An Exploration of Theoretical and Practical Foundations for Assessing Attitudes Toward Computers: The Computer Attitude Measure (CAM)

Robin H. Kay

University of Toronto

Citation for this paper:

Kay, R. H. (1993b). An exploration of theoretical and practical foundations for assessing attitudes toward computers: The computer attitude measure (CAM). *Computers in Human Behavior, 9,* 371-386.

Abstract

Over the past 10 years, researchers have assessed over 15 different constructs with respect to computer attitudes, making it difficult to interpret and compare studies using these attitude measures. An absence of theoretical justification for many constructs further complicates interpretation. In this study, four theoretically distinct constructs (cognitive, affective, behavioral, and perceived control), based on over 45 years of general attitude scale development, are examined in the form of the Computer Attitude Measure (CAM). This measure, consisting of 50 items, was administered to 647 pre-service teachers to assess cognitive (student, personal, general), affective, behavioral (classroom and home), and perceived control components of computer attitudes. The internal reliability coefficient for the full measure was .95. The alpha coefficients for each attitude subscale ranged form .70 to .97. The principal components factor analysis supported the a priori assumption that attitude the four attitude dimensions and their subscales were structurally independent. Significant positive correlations (p <.001) among all attitude subscales and computer awareness, software skill, and programming, provided support for the external validity of the CAM. Strong theoretical foundations coupled with the promising statistical results of this study suggest that the four-dimension model may be one way to re-organize and assess the multitude of constructs already

identified by computer attitude researchers.

An Exploration of Theoretical and Practical Foundations for Assessing Attitudes Toward Computers: The Computer Attitude Measure (CAM)

Computer attitude measures have included a mixed assortment of constructs including enjoyment, anxiety, efficacy, gender-typing, policy concerns, educational support and benefits, computer use, CAI, programming, social issues and impact, liking, value of computers, potency of computers, helpfulness, awesomeness, negativity, and science fiction (Anderson, Hansen, Johnson, and Klassen, 1979; Bear, Richards, Lancaster, 1987; Cohen & Waugh, 1989; Gressard & Loyd, 1986; Hill, Smith and Mann, 1987; Koohang, 1989; Lee, 1970; Loyd and Gressard, 1984, 1985; Massoud, 1990; Mahmood & Medewitz, 1989; Meier & Lambert, 1991; Popovich, Hyde & Zakrajsek, 1987; Turnipseed & Burns; 1991; Rosen, Sears, & Weil, 1987; Woodrow, 1990; Wu & Morgan, 1989). The sheer volume of constructs makes it difficult to identify a common theme or language among these instruments. Yet a unified foundation for attitude assessment is desirable in order to better understand the role of attitudes in human-computer interaction.

For example, in computer gender research, out of 98 instances of attitude measurement, males surpassed females on 48 occasions, females surpasses males on 14 occasions, and males and females had similar attitudes on 36 occasions (Kay, 1992a). Any clear interpretation of these results is constrained by the fact that attitudes were assessed in at least 14 different ways. Until a common metric is developed, results like those reported in computer-gender research will remain isolated pieces of a complex puzzle.

One method of developing a common language among attitude scales is to develop a composite of the various constructs already identified. This process is hindered somewhat by a noticeable absence of theoretical justification provided by researchers in support of their constructs. In a number of studies, independent constructs are identified in a post-hoc fashion (Bear et al., 1987; Cohen & Waugh, 1989; Gressard & Loyd, 1986; Hill et al., 1987; Koohang, 1989; Lee, 1970; Loyd and Gressard, 1984, 1985; Popovich et al., 1987; Turnipseed & Burns; 1991; Woodrow, 1990). Without some theoretical sustenance, it is difficult to pick-and-choose constructs from the computer attitude grab bag.

One alternative to developing a composite measure of computer attitudes, is to examine the theoretical foundations of general attitude measurement. A clear benefit of following this approach is having access to over 45 years of extensive theoretical and empirical data.

The most popular attitude classification system, dating back to Plato, distinguishes three categories of attitude responses: affect, cognition and conation (Ajzen, 1988; Allport, 1954; Breckler, 1984; Hilgard, 1980; McGuire, 1969). Affect reflects feelings toward the attitude object; cognition reflects perceptions of and information about the attitude object; conation reflects behavioral intentions and action with respect to the attitude object (Ajzen, 1988). This classification system, was formally articulated as the tripartite model in the late 1940s by Smith (1947) and has been used extensively since 1960 (Hilgard, 1980; Ostrom, 1969; Rosenberg and Hovland, 1960). Breckler (1984) attests to the validity of the model. Current research in cognitive science with respect to understanding how the mind works also accepts the affective-cognitive distinction in human behavior, referring to affective components as "qualia" and cognitive components as "cognitions" (Churchland, 1988; De Sousa, 1987; Izard, Kagan, & Zajonc, 1984). It is generally believed that individuals attempt to maintain consistency among their affective, cognitive and behavioral attitudes (Zajonc, 1968).

A recent addition to the tripartite model is perceived behavioral control (Ajzen, 1988). Ajzen defines perceived control as the perceived ease or difficulty of performing a particular behavior. One could also interpret perceived control as a confidence construct aimed at specific behaviors or activities. Ajzen notes that perceived control was developed from the more generalized concepts of locus of control (Rotter, 1966) of perceived self-efficacy (Bandura, 1982). In an extensive review of the literature, Ajzen observed that perception of behavioral control had a significant impact on a person's motivation and behavior.

