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ABSTRACT

For individuals to use computer tools for learning effectively, they must feel self-efficacious in using them. For this reason, it is important to examine attitudes and perceptions of competence that are encouraged by undergraduate educational programs. The factor validation of two affective measures related to computer technologies is reported. These are the Attitudes toward Computer Technologies (ACT) and Self-Efficacy for Computer Technologies (SCT). The ACT assesses perceived usefulness of and comfort and anxiety with computer technologies. Perceived self-efficacy for computer technologies (word processing, electronic mail, spreadsheets, database programs, statistical packages, and CD-ROM databases) is measured by the SCT. In addition to data on construct validity, the results of exploratory analyses examining predictors of self-efficacy for undergraduate students in business, education, and nursing are presented. Research participants included 97 males and 262 females (125 business majors, 111 education majors, and 123 nursing majors. Results provide construct validation for both instruments. Both are suitable for administration to college students across disciplines. Twelve tables present study data. (SLD)

Computer Technologies:

Attitudes and Self-Efficacy Across Undergraduate Disciplines

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Running Head:

COMPUTER TECHNOLOGIES: ATTITUDES AND SELF-EFFICACY

ABSTRACT

Computer technologies are important tools for learning, communicating, and retrieving information. For individuals to effectively employ these tools, however, they must feel self-efficacious in using them. For this reason it is important to examine attitudes and perceptions of competence that are encouraged by undergraduate educational programs. This paper reports on the factor validation of two affective measures related to computer technologies, ATTITUDES TOWARDS 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, spreadsheets, data base programs, statistical packages, and CD-ROM data bases) is measured by the SCT. In addition to data on construct validity, the results of exploratory analyses examining predictors of self-efficacy for undergraduate students in business, education, and nursing are presented, and implications and future research directions are discussed.

Computer Technologies:

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INTRODUCTION

"In earlier times, technology grew out of personal experience with the properties of things and with the techniques for manipulating them, out of know-how handed down from experts to apprentices over many generations. The know-how handed down today is not only the craft of single practitioners but also a vast literature of words, numbers, and pictures that describe and give directions" (American Association for the Advancement of Science, 1989, p. 39).

The quotation points to the importance that computer technologies have today in shaping our world. These technologies are no longer the sole domain of the computer programmer or engineer, they now provide individuals in all disciplines with a means of learning, communicating, and retrieving information. For individuals to effectively employ technologies, however, they must feel self-efficacious in using them (Bandura, 1977). Previous research on self-efficacy for computer technologies suggests that, for education students, experience, either through training or opportunities to use the technologies, and positive attitudes are predictive of self-efficacy for computer technologies (Delcourt & Kinzie, in press). For this reason it is important to examine what sorts of attitudes and what perceptions of competence are encouraged by our undergraduate educational programs regardless of discipline. In this research, we address the following questions: (a) What is the validity and reliability of an attitude and a self-efficacy measure when administered to an interdisciplinary undergraduate population? and (b) Is self-efficacy for this population predicted by attitudes after the effects of demographic variables and experience with computer technologies are statistically eliminated?

Much of the instrument development to date has focused on 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, for example, compact disc data bases (such as ERIC or Psych LIT) or electronic mail. In this paper, we describe the factor validation of two instruments administered to a mixed population of business, education, and nursing undergraduates: 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, spreadsheets, data base programs, statistical packages, and CD-ROM data bases) is measured by the SCT.

In addition to data on construct validity, we present the results of exploratory analyses examining predictors of self-efficacy. Results will be discussed as they relate to research on self-efficacy. To begin, we will focus on theoretical underpinnings of attitudes and self-efficacy, followed by a summary of related literature on affect and computer technologies in the business, nursing, and education disciplines.

BACKGROUND

The constructs of attitudes and self-efficacy

According to Aiken (1980), attitudes are "learned predispositions to respond positively or negatively to certain objects, situations, concepts, or persons" (p. 2). They can be thought of as a reflection of an individual's global perspective on a topic and can be predictive of behavior. Some have suggested that attitudes toward new technologies are predictive of their adoption (Anderson, Hansen, Johnson, & Klassen, 1979), but Schunk (1985) goes further, suggesting that between learner characteristics (attitudes, aptitudes, interests, and personality characteristics) and task engagement there is an influential intervening factor: efficacy expectancy.

Efficacy expectancy, also known as self-efficacy, reflects an individual's confidence in his/her ability to perform the behavior required to produce specific outcomes and 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, Schunk 1985). High correlations are often found between reported self-efficacy and subsequent performance (Bandura & Adams, 1977; Bandura, Adams & Beyer, 1977). 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. When using a self-efficacy measure, scale scores are reported individually, as each relates to a different task. Within an attitude measure, on the other hand, individual scale scores can be summed to determine an overall attitude score.

Affect & Computer Technologies Across Disciplines

To provide a perspective on the research that has been conducted on affect and computer technologies, research in the disciplines of business, nursing and education is summarized below. (As will be described later, individuals from these three disciplines participated in the current research.)

