AN EMPIRICAL STUDY OF STUDENTS' COMPUTER SELF-EFFICACY: DIFFERENCES AMONG FOUR ACADEMIC DISCIPLINES AT A LARGE UNIVERSITY

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ABSTRACT

This study compares the differences in students' computer self-efficacy and attitudes toward computers among four academic disciplines in a university environment. Results indicate that students at a business school have higher expectations from computers and more positive attitude toward computers than students in the other three disciplines. Based on the results of this study, a framework is presented for the development of tools for the comparison of differences in computer self-efficacy and attitudes toward computers among participating organizations in the future. The results of this empirical study suggest that business students do possess a significantly higher degree of computer self-efficacy and attitudes toward computers than non-business students.

INTRODUCTION

Given the computer rich environment we all find ourselves living in today, the importance of computer skills of university students has established itself as an important topic for many within the academic community. In a previous academic era it was reasonable to expect business students to attain and establish a considerable level of computing skills while in college, thus preparing them for employment in the business world. Comparatively, it may not have been as reasonable to expect similar levels of computing capabilities of students from more diverse university disciplines such as liberal arts.

Computing rich academic disciplines such as business and computer science have for sometime investigated and reported on computing skills, impediments, and self-efficacy. Notably, Harrison and Rainer (8) investigated computer self-efficacy and attitudes of students in business majors. But just as the computing environment has expanded in recent times in both our professional and personal surroundings, researchers have begun to examine the computing skills of non-traditional computing use students. Specifically, the TekXam (exam) was developed and employed to investigate the computing abilities of non-business and non-computer graduates (9, 11).

While the computing skills of business and non-business students have been independently investigated, it appears that limited research has been conducted into the potential differences that may exist between students across academic disciplines in regard to computing issues. Presupposing an equitable environment of computing access exists for all university students, the investigation of the level of student computing skills emerges into the focus of computer self-efficacy. This study attempts to gain additional insights into these differences between majors at the university level by surveying students at four colleges at a large university in the Southeast United States. This is accomplished by surveying university students to access their levels of computer self-efficacy and attitudes toward computers while accounting for their computer usage. The survey sample data is empirically tested, with the results providing some evidence suggesting that differences do exist.

This research begins with the outline of the research questions, followed by an examination of the theoretical framework placing this study in the context of previous studies. Then the research methodology, results, and discussion are presented with directions for future study.

RESEARCH QUESTIONS

Three study assumptions were made to assess possible differences in computing behavior among academic disciplines. First, students' computer knowledge, years of experience, and computer software usage would differentiate their scores in computer self-efficacy and attitudes toward computers. This premise is supported by the work of Compeau and Higgins (3), where they conducted a similar research study in business environments.

The second assumption made is that students' cognitive style about computers appears to be a major factor that affects their computer self-efficacy and attitudes. As suggested by Harrison and Rainer (8), cognitive style may represent the individual's modes of perceptional and thinking behavior.

The third assumption proposes that the academic setting for students' computing would have an effect on their computer self-efficacy and attitudes. The foundation for this premise can be found in the work of Schunk (13). He argued that students often receive persuasive information from their educators indicating that they are capable of performing computing tasks. Given the above three assumptions, this study attempts to answer the following research questions:

Research Question 1: Does computer sophistication help explain some of the computer self-efficacy and attitude differences among academic disciplines?

Research Question 2: Do students in different academic disciplines differ on the five dimensions of computer self-efficacy? If so, how and why do they differ?

Research Question 3: Do students in different academic disciplines differ in their attitudes toward computers? If so, how and why do they differ?

THEORETICAL FRAMEWORK

To address the three research questions above, this study utilizes ten factors. Five factors are used to address the issue of computer self-efficacy; with two factors used to address students' attitudes toward computers; and three to address the computer sophistication of the respondent. The five factors of computer self-efficacy are: encouragement by other individuals to use computers, other people's usage of computers, organizational support for computing, outcome expectations from computers, and dealing with an unfamiliar software package.

The two factors of attitudes toward computers represent positive and negative attitudes toward computers, respectively. The remaining three factors of computer sophistication are years of computer experience, knowledge of computers, and computer software usage.

It has been suggested by Gist and Mitchell (6) and others that self-efficacy is a construct derived from social cognitive theory. The theory posits a triadic reciprocal causation model in which behavior, cognition, and environment influence each other in a dynamic fashion (1, 2). Bandura (1) defined self-efficacy as an individual's judgment of his or her capabilities to organize and execute courses of action to attain designated types of performance. He also argued that individuals judging themselves as capable to perform certain tasks or activities will be more likely to attempt and thus successfully execute them.