In summary, researchers and theorists of general attitude measurement have identified four distinct components of attitude assessment: affect, cognition, behavior and perceived control. The Computer Attitude Measure (CAM) examined in this study was constructed according to this basic structure.

The practical rigour of an attitude measure also has to be considered if the measure is to be of any benefit to educators. With respect to computer attitude scales, one important goal is to determine the extent to which these scales predict behavior toward computers. While a number of researchers have examined the effect that computer experience can have on attitudes or vice versa (Arndt, Feltes, & Hanak, 1983, Chapline & Turkel, 1986; D'Souza & Smith, 1985; Gressard & Loyd, 1986; Nelson, 1983; Raub, 1982; Vensel, 1981), none have addressed the relatively tentative link between attitude and behavior that has been observed by attitude-behavior theorists. In a review of 54 investigations assessing the relation between attitude and behavior, Ajzen & Fishbein (1977), 25 failed to show to show significance and the remaining studies rarely reported correlation greater than .40. The common element in these studies was the use of general attitude measures to examine specific behaviors. In other words, global attitudes toward an attitude object, are largely unrelated to specific actions or behavior toward the object (Ajzen, 1988).

With respect to measuring attitudes toward computers, it would be best to be as specific as possible about the content of the attitude object, if we expect to be able to predict behavior toward that object. For example, a scale designed to assess general attitudes toward computers in society would not be expected to provide accurate predictions of whether teachers would use computers in their classrooms. Ajzen and Fishbein (1977) recommend that an attitude measure should be specific in terms of the target and context of behavior being assessed.

Researchers of computer attitudes are only beginning to consider context with respect to computer attitudes (Loyd & Loyd, 1989). Intuitively, context should play a key role in the effectiveness of a particular attitude measure to accurately predict behavior.Different populations have different needs, goals and motivations. Teachers are interested in the educational benefits of computing. Businesses are interested in the economical benefits. The average home owner might be interested in personal benefits such as organization, saving time, having fun. We would not expect measures focusing on attitude toward computers in education to reflect how individuals in a business environment think and feel about computers. Furthermore, if specific attitudes can be isolated, programs for change can be tailored accordingly.

The purpose of this study is twofold: to explore an alternative computer attitude measure based on four constructs borrowed from general attitude research and to investigate the effect of context within this framework.

Method

Sample

The sample consisted of 647 pre-service teachers (27% male, 73% female), ranging in age from 21 to 52 years (M=28.2 years), selected from four universities across the province of Ontario. Of the 647 subjects, 31% (18 males, 172 females) intended to teach primary pupils (junior kindergarten to grade 6), 39% (67 males, 174 females) to teach junior pupils (grades 4 to 6), 27% (78 male, 90 females) to teach intermediate pupils (grades 7 to 10), and 4% (10 males, 13 females) to teach senior pupils (grades 11 and up). Regarding the subject areas to be taught, 41% (44 males, 215 females) of pre-service teachers were planning to teach a general curriculum only, 40% (77 males, 180 females) to teach the humanities, 9% (31 males, 28 females) to teach math/science courses, and the remaining 10% (23 males, 42 females) to teach both math/science and the humanities. Almost one third (37% of males and 27% of females) of all pre-service teachers owned a computer.

Instrument Development

In this study, a modified version of the computer attitude scale (Kay, 1989) was used. The original measure included affective, cognitive and behavioral (conative) subscales. Details of the item selection process can be found in Kay (1987). The current measure adds a subscale to assess subject perceived control over computers. Furthermore, the cognitive attitude scale of the original measure (Kay, 1989) was modified to incorporate three different contexts: student education, personal use and general. The object of behavioral attitudes was divided into 2 contexts: using the computer in the class and at home.

Description of Computer Attitude Scale

The CAM is a self-report measure. Although self-reports are often considered inferior to direct observation, Ajzen (1988) maintains that they are comparable in terms of accuracy.
The CAM scale also refers solely to the use of microcomputers, an

important point in light of recent research suggesting attitude differences with respect to type of computer used (Wu & Morgan, 1989).

The Computer Attitude Measure (CAM) consisted of the following sections: a) demographic information, b) cognitive attitudes, c) affective attitudes, d) behavioral attitudes, and d) perceived control. Gender, age, computer ownership, and subject area to be taught made up the demographic questions.

The cognitive attitude dimension was divided into 3 subscales consisting of five 7-point Likert items each (Strongly Disagree, Disagree, Slightly Disagree, Neutral, Slightly Agree, Agree, Strongly Agree). The affective component of attitudes was assessed using ten 7-point semantic differential scale items (Extremely, Moderately, Slightly, Neither, Slightly, Moderately, Extremely). The behavioral attitude scale consisted of two subscale, consisting of nine 7-point Likert items (Extremely Unlikely, Unlikely, Somewhat Unlikely, Neither, Somewhat Likely, Likely, Extremely Likely), assessing behavior in the class and behavior at home using the computer. The perceived control component of attitudes was assessed using seven 7-point Likert items (Strongly Disagree, Disagree, Slightly Disagree, Neutral, Slightly Agree, Agree, Strongly Agree).

For the behavioral attitudes subscale subjects were specifically asked, "If it were only up to you and no one else, how likely is it that you would perform each of the following behaviors in the next 6 to 8 months." This wording was used to allow subjects who might not have computers to speculate whether they might exhibit computer-related behaviors.

Individual item statements are listed in table 1 (cognitive scales), table 3 (affective scale), table 4 (behavioral scale), and table 5 (perceived control scale).

