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COMPUTER BASED TRAINING, COMPUTER SELF-EFFICACY, AND BEGINNING COMPUTING

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Abstract

This research in progress seeks to measure computer self-efficacy and student comfort with CBT taught courses in Computer Proficiency versus traditional, face-to-face methods. A survey instrument was developed to measure students' computer self-efficacy in use of the Excel application. Preliminary results show that the level of computing experience plays an important role in computer self-efficacy.

Introduction

Introduction to Micro-Computing is a typical offering at Universities across the globe. At many Universities, this is seen as a survey course, offered by the Computer Information Systems department to the University community, designed to indoctrinate novice students into the computer-literate world. The content of the course typically includes office application software (Spreadsheet, Word Processor and Presentation software) and how to use the Internet. Sometimes these courses also include database management concepts.

Many Universities have elected to offer the course through Computer Based Training (CBT). The rationale being that becoming proficient with a computer, requires you to use one. However, becoming proficient, for some, also requires a lot of hand-holding and reassurance. This research in progress seeks to measure computer self-efficacy and student comfort with CBT taught courses in Computer Proficiency versus traditional, face-to-face methods. To measure this, the application Microsoft Excel® was selected because it was common to most introductory computing courses. A survey instrument was developed to measure students' computer self-efficacy in use of the Excel application. Preliminary survey results from 84 CBT students show that level of computing experience plays an important role in computer self-efficacy. Further research will compare CBT and traditional teaching methods, looking specifically at computer experience and gender.

Theoretical Foundation

Two major theories of learning are objectivist and constructivist. The objectivist model represents the traditional method of delivering information via lectures. According to this model, the goal is to deliver knowledge from the expert (i.e., instructor) to the learner. When the delivery is incomplete or imperfect, the learner is bound to make errors. One important assumption of this model is that all learners utilize the same processes to acquire knowledge (Jonassen, 1993).

The constructivist model supports self-learning. According to this model, an individual can learn better when s/he actively participates in a self-discovering process. As such, this model is the exact opposite of the objectivist model (O'Loughlin, 1992). Extending the constructivist model, the cognitive information processing model of learning is based on two major assumptions: learning is based on the individual learning characteristics and their respective mental models (Bovy, 1981). Learning style has been used in several studies dealing with computer training (Bostrom, Olfman, & Sein, 1990; Olfman & Bostrom, 1991; Wu, Dale, & Bethel, 1998). Understanding a system can be defined as having an accurate mental model of the system (Wu et al., 1998). Sein and Bostrom (1989, p. 199) define mental models as "Conceptual representations of the system that provide predictive and explanatory powers to the user in understanding the system and guide their interaction with it." Therefore, the cognitive information processing model of learning proposes that the learning methodology has to take into account the learner's prior knowledge and preferred learning style.

This research concentrates on two major teaching methodologies used at the present time: lecture-based and computer-based. Lecture-based instruction is based on the objectivist model of learning. Computer-based training (CBTs) are one application type that address the cognitive information processing model of learning by providing a flexible environment where the learner not only progresses at her own pace but is also able to skip material known to her from previous experiences (Leidner & Jarvenpaa, 1995).

Research Framework

Previous research studies have reported mixed results of the effectiveness of technology and the different learning theories. Chickering and Ehrmann (1996) supported the notion that technology is not the reason for learning but instead the learning methodology used. Similarly, Ahmad et al. (1998) posited that learning is based on the learning model and not on the technology used. Leidner and Jarvenpaa (1995) concluded that the use of information technology could benefit any model of learning given that substantial changes are applied that take advantage of the technology at hand. They asserted that technology alone could only augment (i.e., automate) existing methodologies, regardless of their efficiency level. In their study, Leidner and Jarvenpaa suggested that future research is needed to assess the added value of the technology for a given learning model. In addition, they suggested investigating the effect of individual learning characteristics, such as the maturity of learner, as a mediating variable in the learning process. This literature leads us to the following set of propositions:

Proposition 1: CBT learning is more effective than face-to-face learning.

Proposition 2: CBT learning is more effective than face-to-face learning for mature learners.[1]

Research Methodology

Independent Variables

The two independent variables are the instructional method and the maturity level of the learner. Instructional method can be CBT or face-to-face. Maturity level is measured by computer experience.

