Creating Gender Parity: An Instruction Aide's Influence

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The decline in the number of women in computing disciplines has been attributed to different causes, and research on the decline continues to grow. While there are numerous reasons suggested for the imbalance in these disciplines, the perceptions that women hold about their computing capabilities continue to be of interest. The current study investigates how a vicarious learning experience can be used to influence computer self-efficacy. To implement the vicarious experience, a computer-assisted peer-modeling instruction aide was developed. The study reveals that vicarious learning has a significant impact on female and male computer self-efficacy, and that the impact may be more significant for females.

Categories and Subject Descriptors: K.3.2 [**Computers and Education**]: Computer and Information Science Education – *Computer science education*; K.4.2 [**Computers and Society**]: Social Issues – *Employment*

General Terms: Design, Experimentation, Human Factors

Additional Key Words and Phrases: Computer self-efficacy, education, gender, IT instruction, social cognitive theory, social modeling, vicarious learning

1. INTRODUCTION

Technology is an integral part of everyday life; its use has become a mainstay in today's society, growing larger with each new, more advanced, innovative system. Hence the need to possess skills to operate and develop these technologies is essential. However, studies indicate that fewer women are earning degrees and receiving training in technology-related disciplines than they did 20 years ago [National Science Foundation 2000]. This disparity is becoming what is known as the "gender gap."

There has been a great deal of research conducted suggesting reasons for the gender gap, among them (1) societal stereotypes; (2) environmental and cultural factors; (3) a lack of visible female role models; and (4) women's different interests and computing experiences [Bunderson and Christensen 1995]. While these and many other suggested reasons for the decline continue to be researched and debated, it is the perceptions that women hold about their computing capabilities that continue to be of interest, and thus provided the impetus for the current research.

2. PURPOSE OF THE RESEARCH

The goal of this research was to investigate the role of vicarious learning on computer self-efficacy. More specifically, the research sought to examine the influence of vicarious learning on female computer self-efficacy and to show that this influence has a more profound effect on females than on males.

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The review of the literature, presented in the next section, led to the following three hypotheses:

- Vicarious learning will have a positive influence on the computer self-efficacy level of both females and males.
- Vicarious learning will have a more positive influence on the computer self-efficacy level of females than on males.
- The training environment will have an impact on the female computer self-efficacy level. Female participants in the vicarious learning environment will exhibit higher levels of computer self-efficacy than their counterparts not exposed to vicarious learning.

3. REVIEW OF THE LITERATURE

In 1977, Albert Bandura introduced the concept of self-efficacy in his work entitled, *Self-efficacy: Toward a Unifying Theory of Behavioral Change.* The concept of self-efficacy is a component of Bandura's social cognitive theory (SCT). SCT explains human behavior from the perspective that human functioning is the product of a dynamic interplay between personal, behavioral, and environmental influences. The interaction creates an interdependent causal structure known as triadic reciprocal causation [Bandura 1997a]. This bidirectional influence, illustrated in Figure 1, gives prominence to the idea that individuals are proactively engaged in their own development and can make things happen by their own actions. SCT emphasizes the role that cognition plays in a person's ability to self-regulate, encode information, and perform behaviors [Pajares 2002]. It has become a widely accepted, empirically validated model on behavior. Consequently, information technology (IT) researchers have been able to use the theory to investigate computer usage and behavior.

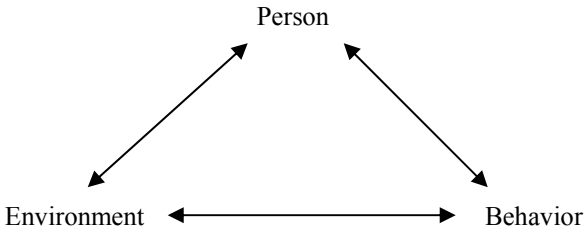

Fig. 1. Triadic reciprocal causation.

3.1 Self-Efficacy

SCT's core construct is self-efficacy. Self-efficacy is defined as the beliefs we have in our capabilities to organize and execute a course of action required to produce given attainments. Self-efficacy has been used in the IT domain to investigate computer usage and adoption. Computer self-efficacy (CSE) is defined as a personal trait that influences an individual's decision to use computers [Compeau and Higgins 1995].