One other scale was administered at the same time as the CAM, assessing computer ability (15 items, α=.97). This scale was comprised of three subscales measuring applied ability (5 items, α=.92), computer awareness (5 items, α=.89), and programming ability (5 items, α=.93). This scale is discussed in detail by Kay (1992b).

Procedure

Letters were sent to the Department of Education in six major universities in the province of Ontario requesting their participation in the study. Four agreed to participate in the study. On the front of each survey was an explanation of how much time it would take to complete the survey (20 to 25 minutes), a statement noting that participation was completely optional and that all surveys would remain anonymous, and a brief explanation of why the survey was being done. Subjects were also told that the questions on the survey referred to the use of microcomputers only. Out of 1175 surveys sent, 647 (55.1%) were returned.

Research Design and Method of Analysis

The means, standard deviations and internal reliability coefficients were determined for each of the seven subscales. Correlations among subscales were calculated to help determine whether a varimax or oblique rotation would be used to evaluate the scale structure. In certain instances where inter-scale correlations are high, a clean factor solution is best achieved using an oblique rotation (see Stevens, 1986 for a more thorough discussion). Correlation coefficients among hypothesised subscales ranged from .18 to .58 (Table 7). While these correlations could be described as low to moderate, in the interest of completeness, both varimax and oblique rotations were used. A principal component factor analysis, followed by a varimax rotation of the factor solution was used to determine the factor validity of individual subscales. Finally, a correlation matrix, incorporating the three CAM subscales and the measures of computer ability, was used to demonstrate the external validity of the CAM. All analysis were done using SPSSX version 3.0.

Results

Cognitive attitudes

The overall mean for the cognitive attitude scale was relatively high at 80.8 (SD = 11.4); possible range 15 to 105). The internal reliability coefficient for the total scale was .86. Total means for the student (M=26.1; range 5 to 35), personal (M=28.2; range 5 to 35), and general (M=26.4; range 5 to 35) were also high. Individual item statistics for all cognitive attitude scales are presented in table 1.

Insert Table 1 about here

The alpha coefficient for cognitive attitudes regarding students and computers was moderately high (α=.73). Pre-service teachers strongly agreed with the statement about computers motivating their students (item mean = 6.0). They were the least sure about computers helping students work with each other (item mean= 4.7) (Table 1).

The alpha coefficient for the personal use subscale was comparable to the student subscale (α=.77). Subjects agreed most with the statement that computers would help them organize their work (M=5.9) and least with the statement about computers helping them to organize their finances (M=5.2) (Table 1).

The alpha coefficient for the general cognitive attitude subscale was .70. Subjects agreed most about computer improving the quality of banking transactions (M=6.1) and least with computer improving the overall quality of life (M=4.8) (Table 1).

The principal component factor analysis produced a three factor solution accounting for almost 51 percent of the total variance. The varimax rotated factor loadings greater or equal to .40 are shown in Table 2. Each of the three contexts of cognitive attitude formed a relatively distinct and cohesive group. One of the personal subscale items and two of the general subscale items showed factor loadings above .40 for the other scales (Table 2).

Insert Table 2 about here

Affective attitude

The total scale mean for the affective attitude subscale was 49.0 (SD=9.5; possible range 7 to 70). The internal reliability estimate for the subscale was .88. Subjects were more likely to see the experience of using a computer as likable (M=5.7) and less likely to see it as natural (M=4.0) (Table 3). A principal components factor analysis revealed only one factor accounting for 50 percent of the total variance (Table 3).

Insert Table 3 about here

Behavioral Attitudes

The overall mean for the behavioral attitudes component of computer attitude was 82.7 (possible range 18 to 126). The variability for this scale was quite high (SD=27.6). The internal reliability estimate for the total scale was very high (α=.95). Individual item statistics are presented in table 4.

Insert Table 4 about here

Behavioral attitudes toward using computers in the class were high (M=45.8; SD=12.9; possible range 9 to 63). The alpha reliability coefficient for this scale was high (α=.92). Subjects claimed that they were most likely to use word processing software (M=5.4) in the classroom and least likely to use graphics software (M=4.7) (Table 4).

Behavioral attitudes to use the computer at home were less than attitudes to use the computer in the class (M=37.1; possible range 9 to 63). Scores also showed much more variability (SD=18.9) than the total score for the class subscale. The alpha reliability coefficient was very high (α=.97). Subjects wanted to do word processing the most (M=4.7) and graphics (M=3.6) the least.

A principal components factor analysis clearly delineated two factors corresponding to behavioral attitudes at home and behavioral attitudes in the classroom. Factor loadings are shown in Table 4). The two factor solution accounted for over 70% of the total variance.

Perceived control

The overall mean for the perceived control subscale was 26.8 (SD=9.3; possible range 7 to 42). The internal reliability estimate for the scale was .89. Subjects were more likely to say that they could make the computer do what they wanted it to do (*M*=4.2) and less likely to say that they needed an experienced person nearby (*M*=3.6) or someone to tell the best way to use the computer (*M*=3.6). A principal component factor analysis revealed only one factor that accounted for almost 61% of the total variance (Table 5).

Insert Table 5 about here

Total CAM

The grand mean for all the subscales was 212.8 (SD=39.9; possible range 50 to 350). The internal reliability estimate for the entire CAM was .95. A principal components factor analysis using a varimax rotation revealed 7 relatively distinct factors corresponding to cognitive attitude (student, personal and general), affective attitude, behavioral attitudes (class and home), and perceived control. The 7 factor solution accounted for 60 percent of the total variance. An oblique rotation produced almost an identical factor solution to that produced by the varimax rotation, therefore only the more conservative oblique rotation is presented in table 6. The eigenvalues from the varimax rotation are also presented in table 6. Note that one of the personal items loaded higher on the student subscale than the personal subscale. This latter item referred to learning (Item 5 personal scale) (see Table 1).

