DOCUMENT RESUME

ED 331 891 TM 016 499

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TITLE Computer Technologies in Teacher Education: The Measurement of Attitudes and Self-Efficacy.
PUB DATE Apr 91
NOTE 21p.; Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, IL, April 3-7. 1991).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Attitude Measures; *College Students; *Computer Literacy; Computers; Education Majors; Factor Analysis; Higher Education; *Self Efficacy; Student Attitudes; Teacher Attitudes; *Teacher Education; *Test Construction; Test Reliability; Test Validity
IDENTIFIERS Computer Anxiety

ABSTRACT

The development and validation of two instruments which measure attitudes and self-efficacy of teacher education students and practicing teachers toward computer use are described. One instrument--Attitudes toward Computer Technologies (ACT)--assesses perceived usefulness of and comfort/anxiety with computer technologies. The second instrument--Self-Efficacy for Computer Technologies (SCT)--assesses perceived self-efficacy for computer technologies (word processing, electronic mail, and CD-ROM databases). These measures were administered to 328 university students in education courses. Principal components analysis of the 19-item ACT found evidence for retaining the concept of the two factors of comfort/anxiety and usefulness. For the 25-item SCT, three empirically identified factors mirrored the concepts of word processing, electronic mail, and CD-ROM data bases. Subscales for both instruments were found to be reliable. Results of regression analyses suggest that actual experience with computer technologies is a strong predictor of attitudes and self-efficacy. These instruments were designed for use with teachers and teacher education students, but could be adapted for other populations. Seven tables present study data. (SLD)

Computer Technologies in Teacher Education: The Measurement of Attitudes and Self-Efficacy

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Paper presented at the annual meeting of the
American Educational Research Association (AERA),
Chicago, April, 1991.

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Computer Technologies in Teacher Education: The Measurement of Attitudes and Self-Efficacy

ABSTRACT

Teachers who use computer technologies are likely to be important models for their students, helping to produce positive student attitudes towards these technologies. In order to do this, however, they must feel self-efficacious and comfortable using technologies and they must perceive the utility of doing so. It is likely that teacher affect is strongly influenced by prior training. For this reason it is important to examine what sorts of attitudes and what perceptions of competence are encouraged by teacher education programs. In this paper, the development and validation of two instruments for use with teacher education students and practicing teachers are described: ATTITUDES TOWARD COMPUTER TECHNOLOGIES (ACT) and SELF-EFFICACY FOR COMPUTER TECHNOLOGIES (SCT). ACT assesses perceived usefulness of and comfort/anxiety with computer technologies. Perceived self-efficacy for computer technologies (word processing, electronic mail, and CD-ROM data bases) is measured by the SCT.

These measures were administered to 328 university students enrolled in education courses. Principal component analysis of the 19-item ACT instrument identified three empirical factors which explained 52.3% of the variance among ACT items. The correlation between Factors II and III (r=.45) is a low to moderately positive correlation that provides evidence for retaining the a priori concept of a two-factor instrument ("Comfort/Anxiety" and "Usefulness"). Alpha reliability for the ACT instrument was fairly high (r=.89); as were reliability values obtained for the two conceptual factors ("Comfort/Anxiety," r=.90; "Usefulness," r=.83). When the 25-item SCT instrument was subjected to principal component analysis, a three-factor solution emerged which accounted for 84.4% of the variance. The empirically identified factors mirrored the conceptual factors of "Word Processing," "Electronic Mail," and "CD-ROM data bases." These subscales were also found to be highly reliable (r=.97 for "Word Processing," r=.98 for "Electronic Mail," r=.98 for "CD-ROM"). Results of the regression analyses suggest that actual experience with computer technologies, either in a course or in regular use, is a strong predictor of both attitudes and self-efficacy.

These results are discussed with reference to needed future research and educational practice. While the instruments were designed for administration to teachers and teacher education students, they could easily be adapted for use with other specialized population groups, such as those from business or medicine.

Computer Technologies in Teacher Education: The Measurement of Attitudes and Self-Efficacy

INTRODUCTION

> "In the broadest sense, technology extends our abilities to change the world: to cut, shape, or put together materials; to move things from one place to another; to reach farther with our hands, voices, and senses" (American Association for the Advancement of Science, p. 39).

