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ABSTRACT

As educational institutions continue to explore e-learning alternatives and as people continue to choose e-learning over traditional programs, additional empirically-supported research is required to understand the impacts and implications of e-learning. The objective of this study was to investigate the role of age and efficacy on computer usage behaviors and attitudes. The Technology Acceptance Model and Self-Efficacy Theory were used to guide the design of the study. Data were collected using a questionnaire survey administered to high school students and to industry professionals. A total of 676 people of differing ages and backgrounds were analyzed. The findings support the validity and appropriateness of the Technology Acceptance Model and Self-Efficacy Theory for explaining computer usage in academic setting. Furthermore, the results suggest that age plays a strong role in understanding computing behaviors and attitudes. (Contains 31 references.) (Author/MES)

The Role of Age and Efficacy on Technology Acceptance; Implications for E-Learning

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Abstract: As educational institutions continue to explore e-learning alternatives and as people continue to choose e-learning over traditional programs, additional empirically-supported research is required to understand the impacts and implications of e-learning. The objective of this study is to investigate the role of age and efficacy on computer usage behaviors and attitudes. The Technology Acceptance Model and Self-Efficacy Theory were used to guide the design of this study. 676 people of differing ages and backgrounds were analyzed. The findings support the validity and appropriateness of the Technology Acceptance Model and Self-Efficacy Theory for explaining computer usage in an academic setting. Furthermore, the results suggest that age plays is strong role in understanding computing behaviors and attitudes.

Introduction

Technological innovations are changing the landscape of employment. Entire job classifications are disappearing and new, more technologically sophisticated positions are being created. Furthermore, new work-related skills and knowledge are required for nearly every organizational position. Greenspan (2000) notes that these changes are so great that even the US Bureau of Labor Statistics failed to anticipate the dramatic impacts of technology on the workforce. Sadly, these changes are creating unprecedented levels of anxiety and insecurity among people about future employability. Despite having the tightest labor market in over a generation, people are more fearful of losing their jobs today than they were in 1991, at the bottom of the last recession (Greenspan 2000; Warr 1990).

In response to these anxieties many individuals are turning to formal education (Greenspan 2000). However, to balance the demands of work, travel, and family many people are exploring alternatives to traditional classroom educational programs. A relatively new and popular training alternative is e-education.

In 1998, the U.S. Department of Education estimated that 1.4 million people were enrolled in e-learning programs. The number of higher education institutions providing e-learning programs increased 33% between 1995 and 1998 offering approximately 50,000 e-learning courses. During 1998 alone, the number of schools providing e-learning options more than doubled resulting in an estimated 34% of all accredited colleges and universities offering e-learning programs (Weiss 2000).

Despite the popularity and growth of e-learning, little is known about its impacts and implications (Webster et al. 1997). Of particular interest are the criteria and characteristics that contribute to the success of e-learning. System success is often defined as the degree to which a system is accepted and used (Davis et al. 1989). Clearly, if the system is not used neither the institution nor the students will benefit. To understand and study system usage behaviors, several computer acceptance models have been proposed. One of the most influential and widely used models is the technology acceptance model (TAM) (Chau 1996). Igbaria et al. (1989) describe the TAM as not only one of the easiest to use, but also one of the most powerful computer usage models.

The TAM posits that if an individual believes that a system is useful and easy to use, he/she will use the system –thereby making the system a success. Within the e-learning context, for a system to be successful it must be used and it must foster learning. Therefore, in studying the success of an e-learning system, we seek to identify and examine those factors contributing to both system usage and learning. Based on the findings of prior research, we identified two factors of particular importance to both areas –chronological age and efficacy.

E-learning research is in its infancy (Webster et al. 1997). While initial findings suggest that individual characteristics may influence the success of the elearning experience (Grill 1999), no study has theoretically investigated the success of e-learning from an IT acceptance perspective. The objectives of the present study are to investigate the direct and indirect relationships among chronological age, efficacy, perceived ease of use, perceived usefulness, and system usage.

The conceptual model for this study, based on self-efficacy theory and the technology acceptance model, is described in the next section.

Conceptual Model And Research Hypotheses

Technology Acceptance Model

The TAM is based on "the cost-benefit paradigm from behavioral decision theory" (p. 321, Davis 1989). In general, the cost-benefit paradigm posits that human behavior is based on a person's cognitive tradeoff between the effort required to perform an action and the anticipated consequences of completing the action. In particular, the TAM asserts that a person will use a computer if the benefits outweigh the efforts in using the computer. The benefits are assessed by measuring the person's anticipated consequences (a.k.a., perceived usefulness; PERUSE) and effort is assessed by measuring the person's belief that using the system will be easy (a.k.a., perceived ease of use; PEOU) (Davis 1989).