Insert Table 6 about here

Correlations among subscales and the Total CAM score range from .52 (perceived control) to .83 (home-behavioral attitudes). With respect to correlations among subscales, coefficients varied from .18 (general cognitions with perceived control) to .57 (student cognitions with general cognitions). All correlations were significant ($p < .001$). In general, subscales were moderately correlated with each other (Table 7).

Insert Table 7 about here

CAM and computer ability

Correlations among CAM subscales and the total computer ability score ranged from .26 (student and general cognitions) to .88 (perceived control). Correlations were highest (.56 to .71) between perceived control and computer ability subscales, moderate (.27 to .57) among behavioral attitudes and affective subscale with ability subscales, and low, but significant, among attitude scales and computer ability. Both awareness and applied ability showed moderate correlations (.24 to .71) with attitude subscales. Programming ability showed the lowest correlations (.12 to .56) with attitude subscales. The overall CAM score showed a .60 correlation ($p<.001$) with the total ability score.

Insert Table 8 about here

Discussion

The purpose of this study was to explore and test a model of computer attitudes based on four principal constructs taken from general attitude research. Three standard subscales, borrowed from the tripartite model of attitude measurement (cognitive, affective, behavioral attitudes), along with Ajzen's (1988) dimension of perceived control were included in the computer attitude measure. Contextual components of cognitive (general, student, personal) and behavioral (class and home) attitude subscales were also tested.

The high alpha coefficients for all four attitude dimensions as well as contextual subscales indicate that all seven subscales were internally reliable. Furthermore, the results from the principle component factor analysis followed by both a varimax and an oblique rotation indicated that 1) the four major dimensions, 2) the three contexts of cognitive attitude (student, personal, and general), and 3) the two behavioral attitudes contexts (class and home) were structurally independent. Moderate, but not excessively high, inter-correlations among all seven attitude components indicate that subscales could be used either independently or together.

Significant correlations between all computer attitude subscales and computer ability subscales provide one measure of external validity for the CAM. In other words, we would expect positive attitudes to correlate significantly with computer ability, and this expectation was confirmed.

The variation in degree to which attitude subscale correlated with each other and with subscales of ability indicate that differentiation of the four dimensions of computer attitude, along with the varied contexts, may be practically useful. For example, programming ability showed relatively low correlations with attitude subscales, whereas computer awareness and applied skill showed moderately high correlations. If an educator wished to improve attitude toward computers, more emphasis could be place on awareness and applied skill than programming. This result is partially supported in the literature (Gilroy & Desai, 1986). Conversely, we might expect pre-service teachers who have positive attitudes about computer to be more enthusiastic about teaching computer awareness and applied software than programming.

Preliminary analysis of the predictive value of these subscales (Kay, 1992c) indicates that personal attitudes and applied software skill are significant predictors of home use of computers, whereas student cognitive attitude, affective attitude, programming and applied software ability are significant predictors of class use of computers.

It seems, then, that the multicomponent design of the CAM could have practical significance in helping to modify curriculum and theoretical significance in understanding how individual components interact to predict computer use.

Caveats

Sample and Survey. When interpreting the results of this study, the nature of the sample should be considered: predominantly female, rural, and pre-service teachers of primary and junior students. Different results could emerge with a different sample consistency, although this sample was substantial and included a large number of male and urban students.

High means for most attitude measures, except for perceived control and home behavior, might be partially attributed to pre-service teacher's desire to project a favourable image of self (Edwards, 1957). The anonymity of questionnaires was designed to reduce this effect.

Contextual variables. The cognitive and behavioral scales were subdivided to test the role of context in attitude measurement. Factor analysis and differential correlations with other subscales indicated that contextual subscales may be theoretically and practically useful. Nonetheless, there are many other contextual divisions and situational variables that have not been addressed. The variety of measure produced by other researchers (Anderson et al., 1979; Bear et al., 1987; Gressard & Loyd, 1986; Hill et al., 1987; Lee, 1970; Loyd and Gressard, 1984, 1985; Koohang, 1989; Turnipseed & Burns; 1991; Woodrow, 1990; Wu & Morgan, 1989) supports this conclusion. In other words, many plausible subscales, could be used to assess attitudes toward computers. In some cases, it may be necessary to tailor cognitive attitude scales to unique environments.

Individual factors. Many personal factors, not accounted for in this study, interact with attitude development and expression including high-self monitoring (Snyder & Swann, 1976), self-consciousness (Scheier, Buss, & Buss, 1978), need for cognition (Petty & Cacioppo, 1981, 1986), amount of knowledge and degree of reflection (Snyder, 1982) and confidence in one's attitude (Warland and Sample, 1973; Fazio and Zanna, 1978). These variables have not been considered with respect to computer attitudes leaving considerable room to improve assessment and predictions (Reed, 1986).

Other factors. Other factors that influence computer use and attitude, but are rarely discussed when measuring these constructs, include hardware and software availability, need for computer teacher staff, and teacher training. These are documented concerns of teachers (Reed, 1986) and useful guides for creating future cognitive attitude scales.