Perceived efficacy is said to influence people's actions, their level of motivation, the

effort that they are willing to extend to a task, as well as their emotional states [Bandura 1997a]. Studies conducted by Hill et al. [1987] and Compeau and Higgins [1995] found that perceived computer efficacy is an important factor in determining the decision to use computers. Similarly, a longitudinal study conducted by Compeau et al. [1999] of 394 end-users over a one-year interval found that self-efficacy and outcome expectations influenced an individual's reactions to information technology. Also, a study conducted by Henry and Stone [1995] of 524 computer-based order-entry personnel and system users found that computer self-efficacy and outcome expectancy had a positive impact on job performance.

3.2 Sources that Influence Self-Efficacy Beliefs

There are four sources that influence self-efficacy. One is enactive mastery experience, or the interpreted results of one's past performance. Repeated success at a task generally raises belief in personal efficacy; similarly, repeated failure lowers efficacy beliefs. Efficacy beliefs are also influenced by a second source, vicarious experience, which is described as observing others performing a task. Personal capabilities are easier to assess when observing the successes and failures of others who have similar capabilities to one's own. Therefore, seeing a person similar to you perform a task successfully will raise your belief in your own efficacy. A third influence that strengthens people's self-efficacy beliefs is verbal persuasion. People who are encouraged verbally to believe that they can successfully complete a task are more likely to exert the concerted effort to do so. However, Bandura [1997a] states that verbal persuasion works more effectively on those who already believe themselves capable of accomplishment. Finally, the fourth influence on self-efficacy is the presence of affective states, including stress, tension, anxiety, and all physiological conditions. Generally, a positive mood increases efficacy beliefs, whereas stress, tension, and anxiety lower them.

Bandura [1997a] states that the mastery experiences are the most influential source of efficacy because "they provide evidence of whether one can muster whatever it takes to succeed." This assertion has been widely investigated by researchers and applied to various domains and fields of study. More specifically, mastery experiences have been shown to have a significant impact on self-efficacy beliefs in the math and information technology domains [Busch 1995; Smith 2001]. Further studies have shown that verbal encouragement and seeing others use and work with technology systems impact self-efficacy as well as performance [Compeau and Higgins 1995]. While researchers support the contention that past performance has a significant impact, and may have the greatest influence on self-efficacy, studies also found that the roles that vicarious learning and verbal persuasion play on self-efficacy may be just as important as mastery experience. Furthermore, researchers have noted that the importance of the roles that each of the sources plays may be divided along gender lines [Smith 2001; Zeldin and Pajares 2000].

In the math domain, Bandura's hypothesis that past performance is the most influential source of self-efficacy beliefs has been confirmed in several studies. For example, Lopez and Lent [1992] in their study of 50 junior-level Algebra II high school students found in their regression results that past performance accomplishments was the most influential source of information on math self-efficacy. Similarly in a study conducted by Lent et al. [1991] of 138 undergraduate college students found that the four sources of self-efficacy were correlated and confirmed Bandura's hypothesis, citing that mastery experience was the most influential source. However, differences between the genders in self-efficacy beliefs were found by both studies, suggesting that these differences be scrutinized further.

Researchers have also examined and applied Bandura's assertion to IT-related areas. Work by Miura [1986] investigated the factors that influenced middle school children toward an interest in and use of computers. The study found that parents' verbal encouragement and computer self-efficacy were the strongest predictors of interest and use, with mastery experience having the most influence on self-efficacy. The study also revealed statistically significant gender differences in all four areas of self-efficacy information. Another study conducted by Smith [2001] found that while mastery experience was the most influential source of computer self-efficacy overall, it was most influential for white males; whereas vicarious learning was the most influential source for females and non-whites. The study consisted of 210 students of varying ethnic backgrounds (115 females and 95 males) at two midwestern universities. Smith used a background questionnaire to collect demographic data and designed a scale consisting of four subscales that corresponded to the four sources of self-efficacy. When Smith explored the differences between gender and the four sources of influence on computer self-efficacy variables, she found that the mastery experience was the most influential source for males and vicarious learning the most influential source for females