For teachers, computer technologies have this potential. Technologies such as word processing, electronic mail, and data bases on compact disc can assist teachers in instructional management and improvement, communicating with both peers and experts in their fields, and identifying new instructional methods and resources, among other things. Besides the benefits in personal effectiveness, teachers who use these technologies are likely to be important models for their students, helping to produce positive student attitudes towards computer technologies. This latter effect may be of critical importance for, as pointed out by a recent report by the American Association for the Advancement of Science (AAAS, 1989), many students are emerging from school with an aversion to science, mathematics, and technology. The consequences of this aversion mean the limiting of students' lives and the reduction of the nation's talent pool from which scientists, mathematicians, and engineers are drawn. Authors of the AAAS report reflect that, "schools may not be able to turn this situation around by themselves, but they are essential to any realistic hope of doing so. It is within teachers' power to foster positive attitudes among their students" (p. 135).

For teachers to embrace these technologies, however, they must feel self-efficacious and comfortable using them. They must also perceive the utility of the technologies, because as Williams and Williams (1984) note, "teachers are the ultimate gatekeepers" (p.30). It is likely that teacher attitudes are strongly influenced by their prior training. For this reason it is important to examine what sorts of attitudes and what perceptions of competence are encouraged by teacher education programs. Much of the instrument development to date in this area has focused on teacher attitudes, neglecting the important construct of self-efficacy (Abdel-Gaid, Trueblood, & Shrigley, 1986; Elkins, 1985; Norris and Lumsden, 1984). In addition, the focus of these instruments tends to be limited to computers and does not reflect the expansion of the field of computer technologies to include compact disc data bases (such as ERIC or Psych LIT) or electronic mail.

In this paper, we briefly describe efforts to measure affect related to computers within the last decade. Then we describe the development and validation of two instruments: ATTITUDES TOWARD COMPUTER TECHNOLOGIES (ACT) and SELF-EFFICACY FOR COMPUTER TECHNOLOGIES (SCT). ACT assesses perceived usefulness of and comfort/anxiety with computer technologies. Perceived self-efficacy for computer technologies (word processing, electronic mail, and CD-ROM data bases) is measured by the SCT. Both scales were developed for administration to teacher education students and practicing teachers. In addition to validation data, we present results from analyses intended to explore the relationships between attitudes, perceived self-efficacy,

and other demographic variables, such as gender, amount of prior experience with and training in computer technologies. Finally, the implications of these findings are discussed for the training of preservice and inservice teachers.

THE MEASUREMENT OF AFFECT RELATED TO COMPUTERS

In this section, we review educational theory relevant to attitudes and self-efficacy, particularly with respect to computers and computer technologies. This is followed by a brief discussion on various instruments developed to measure affect related to computers.

Attitudes are important for study, as they are a reflection of an individual's personal perspective and can be strongly predictive of behavior. According to Aiken (1980), attitudes are "learned predispositions to respond positively or negatively to certain objects, situations, concepts, or persons" (p. 2); a similar definition has been offered by Fishbein and Ajzen (1975).

A construct more specifically related to performance is perceived self-efficacy. Self-efficacy reflects an individual's confidence in his/her ability to perform the behavior required to produce specific outcomes; it is thought to directly impact the choice to engage in a task, as well as the effort that will be expended and the persistence that will be exhibited (Bandura, 1977). In fact, high correlations are often found between reported self-efficacy and subsequent performance (Bandura & Adams, 1977; Bandura, Adams & Beyer, 1977). Self-efficacy is considered to be situation or task specific, correlating with task preference, effort expenditure, and persistence (Schunk, 1987). Research conducted by Owen (1986) suggests that self-efficacy can be reliably measured and that such measurement is facilitated by the identification of a clearly defined set of skills.

A careful review of the literature indicated that no instruments existed which measured attitudes and self-efficacy with regards to the growing field of computer technologies in teacher education. One scale was developed to measure special education teachers' attitudes towards computers (Elkins, 1985), however validation was obtained with only 47 respondents. Norris and Lumsden (1984) measured educators' attitudes towards computers, but the scale they developed contained only three items; no reliability data were reported. Abdel-Gaid, Trueblood, & Shrigley (1986) developed a 23-item scale for use with preservice and inservice teachers, however their scale was limited to measuring attitudes towards computer use in the classroom, and did not reflect other uses of computers or the expanded field of computer technologies. In addition, none of these instruments measures self-efficacy for computer technologies. The scale developed by Murphy, Coover, and Owen (1988) does measure self-efficacy in various computer use skills, but does not extend to use of computer technologies such as electronic mail and CD-ROM data bases.

