more anxious than males (Finley, 1970; O'Toole, 1964; Thompson, 1963) and that left hemispheric dominant subjects tended to be more anxious than those dominated by the right (Tucker, et al., 1978). The literature review also indicated that males tend toward left dominance. This would mean that a male, in general, could be expected to exhibit lower levels of

Computer Anxiety. The male also should tend to be left hemispheric dominant. But a person who is left hemispheric dominant should have greater Computer Anxiety. A discrepancy exists. This study showed no difference on Computer Anxiety between males and females. Left hemispheric dominant subjects in the study exhibited a possible tendency toward greater computer anxiety than right dominant subjects. This is one example of why it is very difficult to make valid generalizations about a large group of people on a particular trait.

Field Dependence Relationship to Computer Anxiety

Scores of field dependence from the Group Embedded Figures Test (GEFT) (Witkin, et al., 1971) were correlated to scores for Computer Anxiety. The correlation of -.1003 (.251 level of significance) indicated that for this group of subjects there was no significant relationship between Computer Anxiety and field dependence. Tabulation of scores on GEFT by sex revealed practically identical results for males and females. This result was inconsistent with the literature that reported that females were more field dependent than males (Nelson, 1977; Witkin, 1950). If anything, the results of this study generated a higher mean score for females indicating a tendency to just the opposite as that reported in the literature. The mean score for females was 11.8 while the mean score for males was 11.6. The females' 11.8 mean score was one full point higher than the published norm (Witkin, et al., 1971). This would indicate that the female subjects in this study tended to be more field independent than the female subjects from which the norm was calculated. One possible reason for this difference is that the females in this sample probably have a more technical background than the females from which the GEFT was normed. The technical background which probably required attention to detail may have made the females in the sample more sensitive than the norm group to picking out the simple figures used by the GEFT.

The GEFT scores tabulated by subject area revealed that the Agriculture majors and the Elementary Education/Child Development majors had the lowest mean scores (Ag — 10.3, ElEd/CD — 10.4). This meant that these two categories, as a group had the most field dependent individuals. The Sciences and Humanities majors had the highest mean score (13.8), showing a tendency for the group to be more field independent than the other groups. Some of the specific curricula in the College of Sciences and Humanities are Math, Chemistry and Biology. These students probably had substantial experience in identifying details within larger systems. The scores of these subjects would tend to raise the group score. On the other hand, Elementary Education, Child Development and Agriculture students probably have more experiences in looking at how larger systems operate rather than picking out specific details. These experiences would tend to lower the scores of these two groups.

The Computer Anxiety Index

From the results of this study, several comments about the CA Index can be made. It is gratifying to see the high reliability estimate for both the pilot test (r = .88) and the main study (r = .86). These data suggest that the CA Index is in fact a consistent measure. The remaining concern is the question of validity. Is the CA Index actually measuring Computer Anxiety? With confidence, it can be said that for this group of subjects the instrument is not influenced by subject sex, college major, or field dependence. The instrument may have some relationship to hemisphericity, but with the low correlation coefficient between these two variable scores, it would be safe to say that the entire instrument is not an effective measure of hemisphericity.

Few would argue with the previous statements about what the CA Index does not measure. Most would probably agree that it is measuring something. The reliability of the instrument would support that. But there most likely would be some question as to whether the construct that is measured truly is Computer Anxiety.

The ten statements that made up the final CA instrument referred to future use of and past experiences with computers. The obvious questions similar to "I feel anxiety about using computers" were eliminated during the pilot study because they failed to discriminate. Because of this question of validity, several educators who were identified as being highly computer anxious completed the CA instrument in a post hoc analysis. The scores from these subjects were variable. Some of the highly computer anxious subjects did indeed receive high scores on the CA Index. Other scores, however, were within one or two points of 15. A score of 15 would indicate a generally neutral feeling. None of these highly anxious subjects' scores was below 10. In informal interviews with these computer anxious subjects and computer professionals, it appears the instrument might be measuring a construct that could be called "intent to use."