Business. A 1984 survey of 91 Utah-based firms that used computer technologies suggested the importance of teaching business students the microcomputer applications used most by business--spreadsheets and word processing (Bartholome, 1984). In fact, computer technologies have been an important tool covered by business schools since the early to mid-1980's (Adams, 1988). Results from nationwide surveys of undergraduate institutions suggest that between 1984 and 1986, the average number of courses in which microcomputers were used by business programs jumped by 59% (Brooker, 1987). A directive published by the American Assembly of Collegiate Schools of Business (AACSB, 1987-88) supports this focus on computer technologies, recommending that students receive "instruction in the design, use, control, and audit of computerized information systems" (p. 44). Doney and Ross (1987) extended this recommendation to include basic computer operation, word processing, statistical analysis, spreadsheet analysis, as well as data base creation and management. Adams (1988) concurred, suggesting that one of the aims of business education should be to "enable students to become comfortable with these major tools," ensuring that students will be able to apply them both across subject areas and in their professional career. The degree to which business schools are successful in this endeavor, however, continues to be debated (Simmons, Rice, & Buttermilch, 1991).

Nursing. In the education of nurses, a similar pattern has emerged with respect to implementation of instruction on computer technologies. According to Delaney (1989), as recently as in 1984, only 3% of 1,684 nursing programs in the United States required their graduates to be "computer literate." By 1985, Thomas found that 25% of the 157 undergraduate and graduate nursing schools surveyed had explicit provisions for literacy with computers. By 1989, 56% of the 36 undergraduate nursing programs at the private schools surveyed by Delaney (1989) had curricular objectives related to computer literacy.

Despite this increased emphasis on computer technologies in nursing curricula, a number of studies suggest the persistence of computer anxiety among nurses and nursing students. Two-thirds of the upper-class and graduate students surveyed at one nursing school felt "not comfortable" or "minimally comfortable" using a computer for work (Van Dover and Boblin, 1991). Wilson (1991) noted that among students at five nursing schools, 21% evidenced high computer anxiety, according to their responses to a computer anxiety scale. In the same sample, 48% had no prior hands-on computer experience. Similar findings were obtained by a survey of over 600 nurses, nursing students, and nurse educators (Jacobson, Holder, and Dearner, 1989): the group as a whole exhibited "mild" computer anxiety, and 20% reported no experience with computers. Not surprisingly, more positive attitudes among nurses and nursing students have been linked with higher levels of experience with computer technologies (Coover & Delcourt, 1992; Schwirian, Malone, Stone, Nunley, & Francisco, 1989; Wilson, 1991), and individuals in this population report the desire to learn more about computer technologies (Van Dover & Boblin, 1991).

Education. As with business and nursing, the field of education has been influenced by the rapid infusion of computer technologies into the work place, in this case the classroom. Between 1983 and 1985, there was a four-fold increase nationwide in the number of microcomputers in K-12 schools, and a three-fold increase in the number of students using computers (Becker, 1986). Results from a national survey published in 1986 by the U.S. Department of Education's Office of Educational Research and Improvement (OERI) suggested that 89% of the teacher education programs in the United States had addressed computer technologies in some way within their curriculum.

However, despite the prevalence of computer technologies, not all teachers feel comfortable using them. A critical factor, again, is experience. The more experience teachers have had, the more positive their attitudes have been (Loyd & Loyd, 1985). When researchers have extended their inquiry to self-efficacy, greater experience and more positive attitudes have been related to higher levels of self-efficacy with computer technologies for education students and public school administrators (Delcourt & Kinzie, in-press; Jorde-Bloom, 1988).

METHOD

Subjects

Participants in this research included 359 undergraduate students (97 males, 262 females). Of this group, 125 were majoring in business (73 males, 52 females), 111 were in the field of education (22 males, 89 females), and 123 were studying nursing (2 males, 121 females). These three programs represented three major state university systems from the Western, Midwestern, and Eastern sections of the United States. Individuals ranged in age from 18-36 years in the business program, 19-51 years in the education program, and 18-42 years in the nursing school. The majority of students ranged from freshmen to seniors, with the average student enrolled at the junior level; six students reported being in their 5th year of undergraduate studies. Participation was voluntary, and involved completion of a questionnaire containing the criterion measures described below. The questionnaire required between 10 and 15 minutes to complete.

Criterion Measures

To measure attitudes regarding computer technologies, the ATTITUDES TOWARD COMPUTER TECHNOLOGIES (ACT) instrument was developed (Delcourt & Kinzie, 1990). The 19-item ACT questionnaire is used to assess perceived usefulness of and comfort/anxiety with computer technologies, and was originally developed for administration to students and professionals in the field of education (Form A). The ACT was adapted in this research, to be suitable for use across disciplines (Form B). In the ACT, 11 items measure Usefulness (for example, "Using computer technologies to communicate with others over a computer network can help me to be more effective in my job.") and 8 items measure Comfort/Anxiety ("I feel at ease learning about computer technologies."). The items are equally balanced between positively and negatively phrased item stems. A Likert scale with a 4-point response format is used, with descriptors ranging from Strongly Disagree (1) to Strongly Agree (4). To score the ACT, responses to negatively phrased items are first re-coded (1 = 4, 2 = 3, 3 = 2, and 4 = 1). Item responses are then summed for each scale; scores of 44 and 32 are the highest possible scores for the Usefulness and Comfort/Anxiety scales, respectively. Scale scores may be added together to obtain an overall measure of attitudes; 76 is the highest possible total score for the entire ACT. Respondents with high scores on these scales view computer technologies as valuable tools for performing a variety of tasks and feel a high degree of comfort about them. Alpha reliability for Form A of the ACT (education) has been reported to be .89 for the entire measure and .90 and .83 for the Comfort/Anxiety and Usefulness scales, respectively (Delcourt & Kinzie, in press).