Compeau and Higgins (3, 4) suggested that computer self-efficacy refers to one's individual judgment of the capacity to use computers. Furthermore they suggested individuals with a higher computer self-efficacy could accomplish more difficult computing tasks than those with lower computer self-efficacy. To complete the self-efficacy instrument, Compeau and Higgins (4) included two computer attitude factors. This study is built primarily upon two established social cognitive theories, Bandura's theory of self-efficacy (1) and Compeau and Higgins' computer self-efficacy studies (3, 4). To best replicate their study, these first seven factors are also applied to this study.

With the proliferation of personal computers, it is believed necessary to address the issue of computer sophistication. To accurately depict students' computer self-efficacy, this study includes the last three factors of years of computer experience, knowledge of computers, and computer software usage.

For this study, each of these indicator characteristics was defined in terms of a six or ten-point established Likert-type scale. Table 1 depicts the seven factors with the number of relevant indicators and the observed computer usage variable in this study.

TABLE 1
The Seven Factors and Observed Variable in the Study

Factor Number	Factor Name	Number of Questions	Remarks
1	Encouragement of Others	17	Computer Self-Efficacy
2	Others Computer Use	16	Computer Self-Efficacy
3	Organizational Support	3	Computer Self-Efficacy
4	Outcome Expectations	11	Computer Self-Efficacy
5	Unfamiliar Software	7	Computer Self-Efficacy
6	Positive Attitude	9	Positive Attitude
7	Negative Attitude	10	Negative Attitude

Independent Observed Variable – Computer Software Usage (the Mean is derived from the 11 questions while treating all of them with the same weight).

RESEARCH METHODOLOGY

Data Collection

This study empirically examined student survey sample data on computer self-efficacy by university student demographics and makes inferences about the population. The data were collected during the Summer and Fall 1999 terms. The final sample was comprised of 350 senior level students enrolled in four different colleges within the same university. Of this sample, 50.7% were female, 49.3% were male, 93 were from the college of education, 63 were from the college of liberal arts, 144 were from the college of business, and 50 were from the college of forestry and wildlife. The average age of the participants was 22.6, ranging from 22 to 42 years old. The actual questionnaire contained 105 questions on students' demographics, computer self-efficacy, computer software usage and attitudes. These questions originated primarily from the three empirical studies: Harrison and Rainer (8), Murphy et al. (11), and Compeau and Higgins (3, 4). This study focused on 86 of the 105 questions in the survey to address the research questions.

At the onset of the study, meetings were conducted with the deans of each discipline involved to gain approval for the study and access to the students. Upon approval, arrangements were made to administer the questionnaire to senior level courses in each discipline. The actual questionnaire was anonymous and took approximately 10 to 15 minutes for each student to complete.

Statistical Methods and Results

From a theoretical and operational perspective, this investigation was organized into two phases: a preliminary phase, which addressed research question one, and an investigation phase, which addressed questions two and three. Based on the results from the preliminary phase, only statistically significant variables were incorporated into the investigation phase.

In the preliminary study phase, a factor analysis was performed to determine if the number of actual factors were consistent with previous research. This test was followed by reliability analysis on the resulting factors. Finally, the three variables measuring computer sophistication were considered covariate candidates. The three variables we considered were: years of computer usage, computer knowledge, and software usage. The objectives of these tests, as an exploratory stage, were to identify variables that could assist in explaining computer self-efficacy and attitude. Variables that appeared to assist in explaining were carried forward into the next phase.

As reported in previous research, our factor analysis also resulted in the identification of seven factors. The seven factors included all 73 indicators with significant correlation among the factors. The first five factors represent student computer self-efficacy and labeled as previously defined above.

The other two factors were students' positive and negative attitudes toward computers. Second, the measurement characteristics of the seven factors were assessed to determine the reliability based on internal consistency for each scale. This was accomplished by calculating Cronbach's alpha for each factor. The alpha values for the individual factors ranged between .87 and .94 (actual alpha values are reported in Table 4). These alphas are well above the cutoff value suggested by Nunnally (12) of .70 for hypothesized measures of a construct.

Third, a MANOVA was performed to examine the level of student computer sophistication. The purpose of this analysis was to determine if any of the measures aided in the understanding of differences in students' computer experience, knowledge, and software usage among the four disciplines. Table 2 reflects the test results, showing that only computer software usage was significant and was thus utilized for further examination.

TABLE 2
The Results of a Computer Sophistication Test

Variable	F values	P value	Remarks
Years of Computer Experience	1.60	.19	Not significant
Knowledge of Computers	1.92	.13	Not significant
Computer Software Usage	6.42	.00	Significant

Wilke's Lamda's p-value was .004 for this test.