METHODOLOGY

Instrument Development: Content Validity

> "First and foremost, the scale developer should have a well-though-out conceptualization of the nature of the attribute that he is attempting to measure. This conceptualization can spring from a theoretical foundation, from a practical knowledge of the situation, or from interaction with other experts regarding that attitude" (Severy, 1974, p. 6).

With this quote in mind, the ATTITUDES TOWARD COMPUTER TECHNOLOGIES and SELF-EFFICACY FOR COMPUTER TECHNOLOGIES instruments were developed. The scale development process was based on three categories of information: a review of books, articles, and instruments; experiences in teaching computer technologies; and student as well as expert input. As indicated previously, a review of the literature indicated that no instruments existed which measured attitudes and self-efficacy with regards to computer technologies in teacher education.

To develop appropriate scales, procedures based on those advanced by Gable (1986), were followed. General categories were identified for each proposed instrument. Following an analysis of scales developed by Delcourt and Lewis (1987), Murphy, Coover, and Owen (1989), and Loyd and Gressard (1984), a number of items were selected and revised with author permission. The remainder of items were generated based on student comments and personal experience in teaching computer technologies.

A total of 19 items were developed for the attitude instrument, 11 measuring Usefulness (for example, "Communicating with others over a computer network can help me to be a more effective teacher.") and 8 measuring Comfort/Anxiety ("I feel comfortable about my ability to work with computer technologies."). These items are equally balanced between positively and negatively phrased statements, as recommended by Likert (1935). The Self-Efficacy instrument consists of 27 items, with subscales of 10 items on word processing, 10 items on electronic mail, and 7 items on compact disc (CD-ROM) data bases. In addition, eight items are included to provide demographic information, such as age, sex, educational status, and experience with and training in computer technologies.

Seventeen content judges (computer technology instructors, measurement experts, educational consultants, and graduate students) reviewed the initial instruments and related items to the categories of Comfort/Anxiety and Usefulness for the Attitude instrument, and to the categories of Word Processing, Electronic Mail, and CD-ROM data bases for the Self-Efficacy instrument. On receipt of this information, the items were revised. A Likert scale with a four-point response format was chosen for both instruments utilizing descriptors ranging from Strongly Disagree (1) to Strongly Agree (4). Additional critique was provided by a six member instrument review committee from a School of Education at a major university. Final revisions were then made to the instruments.

Methods, Procedures, and Data Sources

The resulting instruments were administered to 328 undergraduate and graduate students enrolled in education courses at universities across the country during 1990 and 1991: Arizona State University (n=30), The College of St. Thomas in St. Paul, MN (n=21), University of Alabama (n=86), University of Nebraska (n=28), University of South Carolina (n=24), and University of Virginia (n=139). Demographic information for this sample included age, sex, and current level of education. Participants were also asked about their past experiences in using computer technologies (word processing programs, electronic mail, CD-ROM data base systems).

The mean age for the sample was 25 (range=18 to 60, median=21). Responses were received from 67 males and 259 females. Most of these individuals were enrolled in undergraduate degree programs (n=207). The remaining participants were graduate degree students (n=97).

Regarding the frequency of using the three types of computer technologies (never, at least once/year, at least once/month, at least once/week, daily), it is interesting to note that 36% (n=118) of the sample reported using word processing at least once per week but that 15% (n=49) indicated that they have never used this type of technology. Survey results also revealed that electronic mail systems have never been employed by 53% (n=175) of the respondents and CD-ROM data bases have never been used by 45% (n=148) of the subjects. Individuals were also asked, "Have you ever taken any courses in which you've learned to use these technologies (word processing, electronic mail, CD-ROM)?" Over a third of the subjects (34%, n=111) said, "No", for all three categories.

Data from these administrations were used to perform a Principal Component analysis and to examine the internal consistency reliability of each instrument. In addition, exploratory hierarchical regression analyses were undertaken to investigate the relationships between demographic variables, experiences in using computer technologies, attitudes, and feelings of competency.

RESULTS

Principal Component Analysis

ATTITUDES TOWARD COMPUTER TECHNOLOGIES (ACT) Responses to the ACT (n=327) were subjected to a Principal Component Analysis (PCA). The PCA using Kaiser's criterion revealed a three-factor solution (components will be referred to as factors) which accounted for 52.3% of the variance in the set of 19 items. Varimax and oblique rotations generated similar factor structures. Table 1 displays the loadings obtained for each factor resulting from the Varimax rotation. None of the items loaded significantly on more than one factor. Factor I contained 8 items reflecting "Comfort/Anxiety" in relation to computer technologies. Individuals with high scores on this scale feel competent about their ability to employ the designated technologies. The 11 items representing perceived "Usefulness" of computer technologies loaded on Factors II and III. Respondents with high scores on this set of items view computer technologies as valuable tools for performing a variety of tasks.

