Predicting Software Self Efficacy among Business Students: A Preliminary Assessment

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ABSTRACT

An empirical study was conducted to investigate demographic predictors of software self-efficacy among undergraduate business students. The relationship between academic major, gender, ACT scores, computer-related experience, family income, and computer anxiety level with software self-efficacy was investigated. The results indicate significant differences in software self-efficacy among students with different majors, amounts of computer-related experience, family income levels, and computer anxiety levels. Although significant differences between students from families with different income levels were found, however no clear patterns were discernable.

Keywords: Software self-efficacy, individual differences, academic disciplines, computer experience, family income, gender, computer anxiety

1. INTRODUCTION

An individual's use of information technology is influenced by many factors. Discovering and understanding these factors has long been a goal of MIS research. (Lucas 1973) In today's business environment, use of information technology by professionals in all functional areas of business organization is ubiquitous. As recent research has emphasized, understanding the differences among students in different academic disciplines is important. (Chung, Schwager et al. 2002) By recognizing differences in self-efficacy among business professionals and students, prescriptive action may be taken by managers to provide proper IT support or by educators to provide proper training to future business professionals.

Self-efficacy has been defined as "the belief that one has the capability to perform a particular behavior. (Compeau and Higgins 1995)" Self-efficacy has been shown to significantly influence a user's attitude toward using computers, a user's anxiety towards using computers, and a user's actual computer use. (Compeau and Higgins 1995) So identifying where differences exist with regard to self-efficacy may help to explain inconsistencies in studies on successful IT usage. Based on Social Cognitive Theory; (Bandura 1986) individuals' behaviors, personal characteristics and the environment are determined reciprocally. This implies that individual characteristics as well as environmental factors will influence constructs like self-efficacy that have been shown to influence IT use.

This paper presents the results of an empirical study that investigates the impact that individual characteristics have on self-efficacy. A review of the theoretical basis for the study and relevant previous research is presented first followed by the research hypotheses. Then the research method, analysis, results and discussion are given with suggestions for future research.

2. SOCIAL COGNITIVE THEORY

Bandura's social cognitive theory is an empirically validated model of individual behavior. (Bandura 1986) The underlying premise of the theory is that an individual's environment, personal characteristics, and behavior are reciprocally determined. The environment would include factors such as social pressures or situational characteristics, e.g. the availability of computer resources. The personal characteristics include cognitive makeup, personality, and demographic characteristics of an individual. The idea of these three constructs (environment, personal characteristics, and behavior) being reciprocally determined provides a very rich explanatory model to investigate individual computer usage. Based on the theory, behavior is

determined by the environment and personal characteristics and in turn affects an individual's selection of environment and changes in their personal characteristics.

A central thrust of social cognitive theory deals with self-efficacy or beliefs about one's ability to perform a specific behavior. It has been shown that self-efficacy influences which behaviors individuals choose to perform, their persistence or effort to overcome obstacles when performing the behavior, and their actual ability to perform the behavior. (Compeau and Higgins 1995) The current research addresses the question of what other personal characteristics influences self-efficacy.

3. LITERATURE REVIEW & HYPOTHESES

3.1 Self-Efficacy

Self-efficacy as a construct has been studied in psychology for many years. (Bandura 1986) It was introduced to the MIS research community in the form of computer self-efficacy. (Compeau and Higgins 1995; Compeau and Higgins 1995) It has been shown to affect users' attitudes towards computers, actual computer usage, levels of anxiety toward computer use, and the outcomes of using computers. (Compeau and Higgins 1995) Studies have shown that self-efficacy is related to computer anxiety and training as well as learning performance and computer literacy. (Beckers and Schmidt 2001; Chou 2001) Research also indicates that increased performance with computer related tasks was significantly related to higher levels of self-efficacy. (Harrison and Rainer 1997) Computer self-efficacy has also been used as a proxy for an individual's internal control in the IT usage context, i.e. a user that has a high level of self-efficacy feels a stronger sense of control over the activities being performed. (Venkatesh and Davis 1996)

Some research has studied the effects of individual differences on self-efficacy, as a proxy for computer skills. (Harrison and Rainer 1992) The results of this study indicate that males, younger aged users, experience, a confidant attitude, lower math anxiety, and a creative cognitive style were associated with higher self-efficacy. Most recently, Chung et al. (Chung, Schwager et al. 2002)studied the differences in self-efficacy among students in the business, education, forest/wildlife, and liberal arts schools of a major university. They found that, in general, business students tend to have higher expectations from computer usage than students in the other disciplines. They also suggest further research into understanding computer self-efficacy.