Performing an ANOVA with Tukey test revealed differences in computer software usage among the four disciplines. All of the results generated by Tukey, Scheffe, LSD, and Bonferroni procedures were similar. Only the computer software usage of the college of business was significantly different from other disciplines. Since the computer software usage was assumed linearly related to the seven factors, the usage was used as covariance to MANCOVA and ANCOVA in the investigation phase.

It has been suggested that both MANCOVA and ANCOVA are techniques that feature the characteristics of both analysis of variance and regression (5, 10). Table 3 depicts the test results among the colleges with the Tukey procedure.

TABLE 3
Comparisons of Differences in Computer Software Usage Among Four Disciplines

College	College	P-value	Remarks
Business	Education	.00	Significant
	Forest/Wildlife	.05	Significant
	Liberal Arts	.03	Significant
Education	Business	.00	Significant
	Forest/Wildlife	.94	Not Significant
	Liberal Arts	.91	Not Significant
Forest/Wildlife	Business	.05	Significant
	Education	.94	Not Significant
	Liberal Arts	1.00	Not Significant
Liberal Arts	Business	.04	Significant
	Education	.91	Not Significant
	Forest/Wildlife	1.00	Not Significant

P-value <.05 Significant

In the investigation phase, an application of both MANCOVA and ANCOVA techniques were used to determine whether or not differences existed in students' attitudes and computer self-efficacy among the four disciplines. The results would shed light on the research questions related to the computer self-efficacy and attitudes toward computers among the four disciplines. Table 4 depicts the descriptive test statistics for the seven factors.

DISCUSSION OF RESULTS

First, the MANCOVA output was used to examine the differences in the five factors related to computer self-efficacy, positive and negative, and attitudes toward computers. Through our discussion of the results, the independent variables were determined factors. This term was suggested by Hair, Anderson and Tatham (7) for use when ANOVA or MANOVA is used in a model. The model for this test was represented by seven different variables with computer software usage as a covariate. The results of the analysis indicated that the model supports the differences in two factors representing student positive attitude toward computer and outcome expectations among the four disciplines. Table 5 depicts the test results on the four colleges.

TABLE 4
Descriptive Statistics for the Seven Factors in the Study

Factors	Mean	Std Dev	Cron α	Correlation Coefficient 1	2	3	4	5	6	7
Encouragement of Others	4.17	.67	.94	1.00						
Others Computer Use	5.26	.87	.95	.62	1.00					
Organizational Support	4.45	1.25	.94	.47	.38	1.00				
Outcome Expectations	3.73	.75	.91	.42	.39	.24	1.00			
Unfamiliar Software	6.64	1.87	.90	.60	.48	.45	.34	1.00		
Positive Attitude	4.96	.67	.87	.37	.48	.27	.63	.29	1.00	
Negative Attitude	2.84	.87	.86	-.33	-.25	-.16	-.20	-.26	-.24	1.00

TABLE 5
Differences in Computer Self-Efficacy, Attitudes Toward Computers, and Computer Software Usage Among the Four Disciplines

Source	Dependent Variable	F-test	P-value	Remarks
Computer Software Usage	Positive Attitude	23.59	.00	Significant
	Negative Attitude	4.14	.04	Significant
	Encouragement of Others	153.28	.00	Significant
	Others Computer Use	63.16	.00	Significant
	Organizational Support	19.35	.00	Significant
	Outcome Expectations	35.30	.00	Significant
	Unfamiliar Software	58.33	.00	Significant
College	Positive Attitude	8.29	.00	Significant
	Negative Attitude	1.47	.22	
	Encouragement of Others	.61	.66	
	Others Computer Use	.17	.92	
	Organizational Support	1.04	.37	
	Outcome Expectations	4.03	.01	Significant
	Unfamiliar Software	.49	.71	

Wilke's Lamda's p-value was .000 for Computer Software Usage and .002 for College in this test.

Second, using the two significant factors from the first examination with computer software usage, an ANCOVA procedure was used to examine the differences in the two factors among the four disciplines. Both the positive attitude and outcome expectations were significant with the computer software usage. The p-values were .000 and .008, respectively.

Finally, with an application of ANOVA, the differences in positive attitude and outcome expectation were tested among the four disciplines. From the test, all results from Tukey, Scheffe, LSD, and Bonferroni procedures were similar. Table 6 depicts the test results among the colleges from the Tukey procedure.