Insert Table 1 about here.

While the empirical evidence reveals a three-factor solution, the correlation between Factors II and III (r=.45) is a low to moderately positive correlation that provides evidence for retaining the a priori concept of a two-factor instrument. Supporting this decision, Tabachnick and Fidell (1983) recommend that researchers consider merging factors correlated above .30.

An examination of the actual item stems (see Table 1) reveals additional evidence for retaining the original two-factor measure. All items on Factor II are positively phrased and relate to specific uses of computer technologies (i.e., "If I can use word processing software, I can be a more productive teacher."). All items loading on Factor III are negatively stated and reflect more general uses of the construct (i.e., "I don't see how computer technologies can help me learn new skills."). From these observations, it is difficult to formulate one clear reason for the separation of the scale into two factors. A possible follow-up study would include a revised version of this scale with all items phrased similarly.

SELF-EFFICACY FOR COMPUTER TECHNOLOGIES (SCT). This Principal Component Analysis (PCA) using Kaiser's criterion revealed a three-factor solution accounting for 84.4% of the variance in the total set of 25 items for 313 respondents. Similar factor structures were generated by Varimax and oblique rotations. None of the items loaded significantly on more than one factor. Factor I contained 10 items reflecting confidence in employing "Word Processing." Factor II, with 9 items, reflects self-efficacy in using "Electronic Mail." Finally, items representing confidence in using "CD-ROM Data Bases" loaded on Factor III. High scores on all factors represent a high degree of confidence in using each type of computer technology.

Findings for the preceding analysis are located in Table 2. Intercorrelations between factors I and II (r=.42), I and III (r=.46), and II and III (r=.41) indicate low to moderately positive relationships between the factors. Since measures of self-efficacy are related to specific tasks, merging these factors is not conceptually warranted.

Insert Table 2 about here.

Reliability

ATTITUDES TOWARD COMPUTER TECHNOLOGIES. An internal consistency reliability (alpha) estimate of .89 was obtained for the entire 19-item survey. The reliability estimates for individual scales were .90 ("Comfort/Anxiety") and .83

("Usefulness"). Review of the alpha-if-item-deleted data indicated that all items contribute to the high reliability of each scale.

SELF EFFICACY FOR COMPUTER TECHNOLOGIES. Internal consistency reliability (alpha) estimates for the three factors were .97 ("Word Processing"), .98 ("Electronic Mail"), and .98 ("CD-ROM Data Bases").

Hierarchical Regression Procedures

Attitude Outcomes. Attitudes are influenced by an individual's background characteristics and beliefs about behaviors. To explore these influences, data were collected concerning learner characteristics, as well as learner experiences and efficacy expectations regarding computer technologies. Variables in two analyses were entered in four blocks with scores on the two conceptually derived subscales of the ACT serving as the dependent measures.

Learner characteristics (age, sex and educational level) were entered first. This block of variables was followed by course experiences related to learning about word processing, electronic mail, and CD-ROM data bases. Variables in the third block contained responses about the reported frequency of using each type of technology. Finally, the three factors reflecting feelings of efficacy in the use computer technologies were entered in a block. This position was selected in order to examine whether or not information regarding differences in self-efficacy for computer technologies can be used to predict attitudes toward these technologies after differences in learner characteristics and experiences are statistically eliminated.

Results of the analysis with "Comfort/Anxiety" as the dependent measure are summarized in Table 3. While both age ($t=2.408$, $p<.05$) and sex ($t=-2.071$, $p<.05$) were statistically significant within the learner characteristics block, the overall block did not explain a statistically significant amount of variance ($R=.156$) in comfort/anxiety. Males were somewhat more comfortable than females; older respondents expressed greater levels of comfort than younger respondents. When the block representing course experiences was entered, the variables contributed an additional 17% ($R=.328$, $p<.0001$) to the prediction equation; course experience in both word processing ($p<.01$) and electronic mail ($p<.01$) proved influential. Another 16% ($R=.489$, $p<.0001$) of the variability was accounted for with the addition of the third block representing frequency of using the technologies. At the final step, the self-efficacy measures still explained a significant amount of variance for a total of 64% ($p<.0001$). Within this block, both self efficacy for "CD-ROM Data Bases" ($p<.001$), and for "Word Processing" ($p<.0001$) were highly significant predictors of the dependent variable.

