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Interest in Information Technology Careers: Testing a Model

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ABSTRACT

This study explores the impacts of computer self-efficacy, computer use, and group orientation on college students' attitudes towards and decisions to pursue information technology careers. Empirical studies have yet to address this specific topic. The study uses a survey method to gather information from a group of randomly selected undergraduate business college students. Confirmatory factor analysis and path analysis suggest computer use and computer self-efficacy are highly correlated to whether or not a student is interested in pursuing a career in information technology. Gender played a role, as males registered higher levels of computer self-efficacy and use than females. Although the study specifically involves college students, the applicability likely reaches to other levels of schooling and the populace in general.

Keywords (Required)

TAM, gender, information technology careers.

INTRODUCTION

Recent years have witnessed a broad decline in computer and technology related enrollments at colleges within the United States (Hoffman 2005). Although IT enrollments increased during the dot com boom of the late 1990's, they began declining with the dot com fallout and U.S. economic recession. Increasing levels of international outsourcing have also likely contributed to the dropping enrollment numbers, as students fear their future jobs might be shipped offshore (Kessler 2004). However, with the rebounding economy, the U.S. now faces a lack of skilled IT workers. Immigration restrictions mean even fewer skilled foreign workers will have the ability to contribute to American brainpower and skill in technical fields. In India, the number of students taking the Graduate Record Exam fell 56% in 2004 from 2003, and in China test-taking fell 52% (Kessler 2004). As a result of this disturbing phenomena, America will be left with a shortage of technically skilled workers in the near future, and demand for college graduates with bachelors degrees in computer science, computer engineering, information science, or MIS will continue to rise (Bureau of Labor 2004; 2005 statistics available May 24 at http://stats.bls.gov/oes/home.htm#overview).

The continuing development of new technologies will result in broad statewide demand for IT workers, even as outsourcing continues. For example, the integration of Internet technologies into business has resulted in a growing need for specialists who can develop and support Internet and intranet applications, and wireless technology has created new systems to be analyzed and new data to be administered. Explosive growth in these areas also is expected to fuel demand for network, data, and communications security specialists (Bureau of Labor 2004).

Although this is a pressing dilemma, the deeper issue of why students choose information technology as a major, without regard to economic demands, is one that has received little direct attention in the literature. The related issue of IT use and the factors that influence it has been a central focus of research within the information technology field. Many of the most useful models that have been constructed in order to help identify factors related to IT use are based on the Technology Acceptance Model (TAM) (Davis, Bagozzi and Warshaw 1989). In most cases, the primary dependent variable is use or intent to use. The number of and relationship between other common model factors such as computer anxiety (Sievert, Albritton, Roper and Clayton, 1988) and computer self-efficacy (Compeau and Higgins, 1995) are more variable. The intent of this paper is to present a model combining the set of related variables that most contributes to a student's decision to pursue information technology as a major. Although the study specifically focuses on college students, the findings likely reach to other levels of schooling and the populace in general.

This paper is organized in the following manner: The next section covers the theoretical background and introduces the model. The following section discusses the methodology used and measurement issues. The results are then discussed, followed by conclusions.

THEORETICAL BACKGROUND

In its simplest form, TAM posits that perceived ease of use and perceived usefulness are the primary independent variables influencing intent to use (Davis et al., 1989). Research has found that a number of other variables moderate the relationship between ease of use/usefulness and actual use/intent to use, such as trait anxiety (Thatcher and Perrewe, 2002), trust (Gefen, Karahanna and Straub, 2003) and type of information system (van der Heijden 2004). The Unified Theory of Acceptance and Use of Technology (UTAUT) has expanded significantly upon the original TAM model in both its scope and its predictive ability (Venkatesh, Morris, Davis and Davis, 2003). UTAUT finds three direct determinants of intention to use: performance expectancy, effort expectancy and social influence. Two direct determinants of usage behavior are intention and facilitating behavior. Significant moderating influences include experience, voluntariness, gender, and age.

The notion of social influence and gender as predictor and moderator of IT use and attitudes is particularly relevant to the dilemma of sub-par IT enrollments. The low percentage of women in technical fields has been cause for social concern, as evidenced by the National Science Foundation's recent funding drive to increase female participation in information technology (NSF Press Release, 2004). Of even greater concern is the effect this trend has on the ability of the United States to remain competitive in a world that is ever more dependent on the skills required to accelerate technological innovation and efficiency. Women now make up 57% of college students in the U.S. (Fletcher 2002), and low interest in IT by female students has resulted in a smaller pool of candidates from which to draw IT employees.