3.2 Individual Differences and Self-Efficacy

Much early MIS research focused on the effects of individual differences on various IS success constructs and a review is provided by Zmud. (Zmud 1979) Zmud categorized these variables into three groups: demographics, personality, and cognitive style. Demographic variables are personal characteristics such as age, gender, education, and computer experience. Personality variables include an individual's cognitive and affective structures used to understand events and people. This research addresses several relationships among individual characteristics and self-efficacy.

3.3 Academic Discipline/Business Function & Self-Efficacy.

Chung et al.'s study (Chung, Schwager et al. 2002) focused on examining the differences among students from different colleges at a large university (education, business, liberal arts, and forest/wildlife). They found that business students had significantly higher levels of computer self-efficacy. Other research has found differences in computer anxiety among students with different majors within the business school. (Broome and Havelka 2002) It appears likely that students studying information systems or other computer intensive majors would possess higher levels of self-efficacy toward computer use due to their experience with technology and interest in using technology.

Whether self-efficacy is antecedent to or a result of the selection of a computer-oriented major has not been addressed by previous research and is not addressed by this study. However, given prior research into the relationship between self-efficacy, training, and performance; (Harrison and Rainer 1997; Chou 2001) the usefulness of self-efficacy as a tool for administrators or managers in gauging individuals computer skill levels and the level of preparation or training needed for specific disciplines is emphasized. This also reinforces the importance of determining these differences. Based on this prior work and the overall research question being addressed the following hypothesis (in null form) is proposed:

H1: There are differences in software self-efficacy among students with different academic majors.

3.4 Computer Experience & Self-Efficacy.

Based on the social cognitive theory, computer related experience would be expected to have a positive correlation with software self-efficacy. As individuals perform computer-related tasks this would affect their perceptions of self-efficacy in using the computer. Prior research in end-user computing found that individuals with more computer experience had higher levels of computer skill (Harrison and Rainer 1992)and computer experience has been shown to have a positive effect on computer attitudes (Loyd, Loyd et al. 1987; Colley, Gale et al. 1994; Conger, Loch et al. 1995; McIlroy, Bunting et al. 2001)and a negative effect on computer anxiety(McInerney, McInerney et al. 1994; Goss 1996). (Todman and Monaghan 1994; Ayersman 1996; Bradley and Russell 1997; Mahar, Henderson et al. 1997; Todman 2000; McIlroy, Bunting et al. 2001).

The current research uses three items to investigate computer experience: 1) number of years of computer use, 2) number of computer courses taken, and 3) number of application software packages or computer languages learned as measures of computer-related experience. First, it would be expected that students who have more years of experience using a computer would have higher software self-efficacy. Therefore, the following hypothesis will be tested:

H2: There are differences in software self-efficacy among students with different years of experience using a computer.

In addition to the number of years of experience using a computer, the amount of formal training in the form of computer coursework may be a better predictor of self-efficacy, so the number of courses that students have taken would also be expected to positively influence software self-efficacy. This should also give some indication as to whether additional coursework would be effective in increasing students' self-efficacy. Therefore, hypothesis three is stated as:

H3: There are differences in self-efficacy between students with different amounts of computer coursework.

An additional measure of computer experience is the number of applications, software packages, or programming languages a student has used. By learning different software packages or applications, individuals would learn more of the intricacies of how software works and problem-solving strategies for dealing with new situations. It would be expected that as the number of different programs that a student uses increases; their level of software self-efficacy would improve. Hypothesis four is stated as:

H4: There are differences in software self-efficacy between students that have used different numbers of software applications.

As mentioned in the introduction, almost all career choices made in today's business environment require at least a modicum of skill in using information technology. Again, the results should give some guidance as to whether encouraging or requiring students to learn multiple, different applications would increase their self-efficacy.