The SELF-EFFICACY FOR COMPUTER TECHNOLOGIES (SCT) instrument was developed to assess self-efficacy with different types of computer technologies (Delcourt & Kinzie, 1990). Respondents indicate their agreement (on a 4-point Likert scale) to statements preceded by the phrase, "I feel confident" (i.e., "I feel confident logging on to e-mail."). In its original form (Form A), the SCT instrument measured perceived self-efficacy for word processing (10 items, score of 40 possible), communicating via electronic mail (9 items, score of 36 possible), and searching CD-ROM bibliographic data bases (6 items, score of 24 possible). Internal consistency reliability estimates were .97, .98, and .98, respectively (Delcourt & Kinzie, in press). For this research, the instrument was expanded (Form B) to include scales for assessing self-efficacy for use of spreadsheets, creation and management of data bases, and use of statistical packages, each of which is composed of 7 items, with 28 points possible for each scale. Scores for the SCT are reported separately for each scale rather than being summed overall. High scores on these scales represent a high degree of perceived ability to use each type of computer technology.

Demographic information was collected on age, sex, year in educational program (because age is not always a reflection of year in school), and declared major. Six items measured frequency of using each of the types of computer technologies, using a 5-point scale (1 = never, 2 = at least once/year, 3 = at least once/month, 4 = at least once/week, 5 = daily). Respondents also indicated if they had ever taken a course in which they had learned to use each type of computer technology (1 = no, 2 = yes). Respondents with missing data were excluded from analyses involving that data; consequently the total number of subjects included across analyses varied.

Statistical Analyses

Data from these administrations were used to perform a Principal Component analysis and to examine the internal consistency reliability of each instrument. Procedures employed were as described by Tabachnick and Fidell (1989). Hierarchical regression analyses were undertaken to investigate the relationships between self-efficacy and demographic variables, experiences in using computer technologies, and attitudes, respectively, based on a model similar to that advanced by Schunk (1985). This approach was taken in order to control for the effects of the preceding factors (demographic variables, course experience, and frequency of use) while studying the independent effects of the subsequent factors (attitudes), as suggested by Pedhazur (1982).

RESULTS

Learner Characteristics

Thirty-two percent (n = 116) of the respondents reported using word processing at least once per week, but ten percent (n = 35) indicated that they have never used this type of technology. Survey results also revealed that electronic mail systems had never been employed by 52% (n = 185) of the respondents. Similar findings were noted for other technologies: 46% (n = 164) had not used spreadsheets, 52% (n = 186) had never used data base software, 91% (n = 326) had no exposure to statistical packages, and 74% (n = 264) had never employed CD-ROM data bases. Individuals were also asked, "Have you ever taken any courses in which you've learned to use these technologies?" Over two-fifths of the subjects (44%, n = 157) said, "No", for all six technology categories.

Construct Validation: Principal Component Analyses

ATTITUDES TOWARD COMPUTER TECHNOLOGIES. Responses to Form B of the ACT (n = 359) were subjected to a Principal Component Analysis (PCA). The PCA, using Kaiser's criterion in a Varimax rotation, revealed a three-factor solution (components will be referred to as factors) which accounted for 55.5% of the variance in the set of 19 items. Table 1 displays the loadings obtained for each factor resulting from the Varimax rotation. Factor I contained 8 items reflecting "Comfort/Anxiety" in relation to computer technologies. Individuals with high scores on this scale feel comfortable about computer technologies. Loadings for items related to this scale ranged from .66 to .82. The 11 items representing perceived "Usefulness" of computer technologies loaded on Factors II and III, similar to the original factor structure reported by Delcourt & Kinzie (in press). 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.

Items reflecting Factor II loaded between .42 and .74; items related to Factor III loaded between .40 and .75. Two items loaded on both Factors II and III ("Using computer technologies in my job will only mean more work for me" and "Computer technologies can be used to assist me in organizing my work").

As Factors II and III were positively correlated ($r = .46$), evidence is provided for retaining the original two-factor measure.

SELF-EFFICACY FOR COMPUTER TECHNOLOGIES. Using Kaiser's criterion and Varimax rotation, Principal Component Analysis (PCA) with this administration revealed a six-factor solution accounting for 86.3% of the variance in the total set of 46 items. Factor I contained 14 Items reflecting confidence in using "Spreadsheets" and "Data Base Programs"; factor loadings ranged from .77 to .83 for "Spreadsheets" and .87 to .90 for "Data Base Programs" scales. This finding might suggest that, for students participating in this research, these two scales may be subsets of some larger data management construct. Factor II, with 9 items, reflects self-efficacy in using "Electronic Mail." Item loadings for "Electronic Mail" ranged from .79 to .87. The ten items representing confidence in using "Word Processing" software loaded on Factor III with values of .70 to .92. Confidence in using "Statistical Packages" was reflected by the 7 items loading on Factor IV; item loadings ranged from.87 to .90. Factor V contained 6 items measuring self-efficacy with "CD-ROM Data Bases" and item loadings were again high: .89 to .94. Factor VI was a weak additional factor on which no item loaded above a .40 level; however items associated with "Spreadsheets" loaded on this factor with loadings ranging from .31 to .37.