Social influence (Venkatesh et al. 2003) and encouragement by others (Compeau and Higgins, 1995) are two similar constructs found to have an influence on computer use. Focusing on these variables in conjunction with the moderating effect of gender may shed light on the perplexing lack of female presence within IT occupations. Venkatesh and Morris (2000) find that women are more influenced by the social or "subjective" norm, which is to say females tend to conform to group norms more than males. This finding highlights possible gender differences based on the established construct of social influence (Venkatesh et al. 2003). Females are more affected by normative influence, but they perceive it as less imposing than males; they do not view normative influence as pressure, whereas males may view this external influence as a threat to their individuality. The female tendency towards group and relationship orientation as opposed to male task orientation may partially explain why males are more comfortable with computers and use them more often than females (Anderson 1996; Busch 1996; Dickhauser and Stiensmeier-Pelster 2002; Hemby 1998; Robertson, Calder, Fung, Jones and Oshea 1995). A lack of critical mass in regards to female group computer use and socialization may help to explain the discrepancy.

There are significant gender effects associated with computer use, with males experiencing greater computer self efficacy, lower computer anxiety, more positive attitudes towards the Internet and longer use of the Internet than females (Dundell and Haag, 2002). Females experience more negative feelings towards computer technology than do males (Bannert and Arbinger, 1996). This trend is evident not only in the workplace (Dryburgh 2000, Faulkner 2000, Morgan 2000), but in schools as well (Reinen and Plomp, 1997).

Clearly, gender seems to be at least partially responsible for choices regarding career paths, but to posit that males are inherently more adept at information technology tasks may gloss over important individual differences such as personality traits and situational variables that influence user attitudes towards and use of information technology (Agarwal and Prasad, 1999).

MODEL CONSTRUCTS AND HYPOTHESES

Computer Self-Efficacy

Self-efficacy is the self-judged ability to accomplish and execute tasks (Bandura, 1986). Computer self-efficacy (CSE) is the self-judged ability to accomplish and execute tasks involving computers (Compeau and Higgins, 1995). Computer self-efficacy is often related to Computer Anxiety (CA), sometimes as a predictor variable (Igbaria and Iivari, 1995) and sometimes as a predicted variable (Bandura, 1997). Computer anxiety is the fear of possible negative consequences of computer use, such as the loss of important data or other mistakes (Sievert et al. 1988).

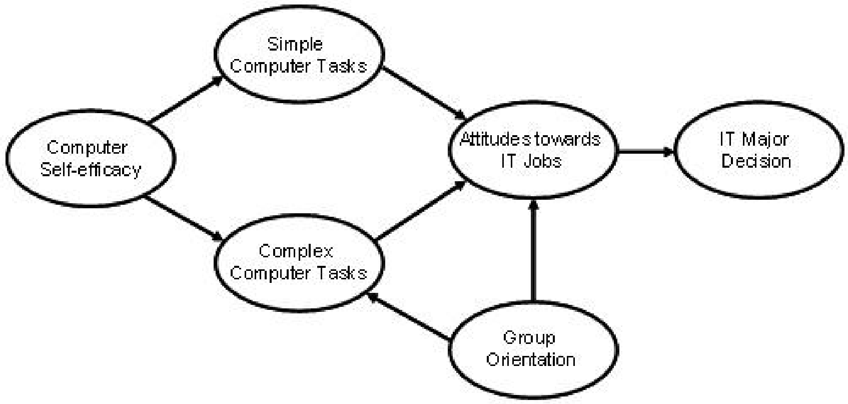

Figure 1.

CA and CSE have been found to have an inverse relationship; as CA grows, CSE and resulting computer use diminishes. Conversely, as CA diminishes, CSE levels and computer use rise (Bandura, 1997). Research indicates computer self-efficacy and computer anxiety have a reciprocal relationship (Marakas and McLean, 1998), with significant correlations between the two (Igbaria and Chakrabarti, 1990). Bandura (1997) also found that efficacy beliefs are the primary influence on decisions about ability to perform tasks or interpretations of experiences, and proposed that because efficacy beliefs are the primary influence on behaviors, it is logical to view computer anxiety as an antecedent to computer self-efficacy.