Additionally, a study conducted by Zeldin and Pajares [2000] found that vicarious experiences and verbal persuasion were critical sources of belief in self-efficacy for women in math, science, and computing, more so than mastery experience. Zeldin and Pajares used a qualitative method to conduct the research, in which 15 women with current careers in mathematics, science, and technology were interviewed. The researchers designed an open-ended interview protocol that was administered to each participant. The analysis of the participants' responses revealed that both vicarious experiences and verbal persuasions are instrumental sources of self-efficacy beliefs for those women in mathematics-related careers. Zeldin and Pajares found that the participants recalled vicarious experiences and verbal persuasions more than performance attainment, which led them to suggest that the perceived importance of these sources of self-efficacy beliefs may be stronger for women in male-oriented domains than for those in more traditional settings. Consequently, the findings of these studies suggest that more research needs to be conducted, specific to the IT domain, in order to determine the role that vicarious learning plays on women's levels of self-efficacy and performance.

3.3 Vicarious Experience

A person's beliefs about his or her capabilities are a significant part of self-knowledge. Vicarious experiences can alter that knowledge via the influence of different types of modeling. The next sections review two processes by which modeling exerts its effects: self-modeling and social modeling. Also presented are several factors that impact modeled information that are important to the current research.

3.3.1 *Self-Modeling.* Self-modeling is defined as the process by which people observe their own performance in a specifically constructed environment that is designed to bring out their best effort, which then causes cognitive and behavioral change in those people [Bandura 1997a]. Several studies suggest that this form of modeling positively influences belief in self-efficacy. For example, in a study conducted by Schunk and Hanson [1985], children were videotaped solving mathematical problems and were then shown the tapes, after which the children were allowed to engage in self-directed practice. The results of the study revealed that children who were involved in self-modeling had higher levels of self-efficacy, motivation, and self-directed strategy than those who were taped but were not allowed to view the tapes.

3.3.2 *Social Modeling.* To learn by observation, the observer must attend to a model, mentally code the information for retention, be capable of producing the modeled actions, and must also be motivated to do so [Schunk 1999]. Social modeling is not only informative, but is also motivating. Consequently, models not only convey behavior, but also motivate the observer. Thus, seeing others succeed can raise the observers' self-efficacy and motivate them: believing that if others can perform the task, they can perform the task also. There are several studies that support the contention that modeling improves self-efficacy and performance levels. For example, Gist et al. [1989] conducted a study using 108 managers and administrators at a state university to investigate the differences between training methods used to teach computer software skills and their effect on self-efficacy beliefs and performance. The two training methods were modeling, which involves using a live or videotaped model to demonstrate the behaviors required for performance, and tutorial training, which uses computer-aided instruction. The study found modeling produced better performance and influenced all levels of computer self-efficacy more than tutorial training. The findings from this study suggest that vicarious learning is an effective approach in teaching computer software skills because it operates through self-efficacy to influence performance. The study further suggests that by watching a model perform specific software tasks, an observer's beliefs about his or her own software skills are heightened. Similarly, Schunk [1981] conducted a study using children who had difficulty learning mathematics. The children received information on long division by means of either modeling or instruction. One group of children viewed a model who verbalized steps in division while applying them to the problems, whereas the other group received written step-by-step solutions to the problems. The study revealed that while both treatments had a positive influence on self-efficacy, persistence, and performance, the modeling approach led to higher achievement and a more accurate correspondence between self-efficacy and performance.

3.3.3 *Factors that Impact Modeled Information*

Performance Similarity. Perceived similarity between model and observer is an important source of information and motivation [Bandura 1997a; Schunk 1999]. It is suggested that the greater the assumed similarity between model and observer, the more persuasive the model's successes and failures are [Bandura 1997a]. Studies that examined the importance of perceived similarity between model and observer have found that the impact of modeled information on self-efficacy depends on how the information is cognitively processed. In his book, *Self-efficacy: The Exercise of Control*, Bandura notes a study in which perceived similarity in performance between model and observer influenced self-efficacy [Bandura 1997a]. The study found that when students were exposed to a model depicted as having similar mathematical, self-efficacy improved. But when students were exposed to a model with different mathematical ability than theirs, the students' self-efficacy was unaffected. It was concluded that even the smallest similarities and dissimilarities between an observer and model could significantly impact self-efficacy and the corresponding behavior.