Findings for the preceding analysis are located in Table 2 and Table 3. Of the inter-correlations between these six factors, all but three were low, ranging from -.36 to .31. Exceptions were the following correlations: Factor I ("Spreadsheets" and "Data Base Programs") and Factor V ("CD-ROM Data Bases") ($r = .63$); Factor I and the weak Factor VI ($r = -.77$); and Factor V and Factor VI ($r = -.63$). These findings might be indicative of relationships to a larger data management construct, as suggested above. Since measures of self-efficacy are by definition related to specific tasks, merging any of the factors is not conceptually warranted, nor is the combining of "Spreadsheets" and "Data Base Programs" scales.

Insert Tables 2 & 3 about here.

Reliability

An internal consistency reliability (alpha) estimate of .91 was obtained for the entire 19-item ATTITUDES TOWARD COMPUTER TECHNOLOGIES survey. The reliability estimates for individual scales were .91 ("Comfort/Anxiety") and .85 ("Usefulness"). Review of the alpha-if-item-deleted data indicated that all items contribute to the high reliability of each scale. For the six factors of the SELF-EFFICACY FOR COMPUTER TECHNOLOGIES survey, internal consistency reliability (alpha) estimates were .95 ("Word Processing"), .98 ("Electronic Mail"), .98 ("Spreadsheets), .99 ("Data Base Programs"), .97 ("Statistical Packages"), and .98 ("CD-ROM Data Bases").

Hierarchical Regression Procedures: Predicting Self-Efficacy

Learner characteristics, including demographic variables, course experience, frequency of use of computer technologies, and attitudes toward computer technologies served as independent variables in six separate analyses, each predicting self-efficacy with a particular type of computer technology. As noted previously, because each self-efficacy subscale is by nature task-specific, we are considering each self-efficacy scale as a separate outcome. A hierarchical approach was taken as a way of exploring a predictive model of self-efficacy in a conservative manner: Personal characteristics and course experiences were entered first and second, in order to remove the variance associated with these factors prior to considering frequency of use and attitudes. Our previous research (Delcourt & Kinzie, in press) suggested that frequency of use is a stronger predictor than course experience, and it was our desire to examine the contribution of frequency after the variance associated with course experience was accounted for. In a similar way, we were interested in conservatively examining the influence of attitudes on self-efficacy, and so entered "Comfort/Anxiety" and "Usefulness" in the final block. Tables 4, 5, and 6 depict measures of correlation between all factors included in the regression analyses.

Insert Tables 4, 5, & 6 about here.

Word Processing. Self-efficacy for Word Processing was the dependent variable in the first equation. Results revealed that after block one, with the demographic variables in the equation, $R = .04$, F

[3, 338] = .17. This set of variables was not significant in predicting Self-efficacy for Word Processing. For block two, course experience with word processing was the independent variable entered in the equation and $R = .19$, F [4, 337] = 3.27, $p < .01$. In the third block, frequency of word processing was entered ($R = .62$, F [5, 336] = 42.11, $p < .0001$). With the addition of attitudes in step four, and with all independent variables in the equation, $R = .68$, F [7, 334] = 41.34, $p < .0001$. Table 7 contains complete regression outcomes.

Insert Table 7 about here.

Electronic Mail. Self-efficacy for Electronic Mail served as the dependent variable for the next equation. See Table 8 for a display of regression results. The first block of demographic variables accounted for a significant amount of the variance ($R = .52$, F [3, 322] = 40.30, $p < .0001$). Adding the blocks of course experience with electronic mail ($R = .69$, F [4, 321] = 73.99, $p < .0001$), frequency of communicating via electronic mail ($R = .86$, F [5, 320] = 186.86, $p < .0001$), and attitudes towards computer technologies ($R = .87$, F [7, 318] = 144.02, $p < .0001$) explained a total of 76% (R^2) of the variance in the dependent variable.

Insert Table 8 about here.

Spreadsheets. R was significantly different from zero at the end of each step of this equation to predict Self-efficacy For Spreadsheets. There was a significant relationship between the dependent variable and the first block containing demographic variables ($R = .47$, F [3, 328] = 31.28, $p < .0001$). Variables entered in the second block, course experience with spreadsheets, contributed significantly, resulting in a 38% increase in explained variance ($R = .77$, F [4, 327] = 121.10, $p < .0001$). Frequency of using spread sheets contributed an additional 8% ($R = .82$, F [5, 326] = 139.25, $p < .0001$) to the equation. After block 4, when attitudes toward computer technologies were entered in the equation, $R = .85$, F [7, 324] = 121.70, $p < .0001$. The prediction equation can be obtained from the data in Table 9.

Insert Table 9 about here.

Data Base Programs. Self-efficacy for Data Base Programs was the dependent variable in the next equation. Table 10 contains outcomes from this regression procedure. Results revealed that block one, demographic variables, contributed significantly to the equation, $R = .50$, F [3, 327] = 36.80, $p < .0001$. For block two, course experience with data bases was the independent variable entered in the equation and $R = .71$, F [4, 326] = 80.85, $p < .0001$. For the third block, frequency of using data base programs, $R = .76$, F [5, 325] = 87.56, $p < .0001$). With the addition of attitudes in the fourth and final block, $R = .78$, F [7, 323] = 71.70, $p < .0001$.