Apart from its relationship to CSE, CA has been found to have an inverse relationship with computer experience (Liu, Reed and Phillips, 1992). CA has also been found to be the strongest predictor of negative attitude toward computers among demographic, personality, and cognitive style variables (Igbaria and Parasuraman, 1989). Necessary and Parish (1996) found that college students with little or no computer experience had more anxiety toward computers than those who had previous experience.

The model presented in this paper takes Banduras' view that CSE is influenced by CA and thus a closer predictor to computer use than CA. CSE has a more direct impact on attitudes towards IT careers and on actual IT use, as people with higher levels of CSE are more likely to form positive perceptions of IT (Venkatesh and Davis, 1996) and are also more likely to use IT (Compeau, Higgins and Huff, 1999). Because the relationship between CSE and CA has been well-researched in previous models, there is no need to include both constructs in the present model. The positive correlations found between CSE and computer use in past studies results in the first set of hypotheses:

H1a: Higher levels of computer self-efficacy will be positively related to simple computer tasks.

H1b: Higher levels of computer self-efficacy will be positively related to complex computer tasks.

Computer Use

Actual system use is most often the ultimate dependent variable in this particular area of research. However, this study treats use as both a dependent variable (preceded by CSE) and an independent variable (as an antecedent to the decision to pursue IT as a major). Use has been shown to increase with higher levels of CSE (Compeau et al. 1999).

The present study divides computer use into two separate constructs: simple tasks and complex tasks. Computers are increasingly ubiquitous, and college students today are more exposed to computer technology than any previous generation. The number of computer applications that are used has increased dramatically as well, indicating a single construct representing "computer use" may be too narrow. The notion that higher levels of computer use result in more positive attitudes towards IT jobs leads to the following hypotheses:

H2a: Higher levels of simple computer tasks will be positively related to attitudes towards IT jobs.

H2b: Higher levels of complex computer tasks will be positively related to attitudes towards IT jobs.

H1a: Higher levels of computer self-efficacy will be positively related to simple computer tasks.

H1b: Higher levels of computer self-efficacy will be positively related to complex computer tasks.

Group Orientation

Group Orientation is a newly created measure designed to judge whether a person's attitudes towards social groups has an effect on decision to pursue IT as a major. It is somewhat similar to the idea of subjective norm (Fishbein and Ajzen, 1975; Venkatesh and Morris, 2000). Subjective norm is the degree to which a person's behavior is influenced by what the person feels peers believe should be done (Fishbein and Ajzen, 1975). Females are influenced significantly more by subjective norm than are males (Venkatesh and Morris, 2000), implying they tend to assimilate to their social surroundings more than males. A great deal of research has shown that women tend to be more relationship oriented and group-minded, while men tend to be more task oriented and individualistic (Venkatesh and Morris, 2000). The high ratio of women to men in relationship oriented professions such as human relations, teaching, and nursing point to the conclusion that women are more group oriented than men (Skitka and Maslach, 1996), and they value serving and pleasing those around them more than do men (Miller 1986).

Two observations can be made here. The first is that the common view of the average IT worker as a socially aloof "computer nerd" may discourage females from pursuing careers in IT. The second is that high levels of group orientation among females suggests their relative lack of participation in IT may result from a lack of computer oriented socialization patterns during teen and pre-teen years. This observation indicates a "critical mass" of girls interested in computer technology may have to be achieved in order to increase female participation in IT.

H3a: Higher levels of group orientation will be negatively related to complex computer tasks.

H3b: Higher levels of group orientation will be negatively related to attitudes towards IT jobs.

Attitudes towards IT careers

Attitudes has been a central construct in TAM-based research, usually used a predictor of technology usage (Davis et al., 1989). However, the meaning of attitudes in this study are somewhat different because it refers to attitudes towards a particular career, not to the use of a specific technology. Just as more positive user attitudes result in higher likelihood of technology usage, it is expected that more positive attitudes towards IT careers will lead to a higher likelihood of choosing IT as a major.

H4: More positive attitudes towards IT jobs will be positively related to the decision to choose IT as a major.

METHODOLOGY

Sample

The sample consisted of students at a large public university in the Southeastern United States. Respondents completed self-reported questionnaires the last month of the fall semester and the first month of spring semester during regularly scheduled class times. In order to eliminate self-selection bias, there were no incentives offered for participation. A total of 255 surveys were handed out, and 246 (96%) were collected. Due to missing data, 218 surveys (89%) were used in the analysis. The sample consisted of 119 males and 99 females. The discrepancy is due to the overwhelming majority of males (43) to females (22) in the IT major. The IT major was sampled more heavily than others, as it is the major of primary concern in the study.