If the CA instrument is reliably measuring "intent to use," and it appears it is, it could be used without much revision to measure just that. A reliable measure of this type could provide curriculum planners valuable information on what kind of training individual teachers or groups of teachers require in schools targeted for implementation of computer assisted instruction (CAI). Subjects whose scores indicate a favorable intent to use computers would receive different training from those whose scores indicate they do not intend to use the computer. Perhaps those teachers who do intend to use CAI would be used to introduce and train those who do not.

Through the post hoc analysis, it appears that computer anxiety and the intent to use computers have some similarities. Intuitively, one would expect them to be related. For the curriculum designer in schools, the critical problem is to make the most effective use of the capabilities of computer technology to support instruction. If the Computer Anxiety Index can be used to reliably measure a specific teacher's intent to use, the results from the test can be quite valuable.

The Computer Anxiety Index probably is measuring anxiety as one factor that inhibits the intent to use. It probably is also measuring some teachers' preferences for using other forms of instruction. But because it can reliably report a person's attitude toward a future event, it could be constructively used "as is."

Finally, even though Computer Anxiety and intent to use are quite similar, there still remains a distinct difference. "Anxiety" certainly is different from "personal preference." Because of this difference and because of the rapid growth of the effects of computers in education and all of society, the attempt to isolate CA from all other variables becomes increasingly important. The CA Index developed in this study can be used as a useful diagnostic tool, but in the future it could be replaced by at least two more specific, more powerful instruments. One future instrument could measure "preference for medium of instruction." The second instrument could measure Computer Anxiety in isolation. The effort to measure CA as an independent construct should be a continuing endeavor. It should not be confined to the pages of this document, nor end with the end of this research.

Conclusions

1. The CA Index is a reliable instrument.
2. The CA Index has no significant relationship to sex.
3. The CA Index has no significant relationship to college major.
4. The CA Index has no significant relationship to field dependence.
5. The CA Index might have a slight relationship to hemisphericity.
6. The CA Index might be used in its current form as a measure of intent to use computers in the classroom.
7. The intent to use computers is probably a combination of Computer Anxiety and personal preference.
8. In the future CA will become an even more critical problem.
9. The effort to isolate and reduce CA should continue.

Summary

The main purpose of this research was to develop a measure of Computer Anxiety. The instrument, consisting of 10 target statements and 20 distractor statements, was administered during the fall of 1980 to 175 education students in the undergraduate media course at Iowa State University. The score from the 10 target items was correlated to sex, hemisphericity, and field dependence. An analysis of variance was calculated between the scores on the Computer Anxiety Index and the subject's college major. While no statistically significant relationships were found for any variable, there appeared to be a slight relationship between hemisphericity and Computer Anxiety. The Computer Anxiety Index reliability estimate was fairly high (r = .86) but the instrument's validity was questioned. Conclusions suggested that the instrument may be a valid measurement of "intent to use" the computer in the classroom which included Computer Anxiety. It was stated that the need to identify and reduce Computer Anxiety will become increasingly important in the future. The recommendation was made that research in Computer Anxiety should continue.

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And to my wife, Kim, and my son, Mike, thank you for your patience and love. I'm looking forward to spending time with you again.

APPENDIX 1.

SAMPLE PAGE — YOUR STYLE OF LEARNING AND THINKING

YOUR STYLE OF LEARNING AND THINKING

Form A

INSTRUCTIONS: On the answer sheet provided, describe your style of learning and thinking by blackening the appropriate blanks. Try to describe your own strengths and preferences as accurately as possible.

1. (a) not good at remembering faces
   (b) not good at remembering names
   (c) equally good at remembering names and faces.

2 (a) respond best to verbal instructions
   (b) respond best to visual and kinesthetic instructions
   (c) equally responsive to verbal and visual/kinesthetic instructions.

3. (a) able to express feelings and emotions freely
   (b) controlled in expression of feelings and emotions
   (c) inhibited in expression of feelings and emotions.