Future Research

Refining the CAM. While the basic structure of general attitude research appears to work well in the domain of computers, further development is required in organizing and identifying specific contextual elements within the four primary dimensions. A good starting point would be to re-organize and assign each of previously assessed constructs identified earlier in this paper into the four-factor general attitude model. For example enjoyment, liking, awesomeness and negativity could be organized within the dimension of affective attitudes; gender-typing, policy concerns, educational support and benefits, social issues and impact, potency of computers, and science fiction within the cognitive attitude dimension ; computer use, CAI and programming within the behavioral attitude dimension; and confidence and efficacy into the perceived control dimension. Restructuring the broad assortment of attitude constructs might help researchers develop a common basis with which to compare currently conflicting research findings (e.g. gender-computer research).

Alternative measures. Survey measures are a quick-and-dirty approach to assessing attitudes toward computers, often necessary because of time constraints. Nonetheless, alternative attitude assessment techniques have proven theoretically and practically useful including: experimental manipulation of attitudes (Orcutt & Anderson (1974), assessing attitudes in a real world situation where computers were introduced in the process of making cookies (Buchanan & Boddy, 1983), qualitative research on students attitude toward using word processing and writing (Baer, 1988), investigating assessment types, coping strategies and categorical frameworks of novices (Nordenbo, 1990) and how attitudes interact with the learning process Kay (1992d, 1992e). These qualitative approached should be considered seriously if we wish to understand the process of attitude development.

Conclusion

A theoretically principled, multicomponent, Computer Attitude Measure (CAM), incorporating cognitive (student, personal, and general), affective, behavioral (class and home), and perceived control subscales, was tested on 647 pre-service teachers. The independence of these subscales was supported by a principal component factor analysis. As well, the CAM was internally reliable and correlated positively with a high degree of computer awareness, applied software skill, and programming ability. The CAM is offered as a theoretical staring point with which to organize the mixed array of constructs identified in the computer attitude literature over the past 10 years.

REFERENCES

Allport, G. W. (1935). The historical background of modern social psychology. In G. Lindzey (Ed.), Handbook of Social Psychology, Vol 1,(pp.3-56). Cambridge, MA: Addison-Wesley.

Anderson, R. E., Hansen. T. P., Johnson, D. C., & Klassen, D. L. (1979). Minnesota computer literacy awareness assessment (Tech. Rep.). St. Paul Minnesota Educational Computing Consortium.

Ajzen, I. (1988). Attitudes, Personality, and Behavior. Chicago, IL: Dorsey Press.

Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. Psychological Bulletin, 84(5), 888-918.

Arndt, S., Feltes, J., & Hanak, J. (1983). Secretarial attitudes towards word processors as a function of familiarity and locus of control. Behavior and Information Technology, 2(1), 17-22.

Baer, V. E. H. (1988). Computers as composition tools: A case study of student attitudes. Journal of Computer-Based Instruction, 15(4), 144-148.

Bandura, A. (1982). Self-efficacy mechanism in human agency. American Psychologist, 37(2), 122-147

Bear, G. G., Richards, H. C., Lancaster, P. (1987). Attitudes toward computers: Validation of a computer attitudes scale.

Journal of Educational Computing Research, 3(2), 207-218.

Breckler, S. J. (1984). Empirical validation of affect, behavior, and cognition as distinct components of attitude. Journal of Personality and Social Psychology, 47(6), 1191-1205.

Buchanan, D. A., & Boddy, D. (1983). Advanced technology and the quality of working life: The effects of computerizes controls on biscuit making operators. Journal of Occupational Psychology, 56, 109-113.

Cohen, B. A., & Waugh, G. W. (1989). Assessing computer anxiety. Psychological Reports, 65, 735-738.

Chapline, E. B., & Turkel, S. (1986). The impact of a computer literacy program on affective variables. Journal of Computers Mathematics and Science Teaching, 5(3), 30-33.

Churchland, P. M. (1988). Matter of Consciousness: A Contemporary Introduction to the Philosophy of Mind (Revised Edition). Cambridge, MA: MIT Press.

D'Souza, P. V., & Smith, C. L. (1985). Attitudinal study of implementing microcomputer instruction into the curriculum. Journal of Education for Business, Dec, 122-124.

De Sousa, R. (1987). The Rationality of Emotion, Cambridge, MA: MIT Press.

Edwards, A. L. (1957). Techniques of Attitude Scale Construction. New York: Appleton-Century-Crofts.

Fazio, R. H., & Zanna, M. P. (1978). Attitudinal qualities relating to the strength of the attitude-behaviour relationship. Journal of Experimental Social Psychology, 14, 398-408.

Gilroy, F. D., & Desai, H. B. (1986). Computer anxiety: sex, race and age. International Journal of Man-Machine Studies, 25, 711-719.

Gressard, C. & Loyd, B. H. (1986). Validation studies of a new computer attitude scale. AEDS, 2, 295-301.

Hill, T., Smith, N., & Mann, M. (1987). Role of efficacy expectations in predicting the decision to use advanced technologies: The case of computers. Journal of Applied Psychology, 72, 307-313.

Hilgard, E. R. (1980). The trilogy of mind: Cognition, affection, and conation. Journal of the History of the Behavioral Sciences, 16, 107-17.

Izard, C., Kagan, J., & Zajonc, R. B. (Eds.) (1984). Emotions, Cognition & Behavior, Cambridge, MA: Cambridge University press.

Kay, R. H. (1987). The effectiveness of attitudes, literacy, locus of control, and gender in predicting commitment to the use of computers. M.A. Thesis, University of Toronto.