3.5 Gender & Self-Efficacy.

In the past, there was a general stereotype that men were more technically-oriented than women. Early studies into gender differences on computer attitudes (Loyd, Loyd et al. 1987; Parasuraman and Igbaria 1990; Siann, Macleod et al. 1990; Kay 1992; Colley, Gale et al. 1994; Gefen and Straub 1997)and on computer anxiety (Parasuraman and Igbaria 1990; Okebukola 1993; Cooper and Stone 1996; Todman 2000; McIlroy, Bunting et al. 2001; King, Bond et al. 2002)had mixed results. Some have found that males have more positive attitudes toward computers and lower levels of anxiety. (Okebukola 1993; Colley, Gale et al. 1994) Other studies found that females had more positive attitudes and lower levels of anxiety compared to males. (Loyd, Loyd et al. 1987; Siann, Macleod et al. 1990) And another set of studies found no significant differences between men and women with regard to computer anxiety. (Kay 1992; Colley, Gale et al. 1994; King, Bond et al. 2002) A survey of computer anxiety levels in men and women undergraduate students since 1992 shows that while male levels of anxiety have decreased, those in women have remained fairly consistent. (Todman 2000) These results have led some to conclude that the gender gap in attitudes toward computers and their levels of computer anxiety has now become negligible due to the ubiquitous nature of technology in daily life and the perception (by females) of the computer as a communications device. (King, Bond et al. 2002) However, more recent studies have found no differences between men and women with regard to anxiety. (Broome and Havelka 2002) Much less research has produced results related to self-efficacy and gender; one study did find that men had higher levels of self-efficacy when compared to women. (Harrison and Rainer 1992)

These studies suggest that women may be at a disadvantage in the workplace where the use of computer technology is involved. To validate the findings of the previous research and to add to the body of evidence, a hypothesis related to gender is tested:

H5: There are differences in software self-efficacy levels between male and female students.

3.6 General Aptitude & Self-Efficacy.

It could be argued that individuals with higher intellect or aptitude would be expected to have a greater understanding of technology and higher levels of software self-efficacy. Although not universally accepted as such, the college entrance exams can be considered one indicator of this characteristic; therefore ACT score was used as a proxy for general aptitude or intelligence. The hypothesis can be stated as:

H6: Self-efficacy will tend to be higher among students with higher ACT scores.

3.7 Computer Anxiety & Self-Efficacy.

Computer anxiety is a psychological construct that has received much attention. (Beckers and Schmidt 2001) Although the exact nature of the construct is still being researched, a generally accepted definition of the construct is the fear of computers when using the computer, or when considering the possibility of computer use. (Heinssen, Glass et al. 1987) Other terms used to describe computer anxiety include aversion to, apprehension of, intimidation by, hostility toward, and

aggression towards computers. (Beckers and Schmidt 2001) Computer anxiety relates to users' general perceptions about computer use (Venkatesh 2000)and has been shown to have a significant impact on attitudes, (Igbaria and Chakrabarti 1990) intention, (Elasmar and Carter 1996) behavior, (Scott and Rockwell 1997) learning, (Martocchio 1994) and performance. (Anderson 1996) At least one previous study found a significant relationship between computer anxiety and computer self-efficacy. (Harrison and Rainer 1992) The last hypothesis to be tested by this study is stated as follows:

H7: Software self-efficacy will tend to be higher for students with lower levels of computer anxiety.

4. RESEARCH METHOD & DATA ANALYSIS

A survey instrument was used to collect data to test the hypotheses. The instrument used to gather the data related to self-efficacy was the software efficacy beliefs instrument developed by Martocchio and Webster (Martocchio and Webster 1992)and validated in several other studies. (Webster and Martocchio 1992; Martocchio 1994; Webster and Martocchio 1995; Webster and Compeau 1996) The instrument used to collect the computer anxiety data is based on the Computer Anxiety Rating Scale (CARS) developed by Heinssen et al. (Heinssen, Glass et al. 1987)and validated by Chu and Spires. (Chu and Spires 1991) These instruments and questions to obtain the demographic data was administered to students enrolled in the introductory MIS (management information systems) course at a large Midwestern university (approximately 15,000 students) in the fall semester of 2001 during the first week of the course. This is a sophomore level, required course for all business majors and the enrollment roughly matches the proportions of majors in the business school (approximately 5000 students). The course is also used as a technology requirement for the university and as such has majors from other academic units as well.