Insert Table 10 about here.

Statistical Programs. Self-efficacy for Statistical Packages was the dependent variable for this equation. The first block of demographic variables accounted for a significant amount of the variance ($R = .16$, F [3, 314] = 2.66, $p < .05$). The blocks of course experience with statistical packages ($R = .41$, F [4, 313] = 15.91, $p < .0001$), frequency of using statistical packages ($R = .49$, F [5, 312] = 20.11, $p < .0001$), and attitudes towards computer technologies ($R = .52$, F [7, 310] = 16.54, $p < .0001$) each provided statistically significant increases in the prediction of Self-efficacy for Statistical Packages. See Table 11 for a display of regression results.

Insert Table 11 about here.

CD-ROM Data Bases. Results revealed that demographic variables explained 10% (R^2) of the variance for Self-efficacy for CD-ROM Data Bases ($R = .32$, F [3, 313] = 12.16, $p < .0001$). After block two, with course experience in CD-ROM systems entered in the equation, $R = .37$, F [4, 312] = 12.29, p

< .0001. For block three, frequency of using CD-ROM Data Bases was the independent variable entered in the equation and $R = .64$, $F[5, 311] = 43.53$, $p < .0001$. For the final block, attitudes toward computer technologies were entered, and $R = .66$, $F[7, 309] = 33.31$, $p < .0001$). Table 12 depicts complete regression outcomes.

Insert Table 12 about here.

DISCUSSION

In responding to the first research question, we obtained results supporting the validity and reliability of the ATTITUDES TOWARD COMPUTER TECHNOLOGIES (ACT) and SELF-EFFICACY FOR COMPUTER TECHNOLOGIES (SCT) instruments when administered to an interdisciplinary (business, education, and nursing) undergraduate population. A principal component analysis of the 19-item ATTITUDES TOWARD COMPUTER TECHNOLOGIES (ACT) instrument identified three empirical factors which explained 55.5% of the variance among the 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 entire ACT instrument was fairly high (.91); as were reliability values obtained for the two conceptual factors ("Comfort/Anxiety," .91; "Usefulness," .85). According to Gable (1986), reliability figures of above .70 are acceptable levels for an attitude measure.

When the 46-item SELF-EFFICACY FOR COMPUTER TECHNOLOGIES (SCT) instrument was subjected to principal component analysis, a six-factor solution emerged which accounted for 86.3% of the variance. The empirically identified factors mirrored the conceptual factors of "Word Processing," "Electronic Mail," "Statistical Programs" and "CD-ROM Data Bases." A fifth factor reflected the conceptual factors of "Spreadsheets" and "Data Base Programs." Because we conceptualized these two activities as being distinct, these conceptual factors were not merged for subsequent analyses. The sixth factor received no item loadings above .40. The subscales were found to be highly reliable (r =.95 for "Word Processing," r =.98 for "Electronic Mail," r = .98 for "Spreadsheets," r = .99 for "Data Base Programs," r = .97 for

"Statistical Packages," and $r=.98$ for "CD-ROM Data Bases"). These high levels of internal consistency are characteristic of self-efficacy scales.

In addressing the second research question, the results support the hypothesis that, for this population, attitudes contribute significantly to prediction of self-efficacy for computer technologies even after the effects of demographic variables and experience are accounted for. Self-efficacy for Word Processing, Electronic Mail, Spreadsheets, Data Base Programs, Statistical Packages, and CD-ROM Data Bases were all positively related to experience in using the technology (through frequency of use and by learning about it in a class) and attitudes toward computer technologies (perceived usefulness and comfort/anxiety levels). Even after accounting for the contributions made by demographic variables (significant for all but Self-efficacy for Word Processing), course experience and frequency of use, it is worth noting that attitudes contributed significant amounts to the explained variance in self-efficacy response. This highlights the importance of considering attitudes as important learner characteristics and precursors to self-efficacy.

IMPLICATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The results provide construct validation for two valuable instruments measuring attitudes and self-efficacy with regard to computer technologies. These instruments are suitable for administration to college and university students across disciplines; the results reported here were obtained from administrations to business, education and nursing undergraduates. Future research will extend this examination to include graduate students of differing disciplines.

The results also suggest that attitudes towards computer technologies, along with experience, either through a course or through frequent use, are critical areas for examination in the study of self-efficacy. The findings resemble those reported for undergraduate and graduate education students (Delcourt & Kinzie, in press) and for public school administrators (Jorde-Bloom, 1988). Similar results were obtained by Zubrow (1987), who found prior experience with computers to be related to both attitudes and confidence in freshman students of differing majors as they entered a university and again at the end of their first year.

Future research should attempt to extend this inquiry to consider the relationship of experience, attitudes, and self-efficacy to the subsequent use of computer technologies. For example, Miura (1987) found self-efficacy to be linked with plans to enroll in a computer science course among undergraduates from across a university. Results reported by Schunk (1981) suggest that self-efficacy can be predictive of subsequent academic performance--Can self-efficacy predict future learning or use of computer technologies? Through this type of investigation, we can come closer to identifying what will make our students successful in accessing the "know-how" handed down today.