Insert Table 3 about here.

When items representing the "Usefulness" scale served as the dependent measure, the learner characteristics block only explained 10% of the variance, which was not

statistically significant. Course experience in computer technologies contributed 16% (R=.255, p<.003) to variance explained. Use of these technologies added 20% (R=.459, p<.0001), with word processing use figuring significantly (p<.05). An additional 4% (R=.499, p<.008) of the variance was explained by self-efficacy, with efficacy for use of "CD-ROM" and for "Word Processing" being significant predictors of whether a respondent thought computer technologies were helpful tools. Table 4 describes the significance of the subsequent blocks with a total of 50% of the variance explained for the entire set of variables.

Insert Table 4 about here.

Self-Efficacy Outcomes. Learner characteristics, attitudes toward computer technologies, course experience and use of computer technologies served as independent variables in three separate analyses predicting self-efficacy. The SCT subscales served as the dependent measures. Using hierarchical regression procedures, learner characteristics were entered as the first block in each equation since they are considered to be precursors to efficacy expectations (Murphy, Coover & Owen, 1988). Course experience and frequency of using computer technologies were entered as blocks two and three, respectively, to examine the variance explained by experience with tasks related to computer technologies. The final block contained the two factors reflecting attitudes toward computer technologies, to investigate whether or not information regarding differences in these attitudes can be used to predict self-efficacy with computer technologies after differences in learner characteristics and experiences are statistically eliminated.

Table 5 displays the results of predicting self-efficacy for "Word Processing." Learner characteristics explained a moderate amount of variance (R=.203, p<.02), perhaps largely due to the influence of the age variable (t=-3.030, p<.01). The second block, reflecting courses taken in computer technologies, added an additional 26% (R=.464, p<.0001) to the predictive equation. Within the third block (R=.780, p<.0001), use of word processing emerged as highly predictive of self-efficacy for "Word Processing" (t=12.615, P<.0001). Despite the high value of explained variance, after the first three blocks were entered, the block representing attitudes provides a significant increase in explained variance (4%, p<.0001), with the values on the "Comfort/Anxiety" scale being highly significant (t=6.547, p<.0001).

Insert Table 5 about here.

Self-efficacy for "Electronic Mail" served as the dependent variable in the next equation (see Table 6). While entering the first block into the equation accounted for a significant amount of the variance (R =.294, p<.0001), adding the blocks of both course experiences (R=.747, p<.0001) and use of computer technologies (R=.839, p<.0001) provided a 55% increase in explained variance. In the fourth step, attitudes add only 0.6%

(R=.845, p<.01) to the prediction of self-efficacy. It is interesting to note within these blocks, that taking a course in electronic mail, using electronic mail, and the "Comfort/Anxiety" scale were the most significant predictors of self-efficacy toward electronic mail.

Insert Table 6 about here.

Table 7 displays the values related to predicting the self-efficacy for "CD-ROM Data Bases." The significant relationship between the dependent variable and the learner characteristics block (R=.545, p<.0001) was due largely to the influence of educational level (t=2.717, p<.01) Each variable in the second block (course experience) contributed significantly, resulting in a 22% increase in explained variance (R=.565, p<.0001). Use of computer technologies contributed an additional 15% (R=.717, p<.0001) to the explained variance, due largely to the influence of enrollment in courses utilizing CD-ROM data bases (t=7.536, p<.0001). While the amount of additional variance explained by attitudes was small (4%, R=.755, p<.0001), this contribution was nonetheless a significant predictor of self-efficacy for "CD-ROM Data Bases." All blocks contributed significantly to the equation which explained 75% of variance in the dependent variable.

Insert Table 7 about here.

DISCUSSION

Principal component analysis of the 19-item ATTITUDES TOWARD COMPUTER TECHNOLOGIES (ACT) instrument identified three empirical factors which explained 52.3% of the variance among ACT items. The first factor reflects "Comfort/Anxiety" about computer technologies. The second and third factors combine to reflect perceived "Usefulness" of computer technologies. Alpha reliability for the ACT instrument was fairly high (.89); as were reliability values obtained for the two conceptual factors ("Comfort/Anxiety," .90; "Usefulness," .83). According to Gable (1986), reliability figures of above .70 are acceptable levels for an attitude measure.

When the 25-item SELF-EFFICACY FOR COMPUTER TECHNOLOGIES (SCT) instrument was subjected to principal component analysis, a three factor solution emerged which accounted for 84.4% of the variance. The empirically identified factors mirrored the conceptual factors of "Word Processing," "Electronic Mail," and "CD-ROM data bases." These subscales were also found to be highly reliable (r=.97 for "Word Processing," r=.98 for "Electronic Mail," r=.98 for "CD-ROM").

