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A Theoretical and Empirical Survey of Computer Attitudes

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For years, research on the impact of students' attitudes on learning has maintained a spot amongst the most highly discussed topics in education. Particularly, over the past decades, researchers have made great strides in better understanding attitudes toward computers. This article presents a critical review of the current state of research by re-examining how attitudes toward computers have been studied. First, the review introduces an overview of the theoretical foundations and the origins of research on attitudes toward computers. Then, the article summarizes previous literature and knowledge about computer attitudes and provides a review of major findings from research on the effects of some factors affecting the formation of computer attitudes. The discussion reveals a number of major issues and challenges, which include unclear characterization of computer attitudes, problems with measurement tools, and the lack of studies using methods other than brief questionnaires. The unsolved problems cause conflicting, inconsistent and inconclusive results and affect interpretation in the study of computer attitudes. The article also suggests the main recent and future directions of research on attitudes toward computers. Finally, it concludes by providing implications for educators.

Keywords : computer attitudes, research on computer attitudes

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Introduction

The importance of raising awareness about computer attitudes among students and factors influencing those computer attitudes cannot be exaggerated. It is particularly crucial in keeping pace with the widespread and rapid diffusion of supplicated computer technologies in our daily lives. Thus, knowing the sources of computer attitudes would be a tremendous help in developing appropriate strategies, interventions, and successful integrated curricular to better serve students (Levine & Donitsa-Schmidt, 1998).

However, despite a growing interest in student attitudes toward educational technology, which has resulted from the widespread and rapid diffusion of sophisticated computer technologies in our daily lives, existing research on computer attitudes has faced several challenges that must be adequately addressed. These challenges include, but are not limited to, (a) little agreement regarding the definition of computer attitudes and related concepts (Garland & Noyes, 2008; Kay 1993), (b) overemphasis on outcome-oriented research trends rather than process-oriented research focused on how attitudes develop (Kay, 1992), (c) problems with measurement tools such as questionnaires and attitudes rating scales (Huang, 2003).

The purpose of this article is to present a critical review of computer attitudes. Specifically, this review will focus on five questions:

1. What do theory and research tell us about attitudes in general?
2. What are the theoretical foundations of research on attitudes toward computers?
3. What do research findings about attitudes toward computers conflict across studies?
4. According to existing research, what are the singular and interactive influences of gender, computer ownership, age and computer experience on attitudes toward computers?
5. What can researchers and educators learn from existing research on attitudes toward computers?

Concept and Theoretical Background

Background on computer attitudes

Research on attitudes in general has been extensively carried out since the early 20th century in various fields of study. Particularly during World War II, the concept of attitudes greatly sparked the interest of psychologists' due to its relationship with behavior change (i.e., propaganda) (Simonson& Maushak,1996). Education researchers have devoted their attention to the vital role of attitudes in the process of learning and learning outcomes (Levine & Donitsa-Schmidt, 1998). In the field of educational technology, special emphasis has been placed on how attitudes affect enhancing students' use and knowledge of computer applications (Levine & Donitsa-Schmidt, 1998; Woodrow, 1994). In other words, with respect to their relationships with computer literacy, students' attitudes toward computers are seen as a "critical determinant" of the acceptance of computer technologies (Smith, Caputi, & Rawstorne, 2000), students' commitment to the use of computers (Kay, 1992), students' perceived computer skills (Schneeberger & Nesler, 2006), and the choice of careers (Busch, 1995). Moreover, positive attitudes toward computing are thought to be the first and foremost component in promoting computer literacy (Bear, Richards, & Lancaster, 1987; Simonson, Maurer, Montag-Toradi, & Whitaker, 1987; Woodrow, 1994) and a key indicator of the successful implementation of the effective computer systems (Al-Khaldi & Al-Jabri, 1998; Huang & Liaw, 2005; Teo, 2008). Putting it differently, it is possible to assume that negative attitudes may hinder individuals from fully enjoying recent technological developments and actively using computers as a professional tool for learning and working (Omar, 1992; Pope-Davis & Vispoel, 1993).

Definition of attitudes

Although social scientists and educators have a hard time coming up with a clear

definition of the concept due to the latent nature of attitudes, they have consistently tried to conceptualize attitudes (Simonson & Maushak, 1996). Eagly and Chaiken (1993) see attitude as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor." More specifically, Zimbardo and Leippe (1991) define attitudes as "an evaluative disposition toward some object based upon cognitions, affective reactions, behavioral intentions, and past behaviors" that can influence cognitions, affective response, and future intentions and behaviors."