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Table 1

Principal Component Analysis: SPSS Varimax Rotation for ATTITUDES TOWARD COMPUTER TECHNOLOGIES (ACT) (n=359)

Item #	Stem	Factor 1	Factor 2	Factor 3
"Comfort/Anxiety"				
3	I am confident about my ability to do well in a course that requires me to use computer technologies.	.72		
6	I feel at ease learning about computer technologies.	.72		
8[a]	I am not the type to do well with computer technologies.	.66		
11	The thought of using computer technologies frightens me.	.82		
12	Computer technologies are confusing to me.	.79		
14	I do not feel threatened by the impact of computer technologies.	.73		
15	I am anxious about computers because I don't know what to do if something goes wrong.	.69		
18	I feel comfortable about my ability to work with computer technologies.	.74		
"Usefulness"				
1	I don't have any use for computer technologies on a day-to-day basis.		.42	
2	Using computer technologies to communicate with others over a computer network can help me to be more effective in my job.		.74	
4	Using computer technologies in my job will only mean more work for me.		.42	.40
5	I do not think that computer technologies will be useful to me in my profession.		.66	
7	With the use of computer technologies, I can create materials to enhance my performance on the job.		.61	
9	If I can use word processing software, I will be more productive.			.50
10	Anything that computer technologies can be used for, I can do just as well some other way.			.60
13	I could use computer technologies to access many types of information sources for my work.		.73	
16	Computer technologies can be used to assist me in organizing my work.		.65	.43
17	I don't see how I can use computer technologies to learn new skills.			.63
19	Knowing how to use computer technologies will not be helpful in my future work.			.75

[a] Underlined item numbers reflect negatively phrased stems.

Note: Blanks indicate loadings below .40.

Table 2
Principal Component Analysis: SPSS Varimax Rotation for SELF-EFFICACY FOR COMPUTER TECHNOLOGIES (SCT) (N=359)

Item #	Stem	Factor 1	Factor 2	Factor 3
"Spreadsheets"				
	I feel confident...			
20.	...formatting the columns and rows in a spreadsheet.	.81		
21.	...naming the columns and rows in a spreadsheet.	.83		
22.	...entering appropriate formulas for calculation in a spreadsheet.	.78		
23.	...entering data in a spreadsheet.	.82		
24.	...editing previous spreadsheet files.	.81		
25.	...printing out the spreadsheet.	.77		
26.	...saving a spreadsheet file.	.82		
"Data Base Programs"				
	I feel confident...			
27.	...formatting data fields in a data base.	.87		
28.	...naming data fields in a data base.	.89		
29.	...entering records in a data base.	.90		
30.	...searching records in a data base with specific terms.	.88		
31.	...sorting records in a data base.	.89		
32.	...printing out records in a data base.	.88		
33.	...saving data base files.	.89		
"Electronic Mail"				
	I feel confident...			
11	...logging on to e-mail.	.43	.86	
12	...reading mail messages on e-mail.	.44	.86	
13	...responding to mail messages on e-mail.	.45	.86	
14	...deleting messages received on e-mail.		.85	
15	...sending mail messages on e-mail.	.43	.87	
16	...sending the same mail message to more than one person on e-mail.		.84	
17	...responding privately to messages sent to more than one person on e-mail.		.84	
18	...forwarding messages received on e-mail.		.79	
19	...logging off of e-mail.	.45	.86	

Table 3
Principal Component Analysis: SPSS Varimax Rotation for SELF-EFFICACY FOR COMPUTER TECHNOLOGIES (SCT) (N=359) *(continued)*

Item #	Stem	Factor 3	Factor 4	Factor 5
"Word Processing"				
	I feel confident...			
1	...using a word processing program to write a letter or a report.	.88		
2	...accessing previous files with a word processing program.	.85		
3	...making corrections while word processing.	.92		
4	...formatting text (e.g., bold, underlining) while word processing.	.88		
5	...moving blocks of text while word processing.	.75		
6	...using the spelling checker while word processing.	.86		
7	...using the searching feature in a word processing program.	.70		
8	...printing out files I've written while word processing.	.87		
9	...saving documents I've written with a word processing program.	.88		
10	...renaming a word processing file to make a back-up copy.	.72		
"Statistical Packages"				
	I feel confident...			
34.	...entering data into a file for analysis.		.89	
35.	...getting into a particular file.		.87	
36.	...writing the statistical procedure.		.88	
37.	...running a statistical procedure.		.89	
38.	...correcting procedural errors.		.87	
39.	...printing out statistical results.		.90	
40.	...saving related files.		.88	
"CD-ROM Data Bases"				
	I feel confident...			
20	...using a data base on compact disc, such as ERIC, MedLine, Dialog, Science Citation Index, etc.			.89
21	...selecting the right data base on compact disc for a specific topic.			.94
22	...selecting search terms for a data base literature search.			.93
23	...getting into a data base on compact disc and starting a literature search.			.93
24	...using descriptors from a data base literature search to obtain new search terms.			.94
25	...using the print function in a data base search on compact disc..			.92

Table 4
Correlations Between Demographic Variables and ACT and SCT measures and scales.