Results of the regression analyses suggest the relative unimportance of demographic variables (such as age, sex, or current educational level) in predicting attitudes toward computer technologies, as compared to other types of variables. Actual experience

with computer technologies, either in a course or in regular use, was a strong predictor of both "Anxiety/Comfort" and perceived "Usefulness." Placed at the end of the hierarchical regression equation, the self-efficacy block ("Word Processing," "Electronic Mail," and "CD-ROM") nonetheless explained a significant amount of additional variance for both attitude sub-scales, underlining the importance of self-efficacy in the consideration of attitudes.

Demographic variables proved somewhat more significant in the regression analyses for the SCT instrument, but experience (obtained in a course or through frequent use) proved even more powerful as a predictor of self efficacy across subscales. Despite the relatively high levels of variance explained by the demographic, course, and use blocks, attitudes toward computer technologies added still more to the explained variance, particularly for self efficacy on the "Word Processing" and "CD-ROM" subscales.

IMPLICATIONS AND DIRECTIONS FOR FUTURE RESEARCH

Results from these administrations provide a validation of the proposed factors for two valuable instruments measuring attitudes and self-efficacy with regard to computer technologies. While the instruments were designed for administration to teachers and teacher education students, they could easily be adapted for use with other specialized population groups, such as those from business or medicine. Future research will be directed to examine the efficacy of this type of adaptation, as well as the resulting validity and reliability.

In addition, results also suggest that experience with computer technologies, either through a course or through frequent use, is a critical area for examination in the study of attitudes and self efficacy. Research conducted by Loyd and colleagues (Loyd & Gressard, 1984; Loyd, Loyd, & Gressard, 1986; and Loyd & Loyd, 1988) suggest that experience is closely related to attitudes towards computers on the part of middle school students, high school students, and inservice teachers. Similar findings were obtained by Koohang (1986) with college students. These outcomes suggest that strategies to enhance teacher experience with computer technologies could contribute to the formation of positive attitudes and self-efficacy, and in this way influence teacher adoption, use, and modeling of computer technologies. According to a recent survey of school superintendents in the state of Virginia, the most important factors having a positive impact on the implementation of technology in the schools are having teachers trained in technology use and a related in-service program (Bailey, 1990). This sentiment is echoed by Williams and Williams (1984), who suggest that "long range success of in-school computing might be encouraged more by investing in the early training of teachers than by rushing new machines into the classroom" (p. 31). Future research should test the possible relationships between teacher experience with computer technologies, positive attitudes and self efficacy, and adoption, use, and modeling of the technologies in the classroom.

That only small sex differences were found in attitudes and self efficacy was unexpected (sex proved influential only in the prediction of "Comfort/Anxiety" by the learner characteristics block), as a preponderance of research findings suggest that males are more interested in computers and report higher levels of use (Chen, 1986; Miura, 1986), and express more positive attitudes and demonstrate higher aptitude (Dambrot,

Watkins-Malek, Silling, Marshall, & Garver, 1985) than do females. However, other research does suggest that sex may not always predict computer attitudes (Loyd & Gressard, 1984; Loyd & Loyd, 1990).

Finally, because attitudes proved significant in predicting self-efficacy, and self-efficacy emerged as significantly correlated with attitudes, it is apparent that both constructs should be employed in affective measures related to computer technologies.

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Table 1
Principal Component Analysis: SPSS Varimax Rotation for ATTITUDES TOWARD COMPUTER TECHNOLOGIES (ACT) (n=327)

Item Number	Stem	Loading
Factor I: "Comfort/Anxiety"		
3	I am confident about my ability to do well in a course that requires me to use computer technologies.	.75
6	I feel at ease learning about computer technologies.	.76
8[1]	I am not the type to do well with computer technologies.	.77
11	The thought of using computer technologies frightens me.	.85
12	Computer technologies are confusing to me.	.79
14	I do not feel threatened by the impact of computer technologies.	.69
15	I am anxious about computers because I feel like I might break them.	.50
18	I feel comfortable about my ability to work with computer technologies.	.76
Factor II: "Usefulness" (positively phrased, specific content)		
2	Communicating with others over a computer network can help me to be a more effective teacher.	.61
7	With the use of computer technologies, I can create instructional materials to enhance my teaching.	.63
9	If I can use word processing software, I will be a more productive teacher.	.66
13	I could use computer technologies to access many types of information sources for my work.	.65
16	Computer technologies can be used to assist me with classroom management techniques.	.74
Factor III: "Usefulness" (negatively phrased, general content)		
1	I don't have any use for computer technologies on a day-to-day basis.	.54
4	Using computer technologies in my job will only mean more work for me.	.56
5	I do not think that computer technologies will be useful to me as a teacher.	.76
10	Anything that computer technologies can be used for, I can do just as well well some other way.	.56
17	I don't see how computer technologies can help me learn new skills.	.50
19	Knowing how to use computer technologies will not be helpful in my future teaching.	.53