A total of 390 surveys were collected from three sections of the course. 324 completed surveys were considered useable for the analysis. The majority of the rejected surveys were from students enrolled in programs outside of the business school. The breakdown of the respondents with reference to their declared majors is given in Table 1. The respondents were composed of 173 men and 151 women. The student breakdown by class rank was 1 freshman, 238 sophomores, 68 juniors, 16 seniors, and 1 graduate student.

Each of the hypotheses presented were tested using a one-way analysis of variance, except for computer anxiety and ACT score that was tested using a regression analysis due to the continuous (rather than categorical) nature of that data.

Table 1 – Breakdown of Respondents by Major

Major	**N**
Accounting	52
Economics	21
Finance	71
Management	29
General Business	26
Marketing	83
MIS	42
Total	324

4.1 Academic Major/Business Function

Hypothesis 1, that there are differences in software self-efficacy among students with different academic majors, is significant at the 0.005 level. The ANOVA results are presented in Table 2.

Table 2 – ANOVA for Software Self-Efficacy by Major

Source	**df**	**SS**	**MS**	**F**	**P**
Major	6	223.9	37.3	3.15	0.005
Error	317	3758.7	11.9		
Total	323	3982.6			
Groups	**N**	**Mean**	**Sdev**		
ACC	52	23.615	3.050		
ECO	21	24.286	2.194		
FIN	71	23.634	3.539		
GEB	26	22.731	2.974		
MAN	29	22.241	3.719		
MAR	83	23.880	3.344		
MIS	42	25.452	4.380		

With a p-value of 0.005, there is evidence to assume that at least two of the means of the disciplines considered are different. Fisher's pair wise comparisons (at p = .05 level) reveal that significant differences exist between students that are MIS majors and every other group of students, except economics. In addition, the data indicates a significant difference between management and economics majors and a significant difference between management and marketing majors. In general, these results support the premise that there are differences in software self-efficacy among the various business disciplines. Overall, it appears that MIS and economics majors have the highest level of software self-efficacy and that management and general business have the lowest level of software self-efficacy.

4.2 Computer Experience

Hypothesis 2, 3, and 4 test various measures of computer experience against software self-efficacy. Hypothesis 2, that there are differences in software self-efficacy among students with different years of experience using a computer, is significant at the 0.001 level. The ANOVA results are presented in Table 3. The question used to gather this measure of computer experience used ranges to identify the number of years

of experience (a = 0, b < 1, c = 1-2, d = 2-5, e > 5 years). The data collected show that 269 out of the 323 students indicated that they had greater than five years experience using a computer. While the statistics indicate that there is a significant difference between those with greater than five years experience and those with less, the fact that the survey did not further delineate the amount of experience based on years of computer use is a weakness of the study. However, the pattern of the responses seems to indicate a clear positive relationship between the number of years of experience using a computer and a student's level of software self-efficacy.

Table 3 – ANOVA for Software Self-Efficacy by Number of Years of Computer Experience

Source	**Df**	**SS**	**MS**	**F**	**P**
CYRS	3	187.1	62.4	5.26	0.001
Error	320	3795.4	11.9		
Total	323	3982.6			
Level	**N**	**Mean**	**Sdev**		
<1 yr	1	15.000	0.000		
1-2 yrs	4	22.500	1.292		
2-5 yrs	50	22.500	3.105		
>5 yrs	269	24.063	3.519		

Hypothesis 3, that there is a difference in software self-efficacy due to the number of computer courses taken, is also significant at the p < 0.009 level. Table 4 presents the ANOVA results for self-efficacy by the number of computer courses taken.