In the area of educational computing, computer attitudes have been characterized in a vague way in part because of "the lack of a clear conceptualization of computers and computer use" (Worthington & Zhao, 1999). Indeed, Kay (1992) calls for a clear definition of the computer attitude construct, pointing out that computer attitudes have been defined in 14 different ways; acceptance, affect, cognition, comfort, confidence, courses, interest, liking, locus of control, motivation, programming, training, case scenarios, and stereotypes. Smith, Caputi and Rawstorne (2000) also criticize the fact that there was no single, universally accepted definition of computer attitudes despite recent recognition and popularity. They define computer attitudes as "a person's general evaluation or feeling of favorableness or unfavorableness toward computer technologies (i.e., attitude toward objects) and specific computer-related activities (i.e., attitude toward behaviors)."

Theoretical framework for attitudes toward computers

Understanding an established social psychological model of attitudes and human behavior is crucial in explaining the effect of attitudes on behavioral intentions and actual behavior in the future (Klobas & Clyde, 2000; Levine & Donitsa-Schmidt, 1998; Teo, 2008). The most influential framework in analyzing the possible relationships between attitudes and behavior is Fishbein and Ajzen's (1975) Theory

of Reasoned Action(TRA), which includes: (a) behavior is determined by the intention to engage in the behavior, (b) intention is determined by attitude toward the behavior and the subjective norm to which the attitude is related, (c) attitude is determined by behavioral beliefs and evaluation of the likely outcomes of a behavior, and (d) subjective norms are determined by the normative beliefs of the person and the motivation to comply with the relevant actions (Simonson & Maushak, 1996, p. 994). In other words, beliefs about an object lead to attitudes toward it, which influences on behavioral intentions concerning the object. Then, the intentions affect actual behavior toward the object and that behavior goes back to beliefs about the object with modification (Gardner, Dukes & Discenza, 1994).

Based on the TRA, Levine and Donitsa-Schmidt (1998) built a comprehensive causal model that consists of a number of variables, such as computer-related attitudes, beliefs in own ability to work with computers, computer experience, and self-perceived computer knowledge. The model suggests that attitudes toward computer use influence the user's behavioral intentions (future desire), which affects actual computer usage (experience). Furthermore, in an investigation of 309 students in grades 7 through 12, they found that computer experience was positively related to computer confidence and attitudes, and those variables had significantly positive effects on computer knowledge.

In addition, under the influence of the TRA theory, numerous researchers have suggested a "multidimensional approach" to the study of computer attitudes. For example, according to Zimbardo and Leippe (1991), attitude consists of (a) affective responses, (b) cognitions, (c) behaviors, and (d) behavioral intentions. The affective responses indicate one's emotion, feelings or evaluation of a certain situation or object. The cognitions reflect one's knowledge and/or awareness of the situation or object. The behaviors involve what one actually does with respect to the situation or object. Finally, the behavioral intentions reflect what one plans to do, regardless of actualization. Those four components are closely interconnected in the formation of the attitude construct (Simonson & Maushak, 1996).

Research

Research methodology and instruments

The most popular research technique adopted in measuring computer attitudes is a quantitative approach using questionnaires, either an existing attitude questionnaire or a self-designed questionnaire. In most cases, computer attitudes are measured by a Likert-type questionnaire, consisting of a number of constructs and statements per each construct included (Leutner & Weinsier, 1994). However, there are growing concerns that many individual researchers have attempted to develop their own questionnaires without having sufficient characterization of computer attitudes, the contexts of computer use, and a population of interest (Roussos, 2007; Schulenberg & Melton, 2008; Shaft, Sharfman, & Wu; 2004; Teo & Noyes, 2008). According to Christensen and Knezek (2000), it has been reported that approximately 14 instruments have acceptable measurement properties in the literature, including the Bath Country Computer Attitudes (Bear, Richards, & Lancaster, 1987), the Computer Attitude Questionnaire (Knezek & Miyashita, 1994), the Minnesota Computer Literacy and Awareness Assessment instrument (Anderson, Krohn, & Sandman, 1980), Computer Survey (Stevens, 1982), Attitudes Toward Computers (Reece & Gable, 1982), Computer Attitudes Scale (Loyd & Gressard, 1984), Computer Attitudes Scale for Secondary Students (Jones & Clarke, 1994), E-mail attitude survey (D'Souza, 1992), and Computer Use Questionnaire (Griswold, 1983).

Yet, the instruments listed above were developed many years ago. In the intervening years, the definition of "computer literacy has been transformed from programming into using applications" (Worthington & Zhao, 1999, p. 304) and computer user's beliefs, self-images, self-efficacy and attitudes toward computers have also changed accordingly. Thus, instruments that can account for today's issues and historical contexts are needed to figure out what we should do with the

results of the research on computer attitudes (Garland & Noyes, 2008; Worthington & Zhao, 1999).

