The Boy Crisis and the Technology Gender Gap: Laying a Framework for Success

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Abstract - **"***They're kinetic, maddening, and failing at school." These words were used in a recent issue of Newsweek to describe the state of boys in school and the debated topic, "The Boy Crisis." While there are many suggested reasons for the crisis, the perception that boys hold about their capabilities is the focus of the work in progress. The current work is an extension of previous work by the researcher who investigated the technology gender gap. However, with the rise in the number of male students who are either failing or dropping out of school, the researcher felt that it was important to revisit the work, with an emphasis placed on how previous research could be used to impact the "boy crisis." The present work lays a foundation for investigating how a vicarious learning experience can be used to influence the computer self-efficacy and performance level of male students.*

Keywords: Computer self-efficacy, vicarious learning, peer-modeling software, boy crisis.

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1. Introduction

After spending years attempting to close the achievement gap between girls and boys, boys are now stated to be struggling. In the *Newsweek* article, a University of Michigan study was cited as finding that the number of boys who said they did not like school rose 71 percent between 1980 and 2001[7]. The shift is now becoming more evident on college campuses. Thirty years ago, men represented 58 percent of the undergraduate student body. Now they are a minority at 44 percent. The intent of the research is to lay a framework that examines how an instruction aide can be used to influence the computer self-efficacy and computing performance level of male students.

2. Purpose of the research

The goal of the research is to investigate the role of vicarious learning on computer self-efficacy and computing performance. More specifically, the research uses a peer-modeling training approach originally used to study the influence of vicarious learning on the computing self-efficacy and computing performance level of females, to examine the computer self-efficacy and computing performance of males.

3. Review of the literature

3.1 Self-efficacy

Self-efficacy has been used by information technology researchers to investigate computer usage and behavior and has been found to be a significant factor in the decision to use the computer [4,6]. Self-efficacy is a core construct of Albert Bandura's Social Cognitive Theory, which explains human functioning as the product of dynamic interplay between behavior, personal, and environmental influences [1]. Self-efficacy is defined as the belief in one's capability to organize and execute courses of actions required to produce given attainments. There are four sources that influence efficacy information:

- *Enactive mastery experiences* – interpreted results of one's past performance
- *Vicarious experiences* – observing others performing a task
- *Verbal persuasion*
- *Affective states* – physiological conditions

Bandura states that mastery experiences are the most influential source of self-efficacy because "they provide evidence of whether one can muster whatever it takes to succeed [1]." This assertion has been widely investigated by researchers and has been shown to have

a significant impact on self-efficacy beliefs in the math and information technology domains [3,11]. While researchers support the contention that past performance has a significant impact and may have the greatest influence on self-efficacy, studies have also found that the roles that vicarious learning and verbal persuasion play on self-efficacy may be just as important as mastery experience.

3.2 Vicarious experience

A person's belief about his or her own capabilities is a significant part of self-knowledge. Vicarious experiences can alter those beliefs through different types of modeling influences. The next section reviews one type of process by which modeling exerts its effect on efficacy beliefs, social modeling. Also presented are several factors important to the current research that impact modeled information.

3.2.1 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 [9]. Social modeling is not only informative, but is also motivating. Consequently, models are not only used to convey behaviors, but to also motivate the observers. There are several studies that support the contention modeling raises self-efficacy and performance levels. For example, Gist, Schwoerer, and Rosen 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 [5]. The two training methods that were used and compared included modeling, which involved using a live or videotaped model who demonstrated the behaviors that were required for performance, and tutorial training which used computer-aided instruction. The study found modeling produced better performance and influenced all levels of computer self-efficacy more so 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 skill capabilities are heightened.

3.2.2 Factors impacting modeled information

Performance similarity. Perceived similarity between model and observer is an important source of information and motivation [1,9]. It is suggested that the greater the assumed similarity between model and observer, the more persuasive the model's successes and failures [1]. Studies that have 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 performance similarity between model and observer influenced self-efficacy [1]. The study found that when students who were exposed to a model who was depicted to have similar mathematical experiences, self-efficacy was raised. But when students were exposed to a model with different mathematical ability, their self-efficacy was unaffected. It was concluded that even the smallest similarities and dissimilarities between an observer and model can significantly impact self-efficacy and corresponding behavior.

Attribute similarity. Efficacy beliefs are not based solely on comparative performance experiences but also on similarity to models in personal characteristics [1]. The more alike observers are to models, greater is the likelihood that the power the modeling influence has on the observer will increase. People tend to identify with those similar in age, gender, ethnic, educational and socioeconomic background. Among those attributes, it is suggested however, that age often carries heavy weight [1]. In a study conducted by Schunk and Hanson of children who observed a peer (student) and a teacher solve math problems, the children who observed the peer developed higher self-efficacy than the children who observed the teacher do the same math problems [10].