Attribute Similarity. Efficacy beliefs are not based solely on comparable experiences but also on similarity to a model's personal characteristics [Bandura 1997a]. The more alike the observer and the model are to each other, the greater the likelihood that the model will influence the observer. People tend to identify with those who are similar to themselves in age, gender, ethnicity, educational and socioeconomic background. But among these attributes it is suggested that age and gender often carry a heavy weight [Bandura 1997a]. In a study by Schunk and Hanson [1985] of children observing a peer

(a student) and a teacher solving (the same) math problems, the children who observed the peer developed higher self-efficacy than the children who observed the teacher. Similarly, in a paper by Schunk [1981] that reviewed 29 studies on model attributes, research supports the idea that the gender of the model influences the performance of the observer. The implication of Schunk's literature review is that peer models of both genders may help to alter ideas, performance, and self-efficacy.

Model Competence. While perceived similarities in performance and attributes between model and observer influence efficacy beliefs, model competence carries an especially heavy weight. It is suggested that competent models command more attention and impose greater instructional influence than do models who are perceived as incompetent [Bandura 1997a]. Schunk [1987] suggested that for children, models of the same age and gender who are perceived as competent by their peers are just as likely to have their behaviors modeled as adults who are viewed as competent. However, when children question the competence of their peers, children tend to model the behavior of adults rather than their peers. Regardless of gender, age, or other personal attributes, model competence overrides attribute dissimilarities in promoting efficacy beliefs and skill development [Bandura 1997a]. If a model is deemed incompetent by an observer, attribute similarity between model and observer has little influence on efficacy beliefs.

The present study was designed to investigate the impact that vicarious learning has on female computer self-efficacy. Social modeling using a peer was used to create the vicarious experience.

4. INSTRUMENTS

4.1 Training Environments

To investigate the influence that vicarious learning has on female computer self-efficacy the researcher examined many educational tutorials and training materials. Since many tutorials and training materials exist for microcomputer software applications, are readily available as freeware through the Internet, and are used in introductory college computer application courses, the content for the tutorial is on the use of a popular microcomputer software application. Furthermore, the impetus was to find an instruction aide with a female modeling computer-based instruction on the software application. However, the researcher was not able to locate any training environment with the aforementioned characteristics. Hence, the development and design of CAPS.

CAPS is an instruction aide that is a computer-assisted peer-modeling software application. In the application a college-aged female provides instruction and demonstrates tasks on a popular microcomputer software application. The model provides step-by-step instructions synchronized with dynamic screen images and text. CAPS was developed to run on microcomputers, both Windows and Mac environments, and is viewed using the QuickTime™ Player. The tutorial is approximately 11 minutes in length.

To explore the influence that CAPS had on female computer self-efficacy, two additional training environments were incorporated into the experimental design. One training environment was the *no training environment*, the control environment, in which only written instructions were provided. The other training environment was a *standard computer-assisted tutorial environment* in which instruction was implemented using a *standard computer-assisted tutorial* (CAST). CAST was designed to resemble already existing commercially produced software tutorials. CAST consists of static screen

captures with synchronized text. CAST has design features that are consistent with CAPS; but it is approximately 10 minutes in length.

4.2 Measures

Data Collector Website. Data was collected through a website connected to a database. The website consists of a demographic survey, descriptions of the microcomputer application tasks, and the computer self-efficacy scale.

Computer Self-Efficacy. To assess change in self-efficacy, a computer self-efficacy scale was developed based on two measures proposed by Bandura [1997b]: the weight-lifting efficacy scale and the problem-solving efficacy scale. The measure consisted of six items and assessed efficacy over three levels of difficulty. Participants recorded the strength of their efficacy beliefs on a 100-point scale, ranging from 0 (I cannot do at all) to 100 (I certainly can do). The computer self-efficacy measure was found to have internal consistency reliability (coefficient alpha) of .89 prior to training and .88 after training was administered.

Performance. To assess change in performance, a pretest measure and a posttest measure were developed. The measures consist of six tasks each worth 10 points per task. Each measure was worth a total of 60 points. Time data was documented using timestamps on the pretest and posttest measures.

Demographic Survey. A background survey was developed which collected demographic information including average computer use and computer experience.