Kay, R. H. (1989). A practical and theoretical approach to assessing computer attitudes: The Computer Attitude Measure (CAM). Journal of Research on Computing in Education, 21(4), 456-463.

Kay, R. H. (1992a). An analysis of methods used to examine gender differences in computer-related behavior. Journal of Educational Computing Research, 8(3), 323-336.

Kay, R. H. (1992b). A practical research tool for assessing ability to use computers: The computer ability survey (CAS). (Manuscript submitted for publication).

Kay, R. H. (1992c). Predicting Pre-Service Teacher's Use of Computers in the Classroom and at Home. Manuscript in preparation.

Kay, R. (1992d). Charting pathways of conceptual change in the use of computer software. AERA Conference, San Francisco, CA.

Kay, R. (1992e). Charting Pathways to Computer Expertise. Ninth International Conference on Technology and Education (ICTE), Paris, France.

Koohang, A. A. (1989). A study of attitudes toward computers: Anxiety, confidence, liking, and perception of usefulness. Journal of Research on Computing in Education, 22(2), 137-150.

Lee, R. S. (1970). Social attitudes and the computer revolution. Public Opinion Quarterly, 34, 53-59.

Loyd, B. H. & Gressard, C. (1984). Reliability and factorial validity of computer attitude scales. Educational and Psychological Measurement, 44, 501-505.

Loyd, B. H. & Gressard, C. (1985). The reliability and validity of an instrument for the assessment of computer attitudes. Educational and Psychological Measurement,45, 903-908.

Loyd, B. H., & Loyd, D. E. (1989). Computer attitudes: Differences between present and future teachers by gender and amount of computer experience. AERA Conference, San Francisco, CA.

Mahmood, M. A. (1989). Assessing the effect of computer literacy on subjects' attitudes, values, and opinions toward information technology: An exploratory longitudinal investigation using the linear structural relations (LISREL) model. Journal of Computer-Based Instruction, 16(1), 20-28.

Massoud, S. L. (1990). Factor validity of a computer attitude scale. Journal of research on Computing in Education, 22(3), 290-299.

McGuire, W. J. (1969). The nature of attitudes and attitude change. In G. Lindzey & M. J. Rosenberg (Eds.), The Handbook of Social Psychology, Vol 3, pp. 136-314. Reading, MA: Addison-Wesley.

Meier, S. T. (1991). Psychometric properties and correlates of three computer aversion scales. Behavior Research Methods, Instruments, & Computers, 23(1), 9-15.

Nelson, C. A. (1983). Evaluating a computer literacy program. Journal of Developmental and Remedial Education, 6, 16-28.

Nickell, G. S. (1987). The computer attitude scale. Computers in Human Development, 2, 301-306.

Nordenbo, S. E. (1990). How do computer novices perceive information technology? A qualitative study based on a new methodology. Scandinavian Journal of Educational Research, 34(1), 1990.

Orcutt, J., & Anderson, R. (1974). Human computer relationships: Interactions and attitudes. Behavior Research Methods and Instruments, 6(2), 219-22.

Ostrom, T. M. (1969). The relationship between the affective, behavioral and cognitive components of attitude. Journal of Experimental and Social Psychology, 5, 12-30.

Popovich, Hyde, & Zakrajsek (1987). The development of the attitudes toward computer scale. Educational and Psychological Measurement, 47, 261-269.

Petty, R. E., & Cacioppo, J. T. (1981). Attitudes and Persuasion: Classic and Contemporary Approaches. Dubuque, Iowa: Wm.C. Brown.

Petty, R. E., & Cacioppo, J. T. (1986). The elaboration likelihood model of persuasion. In L. Berkowitz (Ed.), Advances in Experimental Social Psychology, Vol 19. San Diego: Academic Press.

Raub, A. C. (1981). Correlates of computer anxiety in college students. Dissertation Abstracts International, 42(11), 4775 -A.

Reed, W.M. (1986). Teachers' attitudes toward educational computing: Instructional uses, misuses, and needed improvements. Computers in the Schools, 3(2), 73-80.

Rosen, L. D., Sears, D. C., & Weil, M. M. (1987). Computerphobia. Behavior Research Methods, Instruments, & Computers, 19(2), 167-179.

Rosenberg, M. J. & Hovland, C. I. (1960). Cognitive, affective, and behavioral components of attitudes. In Rosenberg, M. J. & Hovland, C. I. (Eds.), Attitude organization and change (pp. 1-14). New Haven: Yale University Press.

Rotter, J. (1966). Generalized expectations for internal versus external locus of control reinforcement. Psychological Monographs, 80(1), 1-27.

Scheier, M. F., Buss, A. H., & Buss, D. M. (1978). Self-consciousness, self-report of aggressiveness, and aggression. Journal of Research in Personality, 12, 133-40.

Snyder, M. (1982). When believing means doing: Creating links between attitudes and behaviour. In M. P. Zanna, E. T. Higgins & C. P. Herman (Eds.), Consistency in social behavior: The Ontario Symposium, Vol 2, pp. 105-30. Hillsdale, NJ: Lawrence Erlbaum Associates.

Snyder, M., & Swann, W. B., Jr. (1976). When actions reflect attitudes: Journal of Personality and Social Psychology, 34, 1034-42.

Turnipseed, D. L., & Burns, O. M. (1991). Contemporary attitudes toward computers: An exploration of behavior. Journal of Research on Computing in Education, 23(4), 611-625.