[1] Underlined item numbers reflect negatively phrased stems.

Table 2
Principal Component Analysis: SPSS Oblique Rotation for SELF EFFICACY FOR COMPUTER TECHNOLOGIES (SCT) (N=313)

Item Number	Stem	Loading
Factor I: "Word Processing"		
	I am confident...	
1	...using a word processing program to write a letter or an essay.	.84
2	...accessing previous files with a word processing program.	.90
3	...making corrections while word processing.	.93
4	...formatting text (e.g., bold, underlining) while word processing.	.90
5	...moving blocks of text while word processing.	.81
6	...using the spelling checker while word processing.	.81
7	...using the searching feature in a word processing program.	.89
8	...printing out files I've written while word processing.	.91
9	...saving documents I've written with a word processing program.	.92
10	...renaming a word processing file to make a back-up copy.	.79
Factor II: "Electronic Mail"		
	I am confident...	
11	...logging on to e-mail.	.89
12	...reading mail messages on e-mail.	.91
13	...responding to mail messages on e-mail.	.93
14	...deleting messages received on e-mail.	.91
15	...sending mail messages on e-mail.	.92
16	...sending the same mail message to more than one person on e-mail.	.88
17	...responding privately to messages sent to more than one person on e-mail.	.88
18	...forwarding messages received on e-mail.	.79
19	...logging off of e-mail.	.91
Factor III: "CD-ROM Data Bases"		
	I am confident...	
20	...using a data base on compact disc, such as ERIC or Psych Abstracts.	.88
21	...selecting the right data base on compact disc for a specific topic.	.90
22	...selecting search terms for a data base literature search.	.90
23	...getting into a data base on compact disc and starting a literature search.	.91
24	...using descriptors from a data base literature search to obtain new search terms.	.91
25	...using the print function in a data base search on compact disc..	.84

Table 3

Hierarchicial Multiple Regression Results for Prediction of "Attitudes of Comfort/Anxiety Toward Computer Technologies" (N=250)

Variables Entered At Each Step	Constant	R	Adjusted R^2	SEE	b	Se b	Beta	tb
Learner Characteristics								
Educational Level					- .026	.030	-.064	- .891
Sex[1]			.012		- .180	.087	- .106	- 2.071 *
Age		.156	.024	.691	.017	.007	.174	2.408 *
Courses Employing Comp. Tech's								
CD-ROM Data Bases					- .010	.102	- .007	- .099
Word Processing			.086		.220	.086	.157	2.544 **
Electronic Mail		.328	.328	.665	- .370	.126	- .257	- 2.933 **
Use of Computer Technologies								
Word Processing					- .060	.048	- .109	- 1.249
CD-ROM Data Bases			.211		- .006	.053	- .010	- .122
Electronic Mail		.489	.240	.618	.107	.052	.187	2.034 *
Self-Efficacy								
"CD-ROM Data Bases"					.174	.048	.280	3.592 ***
"Word Processing"			.380		.373	.065	.487	5.752 ****
"Electronic Mail"	1.272	.640	.410	.548	.019	.062	.030	.307

[1]Coding for Sex = Male (0); Female (1)

* $p < .05$
** $p < .01$
*** $p < .001$
**** $p < .0001$

Table 4

Hierarchicial Multiple Regression Results for Prediction of "Attitudes of Usefulness Toward Computer Technologies" (N=250)