H1a: Perceived Ease of Use has a direct effect on system usage.
H1b: Perceived Usefulness has a direct effect on system usage.
H1c: Perceived Ease of Use has a direct effect on Perceived Usefulness.

Self-Efficacy Theory

Self-efficacy is a measure of one's confidence that he/she is capable of accomplishing a task. Bandura (1997) argues that human behavior is primarily determined by a person's belief that his or her actions will result in positive outcomes (i.e., PERUSE) and that he or she is capable of accomplishing the activity (i.e., self-efficacy).

Human belief systems have been found to be enormously influential in psychology and MIS research. Bandura suggests that "people's motivation, affective states, and actions are based more on what they believe than on what is objectively true" (p. 2, 1997). Similarly, MIS researchers suggest that computer usage is affected more by behavioral influences than by technical factors (Webster et al. 1992). "Effective intellectual functioning requires much more than simply understanding the factual knowledge and reasoning operations for a given activity" (p. 18, Bandura 1995).

In borrowing self-efficacy from cognitive psychology, MIS researchers have defined computer-efficacy as one's general belief that he/she is capable of putting computer technologies to use (Venkatesh et al. 1996; Compeau et al. 1995). Empirical studies show computer-efficacy influencing: technology adoption (Igbaria & Iivari 1995), system usage (Compeau et al. 1995), system ease of use perceptions (Vankatesh et al. 1996), affective states (Igbaria & Iivari 1995), and computer training (Webster et al. 1992).

H2a: Computer-efficacy has a direct effect on system usage.
H2b: Computer-efficacy has a direct effect on Perceived Ease of Use.
H2c: Computer-efficacy has a direct effect on Perceived Usefulness.

Age

The implications and significance of chronological age has been well documented. Age has been shown to influence intelligence (Baltes et al. 1997), information processing ability (Sharit et al. 1994), job-related attitudes, work behaviors, values, needs, and preferences (Rhodes 1983), job satisfaction (Weaver 1980), changing psychological needs (Gibson et al. 1970), outcomes, accomplishment, and extrinsic rewards (Rabinowitz et al. 1981), social pressure and influence (Hall et al.1975), memory (Floyd et al. 1997), attention-span (Plude et al. 1985), IT acceptance (Morris et al. 2000), abilities, traits, and performance (Sharit et al. 1994), task switching (Salthouse et al. 1998), adapting to change (Myers et al. 1992), resolving power in visual systems (Kline et al. 1982), learning (Mead et al. 1998), and finally, auditory and visual signal detection (Forteza et al. 1990).

H3a: Age has a direct effect on system usage
H3b: Age has a direct effect on Perceived Ease of Use
H3c: Age has a direct effect on Perceived Usefulness
H3d: Age has a direct effect on Computer Efficacy

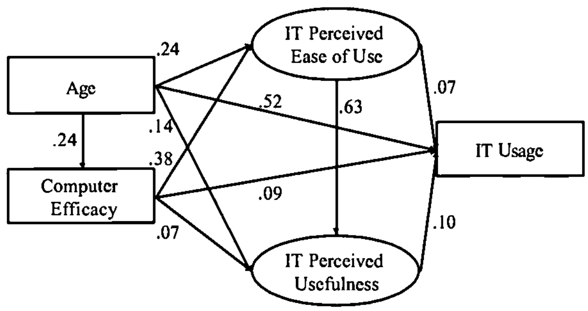

Figure 1. *Research Model*

Research Methodology

Sample and Procedure

The data for this study were collected using a questionnaire survey administered to high school students and to industry professionals. The high school is located in Philadelphia, Pennsylvania and the industry professionals worked for organizations throughout the continental United States of America. The survey was delivered to approximately 700 high school students and 700 industry professionals.

A total of 709 surveys were returned (51% response rate). Of these returned surveys, 33 were incomplete and were excluded from the data. In the end, 676 surveys were deemed usable, representing a final response rate of 48%. This response rate is more than adequate for the chosen data analysis procedure.

Data Analysis

The measurement of all study variables was adapted from prior research. Researchers have tested similar instruments and found the content validity and internal consistency to be satisfactory. The first stage of the data analysis is to assess and reaffirm the reliability of the measures used to operationalize the variables in this study. This involves assessing the contribution and reliability of multiple indicators for this study's latent and manifest variables. The tests for convergent validity, reliability, discriminate validity, and internal consistency were satisfactory. See (Tab. 1) for the results. The second stage of the analysis assesses the proposed conceptual model.