Vensel, G. J. (1981). Changes in attitudes of pre-service special educators towards computers. Teacher Education and Special Education, 4(3), 40-42.

Warland, R. H., & Sample, J. (1973). Response certainty as a moderator variable in attitude performance. Rural Reports, 38, 314.

Woodrow, J. E. J. (1990). Locus of control and student teacher computer attitudes. Computer and Education, 14(5), 421-432.

Wu, Y. K., & Morgan, M. (1989). Computer use, computer attitudes, and gender: Differential implications of micro and mainframe usage among college students. Journal or Research on Computing in Education, 22(2), 229-240.

Zajonc, R. B. (1968). Cognitive theories in social psychology.

In G. Lindzey and E. Aronson (Eds.), The Handbook of Social Psychology, (2nd ed.), Vol 1, pp. 320-411. Reading, MA: Addison-Wesley.

Table 1

Means and Standard Deviations for Cognitive Attitudes (N=616)

Mean	SD[a]	IC[b]	Item	**Student Subscale**
6.0	.9	.47	1.	Computers would motivate students.
5.3	1.4	.51	[c]14.	Computer would significantly improve the overall quality of my students' education.
5.0	1.5	.47	4.	Computer would help students improve their writing.
5.1	1.3	.56	12.	Computers would stimulate creativity in students.
4.7	1.5	.45	9.	Computers would help students work with one another.
5.2	.5	.73[d]		**Total Subscale**

Mean	SD	IC	Item	**Personal Subscale**
5.9	1.2	.61	2.	Computers would help me organize my work.
5.8	1.1	.58	[c]3.	Computers would increase my productivity.
5.7	1.4	.60	[c]6.	Computers would save me time.
5.5	1.3	.52	5.	Computers would help me learn.
5.2	1.6	.43	[c]7.	Computers would help me organize my finances.

5.6	.3	.77[d]		**Total Subscale**

Table 1 (cont)

Mean	SD	IC	Item	**General Subscale**
6.1	1.1	.42	13.	Computers improve the speed and quality of financial transactions (banking, VISA, stock market, billing).
5.2	1.5	.36	[c]8.	Computers improve the overall quality of service at stores.
5.2	1.2	.51	[c]11.	Computers solve more problems than they cause.
5.1	1.3	.50	15.	Computer provide us with better quality products.
4.8	1.3	.51	10.	Computers improve the overall quality of life.
5.2	.5	.70[d]		**Total Subscale**

Note. Item means can range from 1 (Strongly disagree) to 7 (Strongly Agree) [a]Standard deviation. [b]Item-total correlation. [c]These items were worded negatively in the original questionnaire. [d]Cronbach alpha coefficient for subscale.

Table 2

Varimax Rotated Factor Loadings for Cognitive Attitude Subscales

Subscale	Item	Factor 1	Factor 2	Factor 3
Student	12.	.77		
	9.	.69		
	1.	.56		
	4.	.53		
	14.	.52		
Personal	2.		.73	
	6.		.69	
	3.		.69	
	7.		.65	
	5.	.55	.45	
General	15.			.74
	13.			.66
	10.	.44		.61
	11.			.51
	8.		.44	.48

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	5.17	34.4	34.4
2	1.35	9.0	43.5

3	1.07	7.2	50.6

Note. Only factor loadings >= .40 are included in the table.

Table 3

Means, Standard Deviations, and Factor Analysis for Attitude Scale (N=593)

Mean	SD[a]	IC[b]	Item	**Affective Attitude**
5.7	1.2	.66	1.	Unlikable - Likable
5.4	1.5	.62	3.	Bad - Good
5.2	1.2	.71	2.	Unhappy - Happy
5.1	1.4	.74	4.	Pleasant - Unpleasant
5.0	1.4	.57	9.	Dull - Exciting
4.7	1.4	.59	6.	Uncomfortable - Comfortable
4.7	1.2	.58	8.	Empty - Full
4.7	1.3	.66	10.	Suffocating - Fresh
4.3	1.5	.60	5.	Tense - Calm
4.0	1.4	.53	7.	Artificial - Natural
4.9	.5	.88[c]		**Total Subscale**

FACTOR MATRIX:

Item	Loading
4.	.79682
2.	.79081
1.	.75089
10.	.73499

3.	.69888
6.	.67698

Table 3 (cont)

5.	.67348
8.	.66284
9.	.65307
7.	.61072

FACTOR	EIGENVALUE	PCT OF VAR
1	5.00350	50.0

Note. Means can range from 1 to 7 scale. High score represent positive attitudes

[a]Standard deviation. [b]Item-total correlation. [c]Cronbach alpha coefficient for subscale

Table 4

Means, Standard Deviations and Factor Analysis for Behavioral Attitudes Subscale (N=544)

CLASS Mean(SD[a])	IC[b]	**HOME** Mean(SD[a])	IC[b]	Item	**Behavioral Attitudes**
5.4(1.8)	.66	4.7(2.5)	.83	1.	Use a word processor.
5.4(1.6)	.77	4.4(2.4)	.90	2.	Use a computer on a regular basis.
5.4(1.7)	.72	3.8(2.3)	.81	7.	Work with computer-aided instruction.
5.2(1.8)	.75	4.4(2.4)	.87	3.	Do a significant task on a computer.
5.1(1.9)	.78	3.8(2.3)	.87	6.	Investigate different kinds of software.
5.1(1.8)	.74	3.8(2.3)	.87	8.	Experiment with a new computer software package.
5.0(1.9)	.75	4.2(2.4)	.87	5.	Use an disk operating system (DOS).
4.7(1.9)	.65	3.6(2.3)	.80	9.	Work with a computer graphics package.
4.6(2.1)	.67	4.2(2.4)	.86	4.	Buy or borrow computer software or hardware.
5.1(.3)	.92*	4.1(.4)	.97[c]		**Total Subscale**