5. METHODOLOGY

5.1 Population

Data was collected from 44 undergraduate students selected at random from several classes at two universities in the state of Alabama. Among the 44 participants, 36 completed the study successfully and provided valid data that was used for statistical analyses. The study population consisted of 18 females and 18 males of varying ethnicities ranging in age from 18 to 27 years. Students were predominately seniors (47.2%); juniors (22.2%), sophomores (22.2%), and freshman (8.3%) made up the remaining population. The majority of students reported that their major was in liberal arts and/or education (50.0%), while business (27.8%) and engineering (22.2%) made up the remaining majors.

A laboratory experiment consisting of a multiple group pretest-posttest design was developed made up of the three training environments. The training environments were designed so that participants received the same content on the use of the microcomputer software application, but differed in delivery method.

5.2 Experimental Design

The experimental procedure began with a brief introduction given by the researcher to the study participants. The participants were then asked to view the data collector website, in which they completed a background survey, reviewed several microcomputer application tasks, and rated their level of self-efficacy using the computer self-efficacy scale. The pretest measure was then administered. Upon completion of the pretest phase, the three training conditions were utilized.

Participants in the *no training environment* were given a posttest to complete, and upon completion, self-efficacy was measured. Participants in the *two training conditions* completed the respective training conditions, and self-efficacy was measured. The two

training condition participants were then given a posttest, and upon completion, self-efficacy was measured again. The experimental design is depicted in Figure 2.

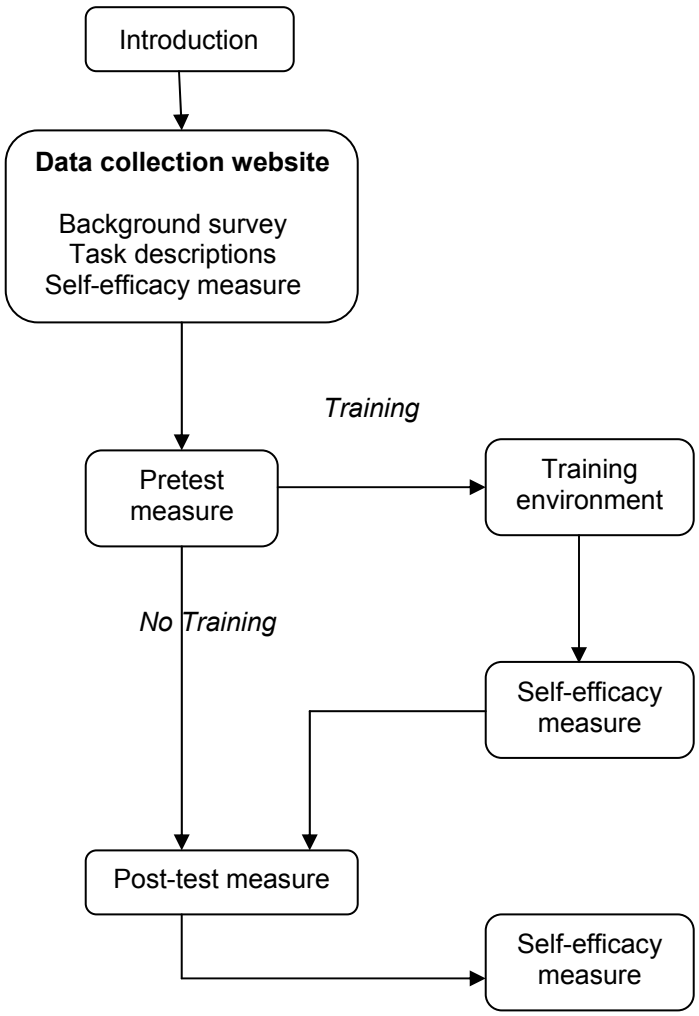

Fig. 2. Experimental design.

6. FINDINGS

To test the three hypotheses, the *t*-test and the analysis of variance (ANOVA) procedure were employed. This section discusses the results of the tests.

To ensure that there was no significant variance in the computer self-efficacy level of the participants before they were divided into the three training conditions, the computer self-efficacy measure was administered. Table I presents the mean scores, standard deviations, and frequencies across the three training conditions. Table II summarizes the ANOVA on computer self-efficacy level between the groups, $F(2, 33) = .484$. No significant difference was found.