Dependent Variable

The dependent variable is the level of computer self-efficacy. Bandura (1986, p. 391) defines self-efficacy as "People's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances. It is concerned not with the skills one has but with judgments of what one can do with whatever skills one possesses". Computer self-efficacy refers to the judgment that someone has regarding using a computer (Compeau & Higgins, 1995) or feels capable of learning from a specific methodology (Leidner & Jarvenpaa, 1995).

The computer self-efficacy instrument developed by Compeau and Higgins (1995) was adapted to this experiment by replacing the opening sentence that reads, "I could complete the job using the software package…" with "I could learn more features of Microsoft Excel (advanced formulas, programming, etc)." This instrument assessed the subjects' beliefs about their capabilities to competently learn advanced features of Microsoft Excel®. It uses a ten-point Likert scale questionnaire consisting of ten questions dealing with a subject's comfort level learning advanced Excel features. The score range for the computer self-efficacy instrument is 1 to 10, where 1 indicates being not at all confident to learn advanced Excel features and 10 indicates being totally confident about learning advanced Excel features.

Data Collection

The study will consist of administering a survey to students taking the introductory course in computer information systems at several Universities. The Universities selected will be divided equally between those offering CBT and face-to-face introductory

[1]"Mature learner" is measured in terms of their computer experience level.

courses. The survey will be administered in class when possible. An electronic survey will be used when class delivery of the survey is not possible. An abstract of the survey is included in Appendix A.

Data Analysis and Results

Data from one University was collected in February 2002. This institution, California Polytechnic University of Pomona, uses the CBT instructional approach in their introductory microcomputer course. Therefore, all students taking this course utilize the CBT-based instruction. Since the surveys were handed-out during class, the majority of the students (84 out of 88) completed the survey. This represents a 95% response rate. Even though this sample represents one instructional method, the initial analysis of the expected outcomes is interesting.

Of the 84 surveys collected, males and females were evenly distributed, 50% each. In terms of age, 55% were between 10-20 years old, 36% between 20-30 years old, 6% between 30-40 years old, and the remaining 3% were at least 40 years old.

Computer experience level was as follows: 3 respondents indicated that they were novice users, 4 were beginner users, 43 moderate users, 28 advanced users, and 6 expert users.[2] Due to the low frequencies in the first two categories, computer experience level (CELCAT) was coded as low (novice, beginner, and moderate levels) and high (advanced, expert).

Analysis of Variance

The means, standard deviations, and cell sizes are shown in Table 1. Individuals reported as having low computer experience level had an average self-efficacy score of 46.38. Those who reported as having a high experience level had an average self-efficacy score of 58.12.

An analysis of variance using Computer self-efficacy and computer experience level was run and the results were significant ($F_{1,82}$=11.413, p=0.001). Subjects who have high computer experience level had a higher self-efficacy score than those with low computer experience level. The ANOVA results are shown in Table 2.

These preliminary results suggest that for CBT-based training, the computer experience of the learner may be an important factor in their subsequent computer self-efficacy score.

Table 1. Computer Self-Efficacy by Computer Experience Level

CELCAT	Mean	Std. Deviation	N
Low	46.38	14.08	50
High	58.12	17.68	34
Total	51.13	16.58	84

Table 2. ANOVA of Computer Self-Efficacy by Computer Experience Level

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	220995.107	1	220995.107	79.259	.071
	Error	2788.250	1	2788.250		
CELCAT	Hypothesis	2788.250	1	2788.250	11.413	.001
	Error	20033.309	82	244.309		

[2]As mentioned earlier, students are required to take this introductory course regardless of their computer experience level.

A second ANOVA was run using Computer self-efficacy and gender. Even though the results were not significant ($F_{1,82}$=3.955, p=0.05), the results suggest that computer self-efficacy may be influenced by gender differences. The ANOVA results are shown in Table 3.