4. (a) playful and loose in experimenting (in cooking, art, athletics, writing, research, teaching, etc.)
   (b) systematic and controlled in experimenting
   (c) equal preference for playful/loose and systematic/controlled ways of experimenting.

5. (a) preference for dealing with one problem or variable at a time
   (b) preference for considering several problems or variables simultaneously
   (c) equal preference for sequential or simultaneous consideration of problems/variables.

6. (a) preference for multiple-choice tests
   (b) preference for open-ended tests which have no single "right" answer
   (c) equal preference for multiple-choice and open-ended tests.

7 (a) good at interpreting body language
   (b) poor at interpreting body language; dependent upon what people say
   (c) equally good at interpreting body language and verbal expression.

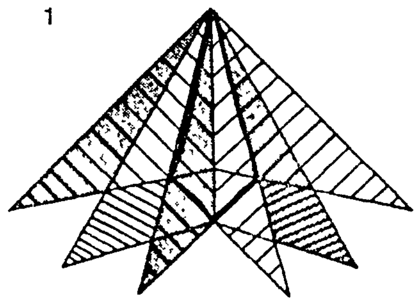
Georgia Studies of Creative Behavior
Department of Educational Psychology
University of Georgia
December 1975

APPENDIX 2.

SAMPLE PAGE - GROUP EMBEDDED FIGURES TEST

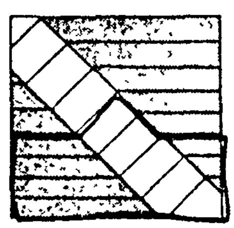
THIRD SECTION

1



Find Simple Form "F"

2



Find Simple Form "G"

Go on to the next page

APPENDIX 3.

PILOT TEST INSTRUMENT (COMPUTER ATTITUDE QUESTIONNAIRE)

COMPUTER ATTITUDE QUESTIONNAIRE

Some of the following statements refer to Computer Assisted Instruction (CAI). When responding to these statements, think of CAI as any educational activity presented or supported by a computer, including drill and practice, tutorial instruction, simulation, games, and computer managed instruction.

Please use the following five point scale to respond to the following statements:

A/1 = Strongly Agree

B/2 = Agree

C/3 = Undecided/No Opinion/Don't Know

D/4 = Disagree

E/5 = Strongly Disagree

1. I am quite knowledgable about the uses of the computer in the classroom.

2. I can think of some great ways to use the computer for teaching in my subject area.

3. To effectively use the computer, you must memorize the computer's language.

4. Recently, I have read many articles concerning CAI.

5. My use of computers has been very limited.

6. My undergraduate coursework has made me knowledgable of computers in schools.

7. My grade level is not appropriate for using the computer.

8. So far, the only constructive use of the computer in schools has been in mathematics.

9. I believe that computers are too expensive for schools to buy.

0. I don't read much about CAI.

1. If my students asked me to help them on the computer, I probably couldn't.

2. I believe computers are too complicated for the average teacher to run.

3. I believe that computers have been used successfully in many schools.

4. Any teacher should be able to make use of the computer in teaching.

5. My subject area is not appropriate for using the computer.

6. I have personally used the computer many times.

7. The cost of some computers is well within the budget of most schools.

8. Few schools have successfully used the computer in instruction.

9. Even if he/she doesn't know the language, a teacher could still use computers in teaching.

0. The computer can be used for instruction in many subject areas.

1. I am not prepared to make use of the computer in my teaching.

2. I believe computers will help keep alive what is best in education.

3. School wide emphasis on experimenting with computers should be encouraged.

4. Computers offer unlimited possibility for schools.

5. I do not find what I want in computers.

26. I believe that more money should be spent on computers in schools.

27. Computers in schools contribute to a sound education.

28. A teacher should not be expected to accept a computer in the classroom.

29. Computers have no place in the classroom.

30. Teachers should be willing to give computers a try.

31. Computers tend to impair normal teacher-pupil relationships.

32. A computer in my room would increase discipline problems.

33. Computers detract from the quality of instruction.

34. Having a computer in my room would improve my instruction.

35. A computer in my room would reduce discipline problems.

36. When there is a staff of well prepared teachers in a school, computers are not necessary.

37. I think the taxpayers would see a computer in my classroom as a waste of their money.

38. This is no time to experiment with the computer in the classroom.

39. By using a computer, I will become a better teacher.

40. I would not want my students to know more about computers than I do.

41. My students will respect me less if there is a computer in my classroom.

42. I look forward to the time when computers are in all classrooms.

43. I worry about the bad consequences of putting computers in schools.

44. If located in my classroom, I would fequently make use of the computer.

45. As a teacher with a computer in my classroom, during my free time, I would explore uses of the computer for instruction.

46. In my classroom, the computer would be in use most of the day.

47. I would not allow my students to experiment with the computer during recess or after school.

48. I would encourage my students to share new discoveries on the computer with me and the class.

49 If there was no computer for instructional use in my school, I would request that one be obtained.

50. I plan to attend meetings about CAI in my spare time.

51. I have attended many meetings in the past about CAI.

52. Given the choice between teaching a subject through a traditional method or on a computer program, I would probably choose the traditional method.

53. If a student wanted to do a project for my class that involved working on the computer, I would strongly encourage him/her to do it.

54. I doubt if I will use the computer in my teaching.

55. I don't plan to get involved in CAI.

56. If a computer was in my classroom, I would use it only when absolutely necessary.

57. I will encourage my students to experiment with the computer.

58. If a computer is in my classroom I will use it only for things with which I am familiar.

59. I would prefer to stay away from meetings on CAI.

60. If available, I would choose CAI over other forms of instruction for some of my teaching.

61. I will discourage students from working independently on the computer.

62. I have never attended a meeting on CAI in my spare time.

63. If there is a computer in my classroom, I will suggest it be placed in another room where it could be put to better use.

APPENDIX 4.

COMPUTER ANXIETY INDEX (EDUCATIONAL INNOVATION SURVEY)

As a graduate student in education, I am interested in teacher attitudes toward innovation in education. To gather information, I am asking for the opinions of students in Education 301. Answering the following questions with your honest opinion will help me a great deal. You will be asked for your social security number, but do not put your name on your answer sheet as the information should be given anonymously.

You are under no obligation to complete the questionnaire. If you decide to not complete it, simply return the blank form to your instructor.

If you have any questions about the survey, or you would like to know the results of this research, send a request for the results to:

Dan Rohner
c/o Dr. Mike Simonson
Instructional Resources Center
321 Curtiss Hall
Iowa State University
Ames, Iowa 50011

Thank you very much for your time and assistance.

Dan Rohner

EDUCATIONAL INNOVATION SURVEY

Please fill in your Social Security Number in the Identification Number section of your answer sheet. Then record your answers using the five point scale below.

A/1 = Strongly Agree

B/2 = Agree

C/3 = Undecided/No Opinion/Don't Know

D/4 = Disagree

E/5 = Strongly Disagree

EDUCATIONAL INNOVATION SURVEY

*1. Having a computer in my room would improve my instruction. $\bar{X}$ = 2.84, s = .94

*2. I can think of some great ways to use the computer for teaching in my subject area. $\bar{X}$ = 2.57, s = .97

3. If a student wanted to do a project for my class that involved recording a video tape, I would strongly encourage him/her to do it.

R*4. My subject area is not appropriate for using the computer. $\bar{X}$ = 2.64, s = 1.21

5. I worry about the bad consequences of putting television in schools.

6. I believe innovation will help keep alive what is best in education.

7. I believe that more money should be spent on television equipment in schools.

8. When there is a staff of well prepared teachers in a school, films are not necessary.

9. Any teacher should be able to make use of photography in the classroom.

10. I don't plan to get involved in educational innovation.

R*11. Given the choice between teaching a subject through a traditional method or on a computer program, I would probably choose the traditional method. $\bar{X}$ = 3.52, s = .88

12. I believe film projectors are too complicated for the average teacher to run.

13. Photography in schools contributes to a sound education.

R*14. A computer in my room would reduce discipline problems. $\bar{X}$ = 3.52, s = .81

R*15. My use of computers has been very limited. $\bar{X}$ = 4.16, s = 1.02

* — CAIN item.
R — score was reversed before calculating CAIN.