	Age	Sex	Freq WP	Freq EM	Freq SS	Freq DB	Freq ST	Freq CD
Age	1.00							
Sex	0.11	1.00						
Freq WP	0.20**	0.00	1.00					
Freq EM	-0.25**	-0.37**	0.10	1.00				
Freq SS	-0.16*	-0.43**	0.28**	0.61**	1.00			
Freq DB	0.01	-0.29**	0.25**	0.48**	0.67**	1.00		
Freq ST	0.00	-0.20**	0.17*	0.20**	0.23**	0.15*	1.00	
Freq CD	0.02	0.10	0.18*	-0.07	0.04	0.03	0.17*	1.00
Class WP	0.20**	0.14*	0.16*	-0.14*	-0.05	0.02	0.01	-0.08
Class EM	-0.18*	-0.40**	0.11	0.65**	0.61**	0.23**	0.17*	-0.13
Class SS	-0.01	-0.37**	0.16*	0.57**	0.55**	0.43**	0.16*	-0.17*
Class DB	-0.04	-0.36**	0.10	0.55**	0.52**	0.45**	0.15*	-0.18**
Class ST	0.01	-0.08	0.04	0.08	0.07	0.06	0.42**	-0.02
Class CD	0.20**	0.06	0.02	-0.09	-0.02	-0.03	0.12	0.32**
ACT Total Score	0.14*	-0.02	0.42**	0.23**	0.25**	0.30**	0.13	0.13
ACT Usefulness	0.12	0.06	0.37**	0.20**	0.25**	0.28**	0.10	0.13
ACT Comfort/Anxiety	0.14*	-0.09	0.36**	0.20**	0.18**	0.24**	0.13	0.10
SCT WP	0.02	0.01	0.59**	0.05	0.10	0.05	0.07	0.16*
SCT EM	-0.15*	-0.38**	0.14*	0.86**	0.60**	0.51**	0.25**	-0.08
SCT SS	-0.08	-0.40**	0.17*	0.63**	0.68**	0.49**	0.18**	-0.10
SCT DB	-0.10	-0.39**	0.14*	0.65**	0.65**	0.58**	0.18**	-0.10
SCT ST	0.05	-0.14*	0.07	0.04	0.15*	0.11	0.39**	0.13*
SCT CD	0.08	0.10	0.12	-0.21**	-0.09	-0.11	0.06	0.63**

Table 5

Correlations Between Demographic Variables and ACT and SCT measures and scales.

	Class WP	Class EM	Class SS	Class DB	Class ST	Class CD
Class WP	1.00					
Class EM	0.02	1.00				
Class SS	0.27**	0.65**	1.00			
Class DB	0.23**	0.65**	0.86**	1.00		
Class ST	0.08	0.14*	0.23**	0.24**	1.00	
Class CD	0.19**	0.04	0.09	0.12	0.14*	1.00
ACT Total Score	0.02	0.17*	0.21**	0.21**	0.03	0.07
ACT Usefulness	0.05	0.16*	0.21**	0.21**	0.02	0.11
ACT Comfort/Anxiety	-0.01	0.14*	0.15*	0.15*	0.04	0.02
SCT WP	0.19**	0.05	0.09	0.03	0.05	0.08
SCT EM	-0.08	0.68**	0.56**	0.54**	0.15*	-0.07
SCT SS	0.08	0.61**	0.76**	0.68**	0.17*	0.01
SCT DB	0.04	0.59**	0.67**	0.67**	0.16*	0.03
SCT ST	0.03	-0.01	0.09	0.06	0.35**	0.09
SCT CD	-0.04	-0.27**	-0.23**	-0.24**	0.00	0.24**

Table 6
Correlations Between Demographic Variables and ACT and SCT measures and scales.

	ACT Total	ACT Usefulness	ACT Comfort	SCT WP	SCT EM	SCT SS	SCT DB	SCT ST	SCT CD
ACT Total Score	1.00								
ACT Usefulness	0.88**	1.00							
ACT Comfort/Anxiety	0.88**	0.55**	1.00						
SCT WP	0.42**	0.28**	0.45**	1.00					
SCT EM	0.30**	0.24**	0.29**	0.10	1.00				
SCT SS	0.35**	0.27**	0.35**	0.18**	0.69**	1.00			
SCT DB	0.35**	0.27**	0.34**	0.11	0.70**	0.84**	1.00		
SCT ST	0.12	0.03	0.19**	0.12	0.19**	0.30**	0.28**	1.00	
SCT CD	0.15*	0.09	0.18**	0.19**	-0.16*	-0.11	-0.08	0.34**	1.00

Table 7

Hierarchicial Multiple Regression Results for Prediction of "Perceived Self-Efficacy For Word Processing" (N=342)

Variables Entered At Each Step	Constant	R	Adjusted R^2 / R^2	SEE	b	Se b	Beta	tb
Learner Characteristics								
Age					-.147	.047	-.132	-3.094 **
Sex[1]			-.007		.623	.736	.037	.846
Year in Program		.038	.001	7.424	.299	.269	.048	1.112
Course(s) in which Word Processing			.026					
was learned		.193	.037	7.301	1.786	.613	.121	2.914 **
Frequency of Word Processing			.376					
		.621	.385	5.843	3.559	.314	.516	11.327 ****
Attitudes								
"Usefulness"			.453		-.138	.069	-.101	-1.990 *
"Comfort/Anxiety"	15.877	.681	.464	5.471	.461	.068	.347	6.811 ****