This study integrated the theoretical perspectives and empirical findings of computer self-efficacy and attitudes toward computers among four colleges in a university environment. The preliminary tests on students' self-efficacy and attitudes showed that a measure of computer sophistication could be used as a control variable. Following the preliminary tests, additional tests were performed to show that there were differences on the positive attitude and outcome expectation dimensions. These two factors were significant. The two differences among the four disciplines were further investigated. This time MANCOVA and ANCOVA were used for multiple comparisons using computer software usage as a covariate. The results indicated a significant difference between the college of business and the other three disciplines. They also provided some hints into how students' computer self-efficacy, computer software usage, and attitude toward computers are impacted by each other.

Students' computer software usage was a significant variable for further investigation on differences in all five factors for their computer self-efficacy and two attitudes toward computers among the four disciplines. This indicated that students' years of computer experience and knowledge were less important than their actual computer usage on a daily basis for academic and personal purposes. Therefore, it is suggested that students' computer software usage has a significant effect on the differences in students' computer self-efficacy and attitudes toward computers in a university environment.

The result of the differences between the disciplines on the first three dimensions of computer self-efficacy (encouragement by other individuals to use computers, other people's usage of computers, and organizational support for computing) did not reveal any statistical significance. They were: the differences in computer self-efficacy by others' encouragement using computers, the differences in computer self-efficacy by others' use of computers, and the differences in computer self-efficacy by support among academic disciplines.

The differences in computer self-efficacy by students' outcome expectations among the four disciplines was significant with their computer software usage. After examining the differences among the four disciplines with a Tukey test in ANOVA, students at the college of business appear to have higher expectation from computers than students at the other three disciplines. While the last dimension of computer self-efficacy, dealing with unfamiliar software, was not significant. Therefore, the second research question is concluded as follows: students at the college of business have higher outcome expectations from computers than students at the other three participating disciplines within a university. The differences in students' positive attitude toward computers were significant, while the differences in their negative attitude toward computers were not significant. After examining the differences among the four disciplines with a Tukey test in ANOVA, students at the college of business appear to have more positive attitude toward computers than students at the other three disciplines. Therefore, research question number three is concluded as follows: students at the college of business have a higher positive attitude toward computers than students in the other three participating disciplines within a university.

TABLE 6
Multiple Comparisons Among the Four Colleges

		Positive Attitude		Outcome Expectation	
College	College	P-value	Remarks	P-value	Remarks
Business	Education	.00	Significant	.00	Significant
	Forest/Wildlife	.00	Significant	.05	Inconclusive
	Liberal Arts	.00	Significant	.02	Significant
Education	Business	.00	Significant	.00	Significant
	Forest/Wildlife	.80	Not Significant	.87	Not Significant
	Liberal Arts	1.00	Not Significant	.89	Not Significant
Forest/Wildlife	Business	.11	Not Significant	.05	Inconclusive
	Education	.12	Not Significant	.87	Not Significant
	Liberal Arts	.12	Not Significant	1.00	Not Significant
Liberal Arts	Business	.00	Significant	.02	Significant
	Education	1.00	Not Significant	.89	Not Significant
	Forest/Wildlife	.82	Not Significant	1.00	Not Significant

Dependent Variables: Positive Attitude and Outcome Expectation

CONCUSION AND DIRECTIONS FOR FUTURE STUDY

The focus of this study was on computer self-efficacy and attitude differences among four different college students within the same university. The study results suggest that students at the college of business have more positive attitude toward computers and higher computer self-efficacy in comparison with the other three participating colleges within the same university. While a few conclusions can be drawn from this study, there are other factors that would be useful in addressing the students' computer self-efficacy and attitudes toward computers.

For example, it would be useful to examine a threefold relationship among students' performance expectations (i.e., GPA, employment), for their computer self-efficacy and computer software usage. Also, computer self-efficacy between genders would be another research question to be examined in future studies.

One of the major limitations of the study is the sample size. With a larger sample from all colleges within a university and other universities in different regions, the model of this study would improve in its overall generalizability. Also, this model does not account for any predisposition toward computers that might account for students choosing particular academic disciplines.

This study presents significant progress toward explaining the relationship among students' computer self-efficacy, attitude toward computers, and their computer software usage in a university environment. The findings are encouraging in light of the fact that there is significant evidence supporting similar computer self-efficacy results in other types of organizations.

Overall, the study results suggest that social cognitive theory can be applicable to the academic context. Professors, college deans, and the academic community should be able to utilize the results of this study to focus on enhancing academic curricula relevant to the development of computing skills for their students. Understanding the differences in students' computer self-efficacy and attitudes toward computers can represent a key consideration in a university's endeavor to implement a computer-related curriculum.

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