16. Films detract from the quality of instruction.

R*17. If there is a computer in my classroom, I will suggest it be placed in another room where it could be put to better use. $\bar{X} = 2.63$, $s = 1.06$

18. Teachers should be willing to give any new teaching method a try.

19. If there were no overhead projectors in my school, I would request that some be obtained.

20. I believe that filmstrips have been used successfully in many schools.

21. Television can be used for instruction in many subject areas.

*22. I look forward to the time when computers are in all classrooms. $\bar{X} = 3.13$, $s = .80$

23. A teacher should not be expected to accept new media in the classroom.

24. If available, I would choose films over other forms of instruction for some of my teaching.

R*25. I doubt if I will use the computer in my teaching. $\bar{X} = 3.09$, $s = .99$

26. I think the taxpayers would see a record player in my classroom as a waste of their money.

27. I believe that, in general, non-print media, (films, video tapes, cassettes, etc.) are too expensive for schools to buy.

28. My undergraduate coursework has made me knowledgable of television in schools.

29. Few schools have successfully used non-print media in instruction.

R*30. I am not prepared to make use of the computer in my teaching. $\bar{X} = 3.60$, $s = 1.06$

* — CAIN item.

R — score was reversed before calculating CAIN.

APPENDIX 5.

USE OF HUMAN SUBJECTS RELEASE FORM

INFORMATION ON THE USE OF HUMAN SUBJECTS IN RESEARCH
IOWA STATE UNIVERSITY
(Please follow the accompanying instructions for completing this form.)
100

1. Title of project (please type): Development and Validation of an Index of Computer Apprehension Among Prospective Teachers

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are properly protected. Additions to or changes in procedures affecting the subjects after the project has been approved will be submitted to the committee for review.

Signature redacted for privacy

Daniel J. Rohner	7/24/80	
Typed Named of Principal Investigator	Date	Signature of Principal Investigator

321 Curtiss Hall	294-6840
Campus Address	Campus Telephone

3. Signatures of others (if any) | Date | Relationship to Principal Investigator

Signature redacted for privacy

Signatures of others (if any)	Date	Relationship to Principal Investigator
	7/24/80	Major Professor

4. ATTACH an additional page(s) (A) describing your proposed research and (B) the subjects to be used, (C) indicating any risks or discomforts to the subjects, and (D) covering any topics checked below. CHECK all boxes applicable.

- [ ] Medical clearance necessary before subjects can participate
- [ ] Samples (blood, tissue, etc.) from subjects
- [ ] Administration of substances (foods, drugs, etc.) to subjects
- [ ] Physical exercise or conditioning for subjects
- [ ] Deception of subjects
- [ ] Subjects under 14 years of age and(or) [ ] Subjects 14-17 years of age
- [ ] Subjects in institutions
- [ ] Research must be approved by another institution or agency

5. ATTACH an example of the material to be used to obtain informed consent and CHECK which type will be used.

- [ ] Signed informed consent will be obtained.
- [X] Modified informed consent will be obtained.

6. Anticipated date on which subjects will be first contacted: Month 8 Day 12 Year 80

Anticipated date for last contact with subjects: Month 9 Day 10 Year 80

7. If Applicable: Anticipated date on which audio or visual tapes will be erased and(or) identifiers will be removed from completed survey instruments: Month NA Day ___ Year ___

8. Signature of Head or Chairperson | Date | Department or Administrative Unit

Signature redacted for privacy

9. Decision of the University Committee on the Use of Human Subjects in Research:

- [X] Project Approved
- [ ] Project not approved
- [ ] No action required

Signature redacted for privacy

George G. Ka	7-31-80	
Name of Committee Chairperson	Date	Signature of Committee Chairperson

Revised 6/78