Measures

Attitudes Towards IT Careers (AIT) and Group Orientation (GRP) are two entirely new constructs and thus the creation of new measures was required. Twelve items were used for AIT, and ten items were used for GRP. After factor analyses, these numbers were reduced to four and five, respectively. The two computer use constructs, simple computer tasks (SCT) and complex computer tasks (CCT), are new constructs as well. Many of the measures used in the past for computer use are outdated and too narrow in the types of computer applications they address. The TAM-based "computer" use constructs deal with specific technologies and are not applicable to this study. CSE used items from the measure tested by Torkzedah and Koufteros (1994). Additional items were added for a total of sixteen items. This number was reduced to eight after factor analysis.

RESULTS

After all the data had been entered, factor analysis was used within constructs to identify the most relevant items within each set. A between-construct factor analysis was then performed, using varimax rotation (see table 1). All cross-loadings were below the .400 level. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) value was .865 with a .000 level of significance, indicating the data is suitable for a factor analysis. The Simple Computer Tasks construct did not have sufficient loadings, and thus was dropped from the model. The resulting model included four latent constructs, measured by a total of 23 items:

1. Computer self-efficacy (8 items)
2. Complex Computer Tasks (6 items)
3. Group Orientation (5 items)
4. Attitudes Towards IT Careers (4 items)

The four factors had eigenvalues of 1.99 and higher, and explain 67.9% of the variance. Discriminant and convergent validity were evaluated by examining each indicator's factor loadings. Convergent validity entails a high single factor loading on the construct in question, and discriminant validity entails low loadings for that same factor on other constructs. Indicators should load higher on the construct of interest than on any other variable. The factor loadings used are high on their respective constructs, and less than .4 on all other constructs, demonstrating adequate discriminant and convergent validity.

	Component			
	1	2	3	4
CSE1	.800			
CSE2	.784			
CSE3	.777			
CSE4	.801			
CSE5	.915			
CSE6	.909			
CSE7	.772			
CSE8	.792			
GRP1		.832		
GRP 2		.858		
GRP 3		.849		
GRP 4		.827		
GRP 5		.850		
GRP 6		.805		
AIT1			.671	
AIT 2			.781	
AIT 3			.798	
AIT 4			.750	
CCT1				.693
CCT2				.756
CCT3				.827
CCT4				.860
CCT5				.725

Table 1

Linear regression between factors was then used for path analysis of the model, to test the strength of the relationships. Figure 2 displays the unstandardized coefficient betas and R squared figures for each relationship. All relationships in the model are statistically significant except for the correlation between GRP and CCT. Overall, the relationships in the model are very weak. Only the relationship from CSE to CCT (.141 R squared) is strong enough to offer substantial support for the model. Thus, only hypothesis 1b was strongly supported. There is a small amount of support for 2b, and the small effects of GRP on AIT and AIT on IT Major Decision were in the opposite direction of what had been hypothesized. Thus, these hypotheses must be rejected.

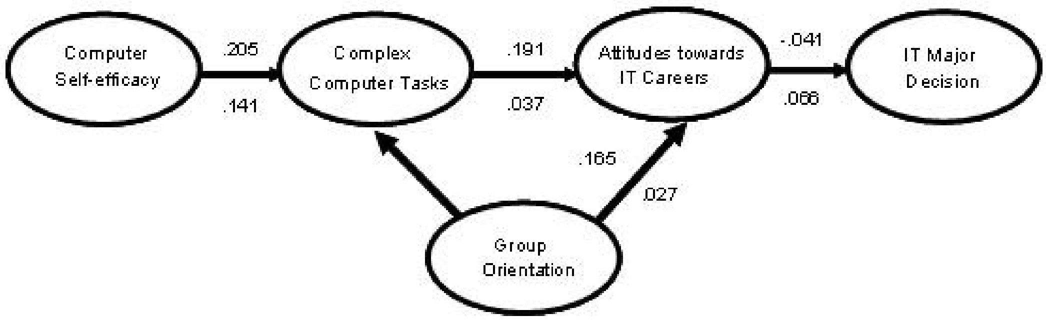

Figure 2

The problematic variables are GRP and AIT. GRP has almost no explanatory power whatsoever. Further testing showed that its relationship with each and every model variable is minimal. The negative relationship between AIT and IT Major Decision is especially interesting, as it had been hypothesized to be positive; more positive attitudes towards IT would seem to result in a higher likelihood of pursuing a career in the field.