In addition, the extent to which the instrument is reliable and valid is another issue. In fact, criticizing the fact that a number of existing instruments have failed to provide sufficient information on the reliability and validity, Francis and Evans (1995) assert that the presence of such psychometric characteristics are very important to clarify a profile of the factors associated with variation in computer attitudes.

Of the instruments listed above, the Computer Attitude Scale (CAS) (Loyd & Gressard, 1984) has been used most frequently. The CAS consists of four subscales: computer anxiety, confidence, liking, and usefulness. Computer anxiety measures anxiety or fear of computers; computer confidence measures the ability to use or learn about computers; computer liking measures liking or enjoying working with computers; and, computer usefulness measures the degree of perceived usefulness of using computers for present and future work. In Woodrow's (1991) study that compares and tests the reliability and factorial validity of four computer attitudes scales, the CAS shows the highest reliability coefficient at .94. She particularly recommends the CAS for computer novices and pre-service teachers due to its main focus on affective and behavioral components. In reality, it has been widely used with adults, professional educators and college students around the world. Moreover, it is often used as an assessment tool to find the reliability, validity, and the intercorrelations of other instruments (Nash & Moroz, 1997; Woodrow, 1991).

However, this popular instrument has faced as much criticism as it has fame. One of the major concerns is that the underlying construct is not clear in spite of its high internal consistency and reliability (Garland & Noyes, 2004). A number of studies suggest that anxiety and confidence should be treated as the same construct (Nash & Moroz, 1997; Woodrow, 1991) rather than two separate subscales, demonstrating their high correlations (Pope-Davis & Vispoel, 1993). Moreover,

researchers argue that computer confidence should be separated from computer attitudes since they present different psychological constructs. According to Levine and Donitsa-Schmidt's (1998) causal model, computer self-confidence is more structurally related to computer self-efficacy and anxiety than to computer attitudes. Furthermore, it has been suggested that theoretical foundations underpinning the dimensionality of the CAS should be reexamined because it measures only two domains, affect and behavior, not including cognitive components (Woodrow, 1991). In addition, on the basis of Ajzen's (1988) observation that perceived behavioral control has a significant impact on motivation and behavior, Kay (1993) recommends that an attitude measurement should include perceived control.

Since a number of different questionnaires on computer attitudes are available, choosing an appropriate instrument is a daunting task to educators and researchers. To choose the right one for a certain population in a certain context, detailed information such as the validity and reliability of an instrument should be obtained and carefully examined before its administration (Woodrow, 1991).

Factors affecting students' attitudes toward computers

Research has demonstrated close relationships between computer attitudes and some variables (e.g., gender, age, nationality, home ownership of computers, learning styles, self-efficacy, experience and computer knowledge). In this section, a review of major findings from recent studies on the effects of four variables, gender, computer ownership, age and experience, will be provided. Other possible influencing variables are beyond the scope of this brief section.

Gender

Gender has been the most frequently researched variable in studies on computer attitudes for the past decades. However, research on gender differences in computer attitudes has produced inconclusive, conflicting results because of the

multidimensional nature of gender differences in computer attitudes (Shashaani, 1997), different questionnaires measuring different aspects of attitudes (Whitley, 1997), and gender differences as the outcome of the interplay with other psychological and sociocultural variables (North & Noyes, 2002). It is also reported that the mixed results associated with gender in computer attitude research become more salient when other variables (e.g., age, gender) are added to the equation (Busch, 1995).

With respect to gender disparities in computer use, research has generally indicated that males tend to have more experience than females in programming and playing games, spend more hours with computers at home and at school, hold more positive attitudes toward technological innovations, and feel more comfortable and competent with computers (Bain & Rice, 2006; Kirkpatrick & Cuban, 2000; Mitra, LaFrance, & McCullough, 2001; Whitley, 1997). Also, it is found that female students are more likely to use computers for school work and networking with people (e.g., email and chatting) while male students are more likely to use computers for games (Bain & Rice, 2006; North and Noyes, 2002). In addition, male students reported themselves to be more appropriate for computer-related tasks than female students (Shashaani, 1997; Whitley, 1997).