Variables Entered At Each Step	Constant	R	Adjusted R^2	SEE	b	Se b	Beta	tb
Learner Characteristics								
Educational Level					- .054	.022	-.197	- 2.412 *
Sex[1]			- .003		.107	.065	.094	1.633
Age		.096	.009	.465	.008	.005	.120	1.474
Courses Employing Comp. Tech's								
CD-ROM Data Bases					.096	.076	.097	1.262
Word Processing			.042		- .017	.055	- .018	- .257
Electronic Mail		.255	.065	.455	- .097	.095	- .101	- 1.017
Use of Computer Technologies								
Word Processing					.073	.036	.202	2.045 *
CD-ROM Data Bases			.181		.028	.040	.062	.709
Electronic Mail		.459	.211	.420	.009	.039	.023	.226
Self-Efficacy								
"CD-ROM Data Bases"					.036	.201	.088	2.290 *
"Word Processing"			.211		.098	.049	.191	1.998 *
"Electronic Mail"	2.567	.499	.245	.413	- .035	.047	- .083	- .748

[1]Coding for Sex = Male (0); Female (1)

* $p < .05$

Table 5

Hierarchicial Multiple Regression Results for Prediction of "Perceived Self Efficacy For Word Processing" (N=250)

Variables Entered At Each Step	Constant	R	Adjusted R^2	SEE	b	Se b	Beta	tb
Learner Characteristics								
Educational Level					- .028	.028	-.052	- .973
Sex[1]			.029		- .086	.085	- .039	- 1.011
Age		.203	.041	.894	.020	.007	- .160	- 3.030 **
Courses Employing Comp. Tech's								
CD-ROM Data Bases					- .056	.096	- .029	- .577
Word Processing			.196		.046	.083	.025	.555
Electronic Mail		.464	.215	.813	.230	.111	.123	2.071 *
Use of Computer Technologies								
Word Processing					.445	.035	.627	12.615 ****
CD-ROM Data Bases			.592		.016	.046	.018	.343
Electronic Mail		.780	.608	.579	- .098	.041	- .132	- 2.372 *
Attitudes								
"Usefulness"			.662		.033	.086	.017	.384
"Comfort/Anxiety"	1.221	.823	.677	.527	.384	.059	.295	6.547 ****

[1]Coding for Sex = Male (0); Female (1)

* $p < .05$
** $p < .01$
*** $p < .001$
**** $p < .0001$

Table 6

Hierarchicial Multiple Regression Results for Prediction of "Perceived Self Efficacy For Electronic Mail" (N=250)

Variables Entered At Each Step	Constant	R	Adjusted R^2	SEE	b	Se b	Beta	tb
Learner Characteristics								
Educational Level					.010	.032	.015	.305
Sex[1]			.075		.028	.097	.010	.287
Age		.294	.086	1.063	- .012	.008	- .076	- 1.522
Courses Employing Comp. Tech's								
CD-ROM Data Bases					- .018	.112	- .008	- .165
Word Processing			.547		- .122	.095	- .055	- 1.285
Electronic Mail		.747	.557	.744	.954	.127	.418	7.503 ****
Use of Computer Technologies								
Word Processing					- .066	.040	- .076	- 1.632
CD-ROM Data Bases			.692		.089	.052	.083	1.701
Electronic Mail		.839	.703	.613	.429	.047	.473	9.048 ****
Attitudes								
"Usefulness"			.701		- .045	.099	- .019	- .450
"Comfort/Anxiety"	.690	.845	.714	.605	.197	.067	.124	2.932 **

[1]Coding for Sex = Male (0); Female (1)

* $p < .05$
** $p < .01$
*** $p < .001$
**** $p < .0001$

Table 7

Hierarchicial Multiple Regression Results for Prediction of "Perceived Self-Efficacy For CD-ROM Data Bases" (N=250)

Variables Entered At Each Step	Constant	R	Adjusted R^2	SEE	b	Se b	Beta	tb
Learner Characteristics								
Educational Level					.110	.040	.166	2.717 **
Sex[1]			.108		.133	.121	.049	1.098
Age		.345	.119	1.058	- .005	.010	- .032	- .530
Courses Employing Comp. Tech's								
CD-ROM Data Bases					.351	.138	.146	2.548 **
Word Processing			.303		- .334	.118	- .148	- 2.827 **
Electronic Mail		.565	.320	.936	.446	.158	.193	2.818 **
Use of Computer Technologies								
Word Processing					.040	.050	.046	.797
CD-ROM Data Bases			.496		.492	.065	.451	7.536 ****
Electronic Mail		.717	.514	.796	- .126	.059	- .136	- 2.126 *
Attitudes								
"Usefulness"			.549		.139	.123	.058	1.132
"Comfort/Anxiety"	- .753	.755	.569	.752	.393	.084	.244	4.688 ****

[1]Coding for Sex = Male (0); Female (1)

* $p < .05$
** $p < .01$
*** $p < .001$
**** $p < .0001$