A readjustment of the model was explored through the use of further regression testing. A model using CSE and CCT as the sole independent variables resulted in an R squared of .316. Adding combinations of the other two IV's resulted in a maximum R squared of only .335. The most effective models involve only CSE and CCT, and all were statistically significant. The final model is presented in figure 3.

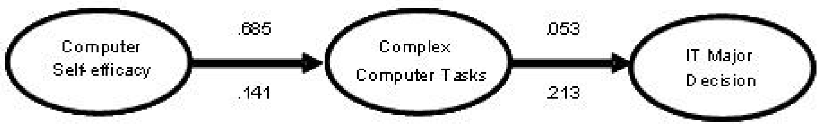

Figure 3

DISCUSSION

There are a number of interesting findings uncovered by this study. The first is the slightly negative relationship between IAT and IT Major. This finding is counterintuitive, as more positive attitudes towards IT would seem to result in a higher likelihood of pursuing a career in the field. However, the tendency to become more realistic regarding subject matter with which one is familiar may explain this paradox. Those who are not majoring in IT may have a more positive view of IT because they are not familiar with the recent IT job market. The four items used to measure IAT asked if respondents found IT jobs to be "flexible," "high-paying," "fulfilling," and "challenging." The minimal difference between IT and non-IT majors does not necessarily indicate a difference in excitement or interest levels. Two items eventually dropped from the IAT construct asked respondents to rate IT careers according to "excitement" and "interest," and IT majors scored noticeably higher on these two items. Clearly, IT majors are more excited about the prospect of working in the IT field, but the model does little to explain what factors contribute to this observation.

Computer use (as measured by CCT) and CSE are clearly related and together explain .316 of the variance in IT Major. They are the strongest predictors of each other and the decision to pursue an IT career. This finding suggests encouraging greater computer use and increasing computer self-efficacy among females may increase their interest in IT. Males scored substantially higher on both measures; mean male CSE was 14% higher than female, and male CCT was 20% higher than female. It should be noted though, that CCT measures only complex computer tasks such as creating multimedia content, using FTP, designing graphics, and editing video. On the twelve original items used to measure simple computer tasks (email, instant messaging, listening to music, writing papers, online shopping, etc), the male and female figures were closer. Males still ranked ahead of females in eleven of twelve categories, but the difference in mean scores exceeded 10% in only two categories (playing games and using chat rooms).

As predicted, females scored 11% higher on group orientation. However, GRP contributed little to the model, and there was only a very small link between GRP and CCT. Based on these findings, it can be concluded that the higher group orientation of females is not a significant factor in explaining their avoidance of IT as a major.

In summary, these results indicate that the gender gap in IT may be due to social influences or innate biological differences. It has been suggested that boys are more strongly encouraged by parents and teachers to go into computer-related disciplines than girls; however, there is no hard evidence to support this notion. In fact, with the explicit female-targeted recruiting done by educational institutions across the nation, it would seem females are actually receiving more encouragement from educational institutions than are males. There is still the possibility that differences are encouraged in the home setting, and this is a topic for further research. The other possibility is that there are innate biological differences in males and females that cause males to naturally be more attracted to computer use and careers. Perhaps it would be more productive for colleges to focus their energy on encouraging males to pursue IT, as males have been shown to have higher degrees of computer use and self-efficacy (Anderson 1996; Busch 1996; Dickhauser and Stiensmeier-Pelster 2002; Hemby 1998; Robertson et al., 1995); according to this study's results, students with higher levels of CSE and computer use are more likely to be interested in IT careers. It is therefore a possibility that the increasing drive to recruit females into science and computer fields may simply be trying to fit a round peg into a square hole. Educators and parents may instead want to focus on encouraging more male participation in science and technical fields, as males appear more likely to be intrinsically interested in the subject. The reason for this apparent higher intrinsic interest is the subject of heated debate, and is beyond the scope of this study.

CONCLUSION

This study found computer self-efficacy and computer use to be significant predictors of the decision to choose IT as a major. Group orientation and attitudes towards IT careers had no significant effect. The difference in computer self-efficacy and computer use between males and females is substantial, indicating there is still research to be done in order to discover the cause of this phenomenon.

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