A research question addressed most frequently is whether the gender gap exists in computer attitudes. It is also the question that has been the most controversial. While a significant body of research reports that males tend to hold more positive attitudes toward computers than females (Colley & Comber, 2003; Schumacher & Morahan-Martin, 2001; Shashanni, 1997; Young, 2000), other studies shows little or no difference in computer attitudes with regard to gender (Bovée, Voogt, & Meelissen, 2007; Jennings & Onwuegbuzie, 2001; Shapka & Ferrari, 2003; Teo, 2008). Despite the discrepant results, recent research indicates that, while still present in some areas (e.g., computer confidence), the gender differences in computer attitudes have diminished over the years due to increased exposure to computers (Bain & Rice, 2006; Popovich, Gullekson, Morris, & Morse, 2008; Teo,

2008).

Then, if it exists, what really results from the computer gender gap? To find the reason for the gender disparities in computer access, use, and attitudes, researchers have been looking into various social and psychological factors, assuming that the gender disparities in computers is a product of multiple factors (Kirkpatrick & Cuban, 2000; Shashaani, 1997). They suggest that gender differences in computer attitudes begin very early as children as a result of the social and cultural environment (Shashaani, 1997), the process of socialization (Busch, 1995; Whitley, 1997), the lack of female role models (Young, 2000), and people's perceptions, attitudes and behaviors (Shashaani, 1997). All of these are basically rooted in the socialization theory. With respect to the process of socialization, Busch (1995) suggests that the computer gender gap mirrors different social experiences. In this regard, it has been reported that parental encouragement is a critical factor in the development of computer attitudes (Shashaani, 1997). That is, it is expected that those who receive more encouragement from their parents become more interested in computers, more self-confident in working with computers, and perceive computers as more useful. Furthermore, Kirkpatrick and Cuban (2000) maintain that the lack of role models for female students could discourage them from participating in computer-related tasks and activities. They also criticize society's tendency to see computers and computer programs as a male enterprise, providing research findings that computer-related magazines and computer game software present males more often than females, and that after-school camps and clubs are dominated by male students.

Amid remarkable research endeavors and theoretical interests in the effects of gender differences on computer attitudes, Kay (1992) cautiously warns researchers of an overemphasis on the gender differences in the formation of attitudes toward computers, stating that "gender is but one piece of the human-computer interaction puzzle (p. 167)."

Computer Ownership

The role of computer ownership in the formation of computer attitudes is rather straightforward compared to other variables. Generally, it has been determined that the presence of computers in the home is positively correlated with students' computer attitudes (Levin & Donitsa-Schmidt, 1998; Schumacher & Morahan-Martin, 2001; Shashaani, 1997; Teo, 2008; Yaghi, 1997), computer experience (Nichols, 1992; Garland & Noyes, 2004) and computer knowledge (Geissler & Horridge, 1993). It is also found that those who own computers at home have lower computer anxiety than those who do not own computers at home (Teo, 2008).

The ownership issue is particularly important in that it closely relates to gender, socioeconomic status, parental support, and geographic areas. With respect to gender, several researchers have indicated that male students are more likely to own a computer than female students (Schumacher & Morahan-Martin, 2001; Shashaani, 1997; Woodrow, 1994). Yaghi (1997) asserts that gender and home ownership of a computer are two key factors influencing computer attitudes. Levine and Donitsa-Schimidt (1998) stress the importance of family support, reporting that the effect of computer ownership on computer attitudes is greater than the effect of computer use at school.

However, one should keep in mind that the presence of computers at home does not always lead to its utilization, positive experience and knowledge acquisition. Woodrow (1994) advise that parents should be aware of the ways in which their children use computers at home and help them gain sound experience in dealing with computers.

Age

Age has been examined in numerous studies on computer attitudes, particularly its relationship with actual computer use. When reviewing the research on the relationship between age and computer attitudes, it is obvious that the relationship

has drawn a complicated picture. While some researchers have suggested that teens and young adults are likely to have more favorable computer attitudes, greater self-efficacy, and lower anxiety than older students (Colley & Crombер, 2003; Huang, 2003; Pope-Davis & Twing, 1991), others have claimed that age has little to do with computer attitudes and performance (Klein, Knupfer, & Crooks, 1993; Massoud, 1991; Roussos, 2007). These mixed results might result from the possible interaction between age and computer experience (Huang, 2003; Woodrow, 1994). Putting it differently, as one gets older, one is likely to get through more computer-related experience and general cognitive growth, which in turn causes changes in attitudes toward computers, either positively or negatively.

Computer experience

A growing body of research focuses on the possible impact of computer experience on students' attitudes toward computers, either positive (Al-Khaldi & Al-Jabri, 1998; Gardner, Dukes, & Discenza, 1993; Levine & Donitsa-Schmidt, 1998; Mitra & Steffensmeier, 2000) or negative (McKinnon, Nolan, & Sinclair, 2000). In other words, no general agreement has been reached with regard to causal relationships between computer experience and computer attitudes (Garland & Noyes, 2004). This lack of consensus is related to the poor definition of computer experience used in the literature, the failure to differentiate computer experience and computer use, and other intervening, uncontrolled variables (Garland & Noyes, 2004; Mitra & Steffensmeier, 2000; Smith, Caputi, & Rawstorne, 2000).