Table I. Mean Scores and Standard Deviations for Pretest Computer Self-Efficacy

Condition	*Mean*	*SD*	*N*
No training	460.00	86.44	12
Standard computer-assisted	492.75	102.62	12
Vicarious learning	453.25	123.16	12
Total	468.67	103.59	36

Table II. ANOVA for Pretest Computer Self-Efficacy

Source	*SS*	*df*	*MS*	*F*
Between groups	10731.50	2	5356.750	.484
Within groups	354902.50	33	11057.652	
Total	376616.00	36		

6.1 Vicarious Learning and Computer Self-Efficacy

Hypothesis 1 states that vicarious learning will have a positive influence on the computer self-efficacy level of both females and males. Table III presents the mean scores, standard deviations, and frequencies across the three training conditions. Higher computer self-efficacy scores were found for participants who completed the vicarious learning experience (528.00) than for those who completed the standard computer-assisted tutorial (433.44) and for those in the no training environment (380.00).

Table III. Mean Scores and Standard Deviations for Posttest Computer Self-Efficacy

Condition	*Mean*	*SD*	*N*
No training	380.00	103.31	12
Standard computer-assisted	433.44	110.50	12
Vicarious learning	528.00	110.13	12
Total	447.11	121.89	36

Table IV summarizes the ANOVA on the computer self-efficacy level in which a significant difference was found between the groups, $F(2,33) = 5.77$, $p < .01$.

Table IV. ANOVA for Posttest Computer Self-Efficacy

Source	*SS*	*df*	*MS*	*F*
Between groups	134840.89	2	67420.444	5.77*
Within groups	385128.67	33	11670.566	
Total	519969.56	35		

*$p<.01$.

Table V. Tukey's HSD for Posttest Computer Self-Efficacy

	Vicarious learning	Standard computer-assisted	No training
Vicarious learning	0.00	94.67*	148.00**
Standard computer-assisted		0.00	53.33
No training			0.00

*p<.10. **p<.01.

To ascertain which means were significantly different, Tukey's HSD was employed and the results presented in Table V. Based on these findings, the first hypothesis was supported.

6.2 Vicarious Learning, Gender, and Computer Self-Efficacy

Hypothesis 2 states that vicarious learning will have a more positive influence on the female level of computer self-efficacy than on the male level of computer self-efficacy.

Table VI provides the means scores, standard deviations, and frequencies for females and males in the vicarious learning computer-assisted training environment. A higher computer self-efficacy mean was found for females (591.17) than for males (464.83).

Table VI. Mean Scores and Standard Deviations for Computer Self-Efficacy by Gender for a Vicarious Learning Environment

Condition	*Mean*	*SD*	*N*
Females	591.17	7.08	6
Males	464.83	130.60	6

Table VII. *t*-Test for Computer Self-Efficacy by Gender for a Vicarious Learning Environment

	t	*df*	*Mean difference*
Equal variances assumed	2.366*	10	126.33
Equal variances not assumed	2.366	5.09	126.33

Table VII summarizes the *t*-test for the two independent samples. The two-tailed procedure revealed that there was a significant difference at the .05 level between the effect of vicarious learning on the female level of computer self-efficacy than on the male level of computer self-efficacy, $t(10) = 2.366$. Hypothesis 2 was supported.

6.3 Training Environment, Computer Self-Efficacy and Females

Hypothesis 3 suggests that the training environment will impact female computer self-efficacy. More specifically, it was hypothesized that the females exposed to the vicarious

learning experience who viewed CAPS will have higher levels of computer self-efficacy than females in the standard computer-assisted learning environment who viewed CAST, and than those in the no training environment. Table VIII presents the mean scores, standard deviations and frequencies for all females across the three treatment conditions. Higher means were found for females who viewed CAPS (591.17) than those who viewed CAST (427.50), and than those in the no training environment (366.67).

Table VIII. Mean Scores and Standard Deviations for Females by Treatment Condition

Condition	*Mean*	*SD*	*N*
No training	366.67	116.73	6
Standard computer-assisted	427.50	133.86	6
Vicarious learning	591.17	7.08	6
Total	461.78	137.14	18

Table IX. ANOVA for Computer Self-Efficacy for Females

Source	*SS*	*df*	*MS*	*F*
Between groups	161775.4	2	80887.722	7.681*
Within groups	157971.7	15	10531.444	
Total	391747.1 17			

*$p < .01$.