VARIMAX ROTATED FACTOR MATRIX:

SUBSCALE	ITEM	FACTOR 1	FACTOR 2
Home	2.	.90	
	3.	.88	
	1.	.86	
	5.	.86	

	8.	.86	

Table 4 (cont)

	6.	.86	
	4.	.85	
	9.	.81	
	7.	.80	
Class	2.		.82
	6.		.80
	3.		.81
	8.		.78
	7.		.78
	5.		.77
	1.		.71
	9.		.70
	4.		.68

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	9.3	51.8	51.8
2	3.3	18.3	70.1

Note. Only factor loadings >= .40 are included in the table.

[a]Standard deviation. [b]Item-total correlation. [c]Cronbach alpha coefficient for subscale.

Table 5

Means, Standard Deviations, and Factor Analysis for Perceived Control Subscale (N=618)

Mean	SD[a]	IC[b]	Item	**Perceived Control**
4.2	1.7	.62	3.	I could probably teach myself most of the things I need to know about computers.
4.2	1.6	.70	4.	I can make the computer do what I want it to do.
4.0	1.6	.73	6.	If I had a problem using the computer, I could solve it one way or another.
3.8	1.7	.72	5.	I am in complete control when I use the computer.
3.6	1.9	.73	[c]1.	I do not need an experienced person nearby when I use a computer
3.6	1.8	.72	[c]2.	I do not need someone to tell me the best way to use a computer
3.5	1.7	.59	7.	I would prefer to learn new computer software packages on my own.
3.8	.3	.89[d]		**Total Subscale**

FACTOR MATRIX:

ITEM	FACTOR 1
6	.82
5	.82

1	.81
2	.80

Table 5 (cont)

4	.79
3	.72
7	.69

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	4.25	60.8	60.8

Note: Means can range from 1 to 7 scale. High scores represent a stronger sense of control. Only factor loading >= .41 are included in the table. [a]Standard deviation. [b]Item-total correlation. [c]These items were worded negatively in the original questionnaire. [d]Cronbach alpha coefficient for the subscale

Table 6

Oblique Rotated Pattern Matrix for Computer Attitude Measure

	FAC 1	FAC 2	FAC 3	FAC 4	FAC 5	FAC 6	FAC 7
BH2[a]	.92						
BH3	.89						
BH1	.89						
BH5	.88						
BH4	.88						
BH8	.87						
BH6	.86						
BH7	.84						
BH9	.82						
PC2[b]		.79					
PC1		.78					
PC6		.75					
PC5		.74					
PC4		.73					
PC3		.73					
PC7		.67					
STU12[c]		.77					
STU9			.75				
STU4			.48				
STU1			.47				
PER5			.45				
STU14			.43				

Table 6 (cont)

BC2[a]	.82		
BC6	.81		
BC3	.80		
BC7	.80		
BC8	.80		
BC5	.78		
BC1	.70		
BC9	.70		
BC4	.66		
A4[d]		.82	
A9		.73	
A3		.73	
A10		.69	
A2		.65	
A8		.60	
A1		.57	
A5		.49	
A7		.43	
A6		.41	
PER3[f]			.66
PER7			.63
PER6			.62
PER2			.57

GEN15[g]	.74	
GEN13		.65
GEN10		.57
GEN8		.47
GEN11		.38

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	14.1	28.2	28.2
2	4.3	8.7	36.9
3	3.9	7.9	44.8
4	3.2	6.5	51.3
5	2.0	3.9	55.2
6	1.3	2.7	57.9
7	1.1	2.2	60.1

Note. Only factor loadings >= .40 are included in the table. [a]BH stands for behavioral attitudes in the home. [b]PC stands for perceived control. [c]STU stands for cognitive attitudes regarding students. [d]BC stands for behavioral attitudes in the class. [e]A stands for affective attitudes. [f]PER stands for cognitive attitudes regarding personal use. [g]GEN stands for general cognitive attitudes.

Table 7

Correlations Among CAM Subscales

	Total Scale	Aff	Home (Beh)	Class (Beh)	Stud (Cog)	Per (Cog)	Gen (Cog)	Cont
Total	1.00	.71	.82	.75	.55	.65	.55	.52
Affective		1.00	.41	.43	.34	.45	.32	.58
Home (Beh)			1.00	.48	.23	.38	.27	.39
Class (Beh)				1.00	.32	.35	.27	.34
Student (Cog)					1.00	.55	.57	.19
Personal (Cog)						1.00	.53	.23
General (Cog)							1.00	.18
Perceived Control								1.00

Note. All correlations are significant at $p < .001$

Table 8

Correlations Among Computer Attitude Subscales and Computer Ability Subscales

	Total Scale	Aff	Home (Beh)	Class (Beh)	Stud (Cog)	Per (Cog)	Gen (Cog)	Cont
Total Ability	.60	.57	.46	.41	.26	.27	.26	.88
Awareness	.55	.47	.42	.37	.26	.27	.26	.66
Applied Abil.	.58	.50	.49	.39	.26	.30	.24	.71
Program Abil.	.37	.36	.27	.29	.15	.12 *	.17	.56

Note. All correlations are significant at $p < .001$ except those with an asterix

* - Significant at $p < .01$