[1]Coding for Sex = Male (1); Female (2)

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

Table 8

Hierarchicial Multiple Regression Results for Prediction of "Perceived Self-Efficacy For Electronic Mail" (N=326)

Variables Entered At Each Step	Constant	R	Adjusted R^2 R^2	SEE	b	Se b	Beta	tb
Learner Characteristics								
Age					.099	.051	.056	1.932
Sex[1]			.266		-.800	.805	-.031	-.994
Year in Program		.522	.273	9.573	-.133	.304	.014	-.436
Course(s) in which Electronic Mail			.473					
was learned		.693	.480	8.111	4.281	.899	.185	4.765 ****
Frequency of using Electronic Mail			.741					
		.863	.745	5.689	4.718	.270	.695	17.497 ****
Attitudes								
"Comfort/Anxiety"			.755		.268	.069	.132	3.881 ***
"Usefulness"	- 2.929	.872	.760	5.532	-.014	.070	-.007	-.195

[1]Coding for Sex = Male (1); Female (2)

*** $p < .001$
**** $p < .0001$

Table 9
Hierarchicial Multiple Regression Results for Prediction of "Perceived Self-Efficacy for Spreadsheet Programs" (N=332)

Variables Entered At Each Step	Constant	R	R^2 / Adjusted R^2	SEE	b	Se b	Beta	tb
Learner Characteristics								
Age					-.057	.040	-.044	-1.422
Sex[1]			.215		-.500	.678	-.026	-.738
Year in Program		.472	.222	7.525	.052	.238	.007	.219
Course(s) in which Spreadsheets			.592					
were learned		.773	.597	5.426	9.190	.658	.538	13.971 ****
Frequency of Spreadsheet Use			.676					
•		.825	.681	4.834	2.493	.287	.335	8.677 ****
Attitudes								
"Comfort/Anxiety"			.719		.361	.056	.235	6.488 ****
"Usefulness"	-4.810	.851	.724	4.507	-.064	.059	-.041	-1.092

[1]Coding for Sex = Male (1); Female (2)

**** $p < .0001$

Table 10

Hierarchicial Multiple Regression Results for Prediction of "Perceived Self-Efficacy for Data Base Programs" (N=331)

Variables Entered At Each Step	Constant	R	Adjusted R^2 R^2	SEE	b	Se b	Beta	tb
Learner Characteristics								
Age					- .109	.047	- .083	- 2.296 *
Sex[1]			.246		- 1.749	.814	- .086	- 2.150 *
Year in Program		.502	.252	7.596	- .787	.289	- .108	- 2.720 **
Course(s) in which Data Base Programs				.492				
were learned		.706	.498	6.234	7.684	.754	.439	10.195 ****
Frequency of Data Base Use			.567					
		.758	.574	5.752	2.102	.312	.274	6.738 ****
Attitudes								
"Comfort/Anxiety"			.600		.311	.068	.197	4.570 ****
"Usefulness"	3.136	.780	.608	5.531	- .010	.071	- .006	- .142

[1]Coding for Sex = Male (1); Female (2)

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

Table 11

Hierarchicial Multiple Regression Results for Prediction of "Perceived Self-Efficacy for Statistical Packages" (N=318)

Variables Entered At Each Step	Constant	R	Adjusted R^2 / R^2	SEE	b	Se b	Beta	tb
Learner Characteristics								
Age					.029	.042	.035	.702
Sex[1]			.015		-.621	.667	-.049	-.931
Year in Program		.157	.025	5.342	.288	.233	.065	1.239
Course(s) in which Statistical Packages			.158					
were learned		.411	.169	4.939	4.801	1.075	.245	4.468 ****
Frequency of Using Statistical Packages			.232					
		.494	.244	4.719	3.841	.711	.303	5.403 ****
Attitudes								
"Usefulness"			.255		-.125	.059	-.126	-2.132 *
"Comfort/Anxiety"	.377	.521	.272	4.646	.200	.058	.205	3.453 ***

[1]Coding for Sex = Male (1); Female (2)

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

Table 12
Hierarchicial Multiple Regression Results for Prediction of "Perceived Self-Efficacy for CD-ROM Data Bases" (N=317)

Variables Entered At Each Step	Constant	R	Adjusted R^2 R^2	SEE	b	Se b	Beta	tb
Learner Characteristics								
Age					.038	.042	.041	.890
Sex[1]			.096		.325	.640	.023	.507
Year in Program		.323	.104	5.677	.685	.238	.140	2.877 **
Course(s) in which CD-ROM Data Bases			.125					
were learned		.369	.136	5.584	.425	.972	.020	.437
Frequency of CD-ROM Data Base Use			.402					
		.642	.412	4.616	3.993	.338	.567	11.811 ****
Attitudes								
"Usefulness"			.417		-.097	.058	-.089	-1.679
"Comfort/Anxiety"	.146	.656	.430	4.558	.181	.057	.167	3.159 **

[1]Coding for Sex = Male (1); Female (2)

** $p < .01$
**** $p < .0001$