Table IX summarizes the ANOVA in which significant differences between the groups were revealed, $F(2,15) = 7.681$, $p < .01$. Additionally, pairwise comparisons among the means were used to illustrate the differences between all pairs of means for the females in the three training conditions. Table X presents the findings of Tukey's HSD. The test revealed differences between the vicarious learning condition and the standard computer-assisted condition and also between the vicarious learning condition and the no treatment condition for female computer self-efficacy. Hypothesis 3 was supported.

Table X. Tukey's HSD for Computer Self-Efficacy for Females

	Vicarious learning	Standard computer-assisted	No training
Vicarious learning	0.00	16.67*	224.67**
Standard computer-assisted		0.00	60.83
No training			0.00

*$p < .05$ **$p < .01$.

7. DISCUSSION

The goal of the research was to investigate the influence of vicarious learning on computer self-efficacy. More specifically, the research examined the effect that a peer-

modeling vicarious learning experience had on female computer self-efficacy in relation to male computer self-efficacy.

The findings from the testing of the hypotheses revealed the following:

- Vicarious learning has a positive influence on computer self-efficacy. This finding is consistent with a similar study that suggests that seeing others use and work with technology systems impacts self-efficacy [Compeau and Higgins 1995].
- Vicarious learning has a more positive influence on female computer self-efficacy than on male computer self-efficacy. This finding is the key to the study and a major objective of the research. The results from this study provide support for the contention suggested in other studies that the role that vicarious learning plays on self-efficacy may be more important for females than for males [Smith 2001; Wilson 2002; Zeldin and Pajares 2000].
- Training environment influences female computer self-efficacy. Female computer self-efficacy across the three training environments was compared and the results reveal that females exposed to the instruction aide featuring a peer-model (college-aged female) providing instruction had higher levels of computer self-efficacy than those exposed to a more traditional educational software application and than those who received only written instructions. The finding is consistent with similar studies suggesting that behavioral modeling is an acceptable method of instruction and that attribute similarity raises efficacy beliefs.

7.1 Limitations

Although effective in revealing the influence of vicarious learning on computer self-efficacy, the present study has certain limitations. One limitation was the time allotted to complete the study in its entirety. Since the study was entirely voluntary for participants, there was a need to keep the completion of the study within a reasonable time frame to deter the threat of lack of participation, maturation, and mortality. Consequently, the researcher scaled the study so that it could be successfully completed within a 60-minute time frame and within one sitting. The 60-minute time frame to complete the study also limited the number of tasks that participants were asked to complete for both the pretest and posttest measures. Another limitation of the study was the sample size. The researcher recognizes the size limitation of the sample; however, the richness of the information extracted from the collected data provides a foundation for future studies to be conducted with larger populations.

7.2 Implications for Computing Education

The purpose of the research was to gain a better understanding about the perceptions that women hold about their computing capabilities. A subsequent purpose was to understand how the perceptions could be influenced to encourage women to actively engage in computing. The contributions that understanding the perceptions that women hold about their computing skills helps computing educators in several ways. For example, results from the study can help educators to understand how incorporating a more interactive vicarious experience into their computing curricula can increase female levels of computer self-efficacy, and hence impact performance. Additionally it brings forth a call from educators to software companies to re-evaluate current instruction aides to ensure that the computing needs and usage styles of girls and women are being met. Lastly, it

brings together a community of educators at all levels who are interested in improving female student participation and retention rates in computer science, engineering, mathematics, and technology-related disciplines.

7.3 Recommendations for Future Research

The findings of this study present several recommendations for the extension of this work and for future research. One recommendation is to incorporate verbal persuasion (i.e., positive performance feedback) into a study that examines its influence and the influence of vicarious learning on computer self-efficacy. Another recommendation is to alter the vicarious learning experience. There are several modes of influence, but in the current work, only social modeling was researched. A final recommendation for future work is the development of a variety of instruction aides in which females provide instruction and training. The inability of the researcher to find such a tool was surprising. It could be the case that the absence of software where females provide instruction may be responsible for much more of the gender gap than previously thought.

8. CONCLUSION

The study shows that vicarious learning has a significant impact on both female and male computer self-efficacy. The findings from the study further show that the role that the vicarious learning experience plays may be more significant for female computer self-efficacy than for that of males. The study also suggests that understanding the perceptions that people, especially women, hold about their computing capability is an important factor in their decision to use technology, and that it may be a key in helping to work towards gender parity.

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