				Discriminate Validity				
	R^2	Average Variance Extracted	Composite Reliability	Age	CEff	PEOU	PERUSE	Use
Computer efficacy	.06	0.51	0.88	.240	.717			
Perceived ease of use	.24	0.70	0.90	.331	.433	.838		
Perceived usefulness	.52	0.80	0.94	.364	.373	.706	.897	
Systems usage	.40	0.84	0.91	.605	.280	.355	.375	.918

Table 1. Measurement Model Validities and Reliabilities

The variable path coefficients represent the total effect that the variable has on the other dependant or mediating variables. This total effect consists of a direct and an indirect effect on the dependant or mediating variable. The non-parametric jackknifing technique (Fenwick 1979) was used in conjunction with t-statistics to determine the statistical significance of the path coefficients. This practice is consistent with prior studies using PLS (e.g., Igbaria et al. 1997).

Results

Tests of the Structural Model

The results of the multivariate test of the structural model are presented in (Fig. 1). The tables show the path coefficients (i.e., standardized regression coefficients) and (Tab. 1) shows the R^2 (i.e., the explained variable) measures. The R^2 measures were significant to at least a p-value of .001, except for computer efficacy, which was not significant to .05. This suggests that the model sufficient explains perceived ease of use, perceived usefulness, and system usage. However, since we analyzed only one determinant of computer efficacy, namely age, we were unable to fully describe the construct. Since explaining computer efficacy was not an objective of the study, it does not impact the findings.

Consistent with hypotheses 1a and 1b perceived ease of use and perceived usefulness significantly effect system usage (β = .07 and β = .10, all p-value < .001). Consistent with hypothesis 1c, perceived ease of use influences perceived usefulness (β = .63, p-value < .001).

Consistent with hypothesis 2a computer-efficacy significantly effects system usage (β = .09, p-value < .001). Consistent with hypotheses 2b and 2c, computer-efficacy influences perceived ease of use and perceived usefulness (β = .38 and β = .07, respectively, all p-value < .001).

Consistent with hypothesis 3a age significantly effects system usage (β = .52, p-value < .001). Similarly, consistent with hypotheses 3b, 3c, and 3d age significantly effects perceived ease of use, perceived usefulness, and computer efficacy (β = .24, β = .24, β = .14, respectively, all p-value < .001).

Discussion

This study integrated the theoretical perspectives of self-efficacy and the technology acceptance model as applied to computer acceptance within educational settings. Furthermore, we investigated the role of age on influencing key acceptance factors such as computer-efficacy, perceived ease of use, and perceived usefulness.

The conceptual model and hypotheses were tested using a structural equation modeling technique, partial least squares.

The results support the use of the technology acceptance model and computer-efficacy within an educational domain. Furthermore, the results indicate that age has a significant direct effect on usage and on the mediating variables (computer-efficacy, perceived ease of use, and perceived usefulness).

Inconsistent with the TAM, which posits that external variables (i.e., age) will influence usage primarily through the mediating variables, age had a very significant direct effect on usage. This anomaly may imply that people are simply required to use computers more as they progress through school and once they enter industry. However, this is unlikely since age has a positive relationship with all variables. The data suggests that people's attitudes and usage increase as a result of age.

Conclusions

This study represents a very early step towards theoretically explaining and empirically testing the role of attitudes on accepting technology within educational settings. The implications for this line of research are farreaching. Based on the results of this study, it appears that age influence the acceptance of technology. If future research is able to validate these findings, e-learning priorities, implementation plans, and e-learning objectives should be adapted. Of particular concern is whether e-learning will discriminate against people based on their biological age. If this is the case, when moving towards e-learning, educational institutions should design different programs for different age groups.

The research design employed in this study was a cross-sectional analysis. While this is typical for survey-based research, the directions for the casual linkages are unknown. As a result, it may be that technology usage develops improved attitudes towards technology rather than visa versa. Longitudinal research can be used to determine the direction of causality. However, regardless of the direction, age is still a significant factor.

The results of this study support using the TAM and computer-efficacy within an academic setting. However, inconsistent with the TAM, age (an external variable) was the single largest determinant of technology usage. Furthermore, the findings presented in this report provide strong support for additional theoretically-oriented, data-supported research within e-learning, in particular the identification and integration of additional external factors (i.e., attitudes and environmental considerations) that influence IT behaviors within an educational setting.

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