Table 3. ANOVA of Computer Self-Efficacy by Gender

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	219607.440	1	219607.440	209.129	.044
	Error	1050.107	1	1050.107		
GENDER	Hypothesis	1050.107	1	1050.107	3.955	.050
	Error	21771.452	82	265.506		

Conclusion and Future Research

As indicated in the previous section, the results of the first data collection suggest that the maturity level of the learner, measured as computer experience level, may be an important factor in their level of computer self-efficacy. Additional data collections are needed to include face-to-face learners.

One possible shortcoming of the study is the survey instrument. Questions 2 and 7 use restrictive phrases that may lead the respondent to answer negatively. Questions 3 and 8 may be redundant in nature. There is also the concern that the first eight questions may be mutually exclusive.

Of the data collected so far, two additional details are of interest. First, most students rated themselves as moderate or high. Considering that this is an introductory computer course, many students are entering the university with computer skills. In further studies, it will be interesting to collect data on where these skills were acquired, at home (self-taught) or in high school (classroom taught).

Interestingly, women had lower computer self-efficacy than men in the data collected from the CBT course. Studies in computer self-efficacy have found gender differences—with men showing higher self-efficacy—for advanced computer skills. The same studies also confirm no gender differences for beginning level computing skills (Busch, 1995; Murphy, Coover, & Owen, 1989). Table 4 shows the comparison of skill, self-rating given by men and women. Considering that most students rated themselves as moderate or advanced computer users, including women, it is somewhat surprising that women still have low computer self-efficacy. If women rated themselves as novice or beginner, the low computer self-efficacy might be expected. However, even though they have computer skills, they still lack confidence in their abilities. No women rated themselves as experts with computers.

Table 4. Self-Rating by Gender

		GENDER		Total
		Male	Female	
CompExpLevel	Novice	1	2	3
	Beginner	1	3	4
	Moderate	16	27	43
	Advanced	18	10	28
	Expert	6		6
Total		42	42	84

If this result proves true once the entire collection of data is made, the results could have dramatic implications for CBT at universities and in industry. If specific courses are only offered through CBT, does this mean that women are disadvantaged when they take them? Given the introductory computing course is a starting point for some technology based majors, does the offering of CBT discourage women from pursuing majors in technological fields of study? Clearly more investigation is needed to examine why women rate themselves as knowledgeable about computing but still report low confidence in ability.

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Appendix A.
Research Instrument (Abstract)

I could learn more features of Microsoft Excel (advanced formulas, programming, etc.):

#		Not at all confident							Moderately confident		Totally confident
1	…if there was no one around to tell me what to do as I go.	○	○	○	○	○	○	○	○	○	○
2	…if I had only the software manuals for reference.	○	○	○	○	○	○	○	○	○	○
3	…if I had seen someone else using it before trying it myself.	○	○	○	○	○	○	○	○	○	○
4	…if I could call someone for help if I got stuck.	○	○	○	○	○	○	○	○	○	○
5	…if someone else had helped me get started.	○	○	○	○	○	○	○	○	○	○
6	…if I had a lot of time to complete the job for which the software was provided.	○	○	○	○	○	○	○	○	○	○
7	…if I had just the built-in help facility for assistance.	○	○	○	○	○	○	○	○	○	○
8	…if someone showed me how to do it first.	○	○	○	○	○	○	○	○	○	○

Gender	○ Male	○ Female			
Marital status	○ Single	○ Married			
How old are you?	○ 10-20	○ 20-30	○ 30-40	○ 40-50	○ 50 or more
What is your cumulative amount of computer experience?	○ Less than one year	○ One year	○ Two years	○ Three years	○ Four or more years
Please rate your experience level with technology in a general sense	○ Novice, I do not use computers often	○ Beginner, I have just started using computers	○ Moderate, I know how to use a computer but, only basic applications	○ Advanced, I use a computer daily and know many applications	○ Expert, I use a computer daily and am expert in several applications
What grade do you expect to earn in CIS101?	○ A	○ B	○ C	○ D	○ F
Do/did you enjoy taking CIS 101?	○ Extremely liked	○ Liked	○ Indifferent	○ Disliked	○ Extremely disliked
Do/did you like the instructional methods used in the CIS 101 course?	○ Extremely liked	○ Liked	○ Indifferent	○ Disliked	○ Extremely disliked