Shashaani (1994) suggests that the relationship between computer experience and computer attitudes depends on the way in which the experience is measured and the components the attitude construct includes. In this regard, Mitra and Steffensmeier (2000) find four different ways to interpret the relationships between computer experience and attitudes toward computers: a relationship between (a) the amount and quality of computer and computer attitudes, (b) access to computers and computer attitudes, (c) length of computer use and attitudes toward

computers, and (d) the category of computer use and different categories of attitude toward computers.

The general research findings indicate that experienced students are likely to have lower computer anxiety (Mitra & Steffensmeier, 2000), and more positive attitudes toward computers (Roussos, 2007; Shashaani 1997; Woodrow, 1994). Furthermore, Levine and Donitsa-Schmidt (1998) find that sufficient computer experience leads to more knowledge of computer applications. Their causal model corroborates that computer experience is positively related to attitudes toward computers and has a positive effect on computer confidence.

However, some researchers provide evidence showing that certain types of experience with computers may increase negative computer attitudes and anxiety, and decrease motivation (Gardner et al., 1993; McKinnon, Nolan, & Sinclair, 2000; Pope-Davis & Vispoel, 1993). For example, in a five-year longitudinal study with secondary students in New Zealand, McKinnon, Nolan and Sinclair (2000) report that the students began to take computer technology for granted after passing the stage of initial fascination about the new environment. Thus, the authors suggest that computer technology should be used as "a means to an end" rather than a motivating factor.

Implications and Conclusion

Implications for future research

First of all, there is a need for a clear definition of the computer attitude construct and related concepts. Without a unified definition, inconclusive, inconsistent and mixed findings from research are inevitable.

Secondly, with regard to the computer attitude scales, researchers must make endeavors to re-examine theoretical frameworks for the various constructs in

computer attitude instruments. In addition, more replication studies using diverse populations and sample sizes are necessary to confirm the reliability and validity of the instrument already obtained.

Thirdly, instead of looking at isolated variables in relation to computer attitudes, a comprehensive examination is needed of the relationships among both computer-related and non-computer related factors, and their influences on the formation of computer attitudes (Garland & Noyes, 2004). Also, longitudinal research is desirable to find answers to emerging questions such as "Does attitude change over time?" and "If so, what might affect the attitude change?"

Finally, despite its considerable size, research on computer attitudes is not diverse in terms of methodological approach. If researchers take more diverse approaches (e.g., qualitative, contextual, fundamental and developmental approaches) to studying computer attitudes, the whole puzzle of human-computer interaction will be better completed (Kay, 1992).

Implications for educational practice

Educators must strive to ensure that schools obtain sufficient computer-based technologies. The lack of access and facilities not only impedes students' opportunities to develop adequate computer skills and positive attitudes, but also leads to teachers using less technology in the classroom (Hunt & Bohlin, 1993).

Moreover, teachers should make every effort to create well-designed learning environments that enhances students' positive attitudes toward computers. To this end, they should become confident in dealing with computers and have positive computer attitudes so that students can model their teachers with regard to those of positive computer attitudes, skills and knowledge (Gardner et al., 1993).

In addition, given that training significantly increases computer attitudes and self-efficacy for both males and females (Torkzadeh & Van Dyke, 2002), special attention must be paid to the ways in which computer training is delivered.

Offering sporadic computer sessions and/or just introducing technology into the curriculum won't benefit students in exploring and adopting new technology that leads to more learning opportunities (Yaghi, 1997) Therefore, the well-planned implementation of computer training sessions and the full integration of technology across the curriculum are needed to promote students' attitudes, motivation and performance (Bain & Rice, 2006; McKinnon, Nolan, & Sinclair, 2000).

Conclusion

In this article, I have attempted to review the existing literature on computer attitudes and describe some problems associated with unclear definitions of computer attitudes, outdated instruments and inconsistent empirical results. Undoubtedly, computer attitudes are "complex phenomena" (Simonson & Mausahk, 1996) interacting with so many other variables. Reviewing the literature has made it clear that the issue of computer attitudes is incredibly complicated, but it is also very important for predicting future use of computer-related technology. Therefore, additional work must be conducted for timely adequate descriptions of computer attitudes that involve rapid changes in user characteristics, computer use and computing environments. It would help us to use the empirical evidence for pedagogical decisions responding to the needs of today's computer users.

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