Table 4 – ANOVA for Software Self-Efficacy by Computer Courses Taken

Source	**Df**	**SS**	**MS**	**F**	**P**
Courses	4	163.9	41.0	3.43	0.009
Error	318	3795.8	11.9		
Total	322	3959.7			
# Courses	**N**	**Mean**	**Sdev**		
0	21	23.762	4.024		
1	82	23.354	3.044		
2	92	23.391	3.691		
3	62	23.484	3.788		
>3	66	25.182	3.053		

Fisher's pair wise comparisons reveal that there were significant differences (at the .05 level) between those with greater than three courses and those students with only one or only two courses. This result may indicate that students' software self-efficacy is not significantly affected by computer courses until they have completed more than three!

Hypothesis 4, that there is a difference in software self-efficacy among students that have learned a different number of applications, software packages, or programming languages, is also significant (p < 0.000). The ANOVA results are given in Table 5.

Table 5 – ANOVA for Software Self-Efficacy by Number of Different Applications Learned

Source	**Df**	**SS**	**MS**	**F**	**P**
Number	4	386.9	96.7	8.58	0.000
Error	319	3595.7	11.3		
Total	323	3982.6			
#Apps	**N**	**Mean**	**Sdev**		
0	23	22.522	3.217		
1	78	22.859	3.360		
2	70	23.057	3.230		
3	44	23.477	4.722		
>3	109	25.275	2.755		

Similar to years of computer experience and number of computer courses taken, it appears that as the number of different applications a student learns increases their level of software self-efficacy increases. Fisher's pair wise comparisons reveal significant differences between the more than 3 applications learned and all other levels. This is consistent with the previous experience measure and implies that the significant increase in software self-efficacy comes only after a student learns more than three applications.

4.3 Gender

Hypothesis 5, that there are differences in the level of software self-efficacy between male and female students, was not found to be significant (p < .547). Table 6 gives the ANOVA results.

Table 6 – ANOVA for Software Self-Efficacy Levels by Gender

Source	**df**	**SS**	**MS**	**F**	**P**
Gender	1	4.5	4.5	0.36	0.547
Error	322	3978.1	12.4		
Total	323	3982.6			
Groups	**N**	**Mean**	**Sdev**		
Male	173	23.665	3.629		
Female	151	23.901	3.380		

These results are consistent with other recent research indicating that disparities between male and female students no longer exist with regard to technology.

4.4 Family Income

Hypothesis 6 tests for differences in software self-efficacy among students from families with different income levels. The data collected indicate that significant differences exist (p < 0.040), see Table 7 for ANOVA results. However, there does not appear to be a general trend in the relationship. Students from families in the lowest income bracket scored had the highest average software self-efficacy and those in the highest income bracket scoring second highest. The

Fisher pairwise comparison indicates a significant difference only between the highest income bracket and the next highest.

Table 7 – ANOVA for Software Self-Efficacy by Family Income

Source	**df**	**SS**	**MS**	**F**	**P**
INC	4	124.6	31.1	2.55	0.040
Error	311	3805.4	12.2		
Total	315	3930.0			
Income	**N**	**Mean**	**Sdev**		
<$30K	10	25.600	2.716		
30-50K	25	23.480	3.787		
50-75K	55	23.745	2.926		
75-100	80	22.938	4.282		
>$100K	146	24.253	3.199		

4.5 Aptitude

To test Hypothesis 7, the relationship between aptitude and software self-efficacy, a regression analysis was performed. The results are presented in Table 8.

Table 8 – Regression Analysis for Software Self-Efficacy by ACT

Predictor	**Coef**	**SE Coef**	**T**	**P**
Constant	21.158	1.911	11.07	0.000
ACT	0.09835	0.07194	1.37	0.173
S = 3.482	**R-Sq=0.7%** **R-Sq Adj = 0.3%**			

There does not appear to be a significant linear relationship between self-efficacy and ACT score based on the observed data (R**2 = 0.7%, p < 0.173).

4.6 Computer Anxiety

Hypothesis 7 states the expected relationship between software self-efficacy and computer anxiety. The results of the regression analysis to test this hypothesis are given in Table 9 and reflected in Figure 1. The results indicate the expected negative relationship between a students' level of computer anxiety and software self-efficacy. The regression equation for the relationship is:

SE = 33.5 – 0.224 CANX

Table 9 – Regression Analysis for Software Self-Efficacy by Computer Anxiety

Predictor	**Coef**	**SE Coef**	**T**	**P**
Constant	33.4864	0.6962	48.10	0.000
Com Anx	-0.22435	0.01569	-14.3	0.000
S = 2.750	**RSq=38.8%**	**R-Sq Adj = 38.6%**		

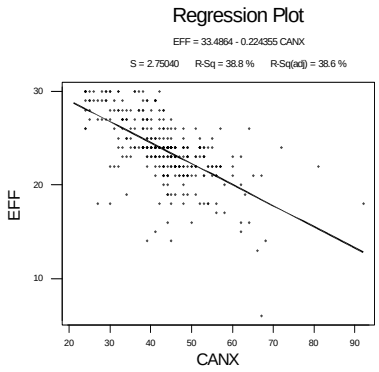

Figure 1 – Regression Plot of Software Self-Efficacy vs Computer Anxiety

5. CONCLUSION & IMPLICATIONS

Based on the results of this study and assuming that software self-efficacy does have an impact on performance, some implications for managers, educators, and educational administrators are discussed. First, the results indicate that students with different business majors have different levels of self-efficacy. Combining this finding with the results related to computer experience, it may be appropriate for administrators or managers to support or require students/employees to take more than three computer-training courses and these should be in different applications. However, the amount of time spent on these courses may need further study. Using the years of computer experience as an indicator, it may be that only with significant years of experience will software self-efficacy improve. This study found no significant difference in software self-efficacy between men and women. The study also found no significant relationship between software self-efficacy and students' ACT scores. A significant difference was found among students from different family's with different income levels; however, upon closer inspection the results are difficult to interpret in that the only significant pair wise difference was between the highest income level and the next highest.

Lastly, the study results indicate a significant negative relationship between software self-efficacy and computer anxiety. The exact nature of the relationship between these constructs was not examined here and no claims can be made regarding a cause and effect relationship, if one exists. In summary, software self-efficacy has been shown to affect other psychological constructs and performance. Identifying potential predictors of software self-efficacy may allow managers, educators, and administrators to more effectively allocate scarce training and educational resources.

This paper presents the results of an empirical study that

investigated the impact of various demographic variables on software self-efficacy for business students. Several interesting findings were made. The results indicate that business students with different majors have significantly different levels of software self-efficacy. The MIS and economics majors were found to have the highest levels of self-efficacy and management and general business the lowest. This result may be due to students self-selecting into areas perceived to rely heavily on technology (or perceived not to do so). The sample for this study was taken from an introductory level MIS course that is a required core course for all business majors; therefore, it seems unlikely that the differences in software self-efficacy are due to specialized training in the disciplines or required computer related courses. However, there may be a relationship between the student's previous experience with computers and their selection of majors. This would be consistent with the results from the hypotheses dealing with computer experience. The results indicate that there are significant differences between students with less experience, fewer computer courses, and that have learned fewer applications and those with higher levels of these variables. Obviously, this should not surprise anyone, yet the results suggest that there may exist a "threshold" level that a student must reach before significant changes in their level of self-efficacy will occur. The study also tested for differences in self-efficacy between men and women and found no significant difference. This result may indicate that previous stereotypes regarding men and computers or women and computers were unfounded. In addition, family income and "aptitude" were also analyzed in relation to software self-efficacy. Although significant differences were found for self-efficacy among students from families with different income levels, no clear pattern exists. Specifically, students reporting family incomes of less than $30,000 per year had the highest levels of software self-efficacy followed by those reporting family income greater than $100,000. No significant relationship between aptitude (as measured by ACT score) and software self-efficacy was observed. This may indicate that aptitude is not significantly related to software self-efficacy, self-efficacy does not measure an individual's actual ability to use software. Or ACT scores may not be a good measure for aptitude. Lastly, the relationship between computer anxiety and software self-efficacy was explored. Not surprisingly, the data suggests a strong negative relationship between the two constructs. These results add to the body of knowledge regarding self-efficacy in the management information systems area. Clearly, more research is needed to clarify the details of the relationships found here.

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