Model competence. While perceived performance and attribute similarity 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 [1]. Schunk suggests 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 [8]. However, when children question the competence of their peers, children tend to model the behavior of adults. Regardless of age, or other personal attributes, model competence overrides attribute dissimilarities in promoting efficacy beliefs and skill development [1]. 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 computer self-efficacy and performance level. Social modeling using peer models was used to create the vicarious experience.

4. Instruments

4.1 Training environments

To investigate the influence that vicarious learning has on computer self-efficacy the researcher examined many tutorials and training materials. Since many tutorials and training materials exist for microcomputer software applications and 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 a tutorial with a college-aged student modeling computer-based instruction on the software application. However, the researcher was not able to locate any training environment with the aforementioned characteristics. Therefore, CAPS was designed and developed.

CAPS is a computer assisted peer-modeling software application in which a college-aged student provides instruction and demonstrates tasks on a popular microcomputer software application. The model provides step-by-step instructions that are 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 impact that CAPS has on both female and male computer self-efficacy and computing performance, *two training environments* were developed. One training environment used a male college-aged student as the model to provide instruction while the other training environment used a female college-aged student to provide instruction.

4.2 Measures

Data collector website. Data were 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, the weight lifting efficacy scale and the problem solving efficacy scale [2]. 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. Both the pretest and posttest measures contained six tasks each worth a total of sixty points.

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

5. Methodology

5.1 Population

Participants are undergraduate students at a university in the state of Alabama. To increase the likelihood of having a diverse population in gender, academic background and ethnicity for the study, students were recruited from degree programs that offer both Bachelor of Arts and Bachelor of Science degrees.

A laboratory experiment consisting of a multiple group pretest-posttest design was created which consisted of the two training environments. The training environments were designed so that participants would receive the same content on the use of the microcomputer software application, but differed in the model presenting the information.

5.2 Procedure

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 self-efficacy scale. The pretest measure was then administered. Upon completion of the pretest, the training conditions were utilized.

Participants in the *two training conditions* completed the respective training condition and self-efficacy was measured. The two training condition participants were then given a posttest and upon completion, self-efficacy was again measured. The experimental design is depicted in Figure 1.

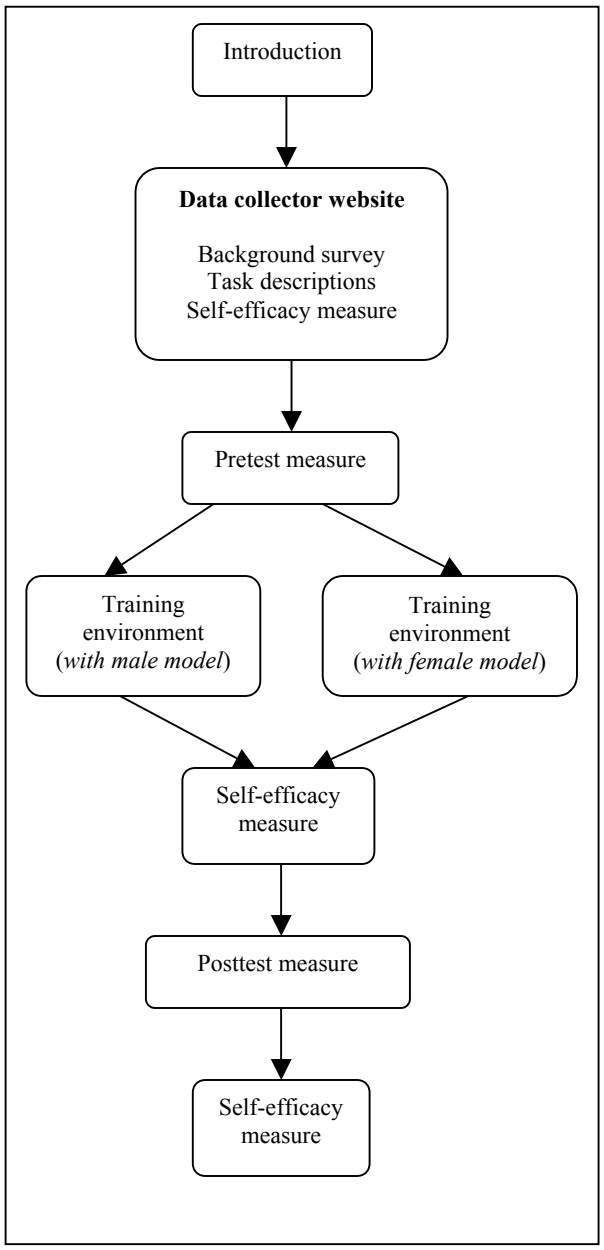

Figure 1. Experimental Design

6. Discussion

The current study is a work in progress. At the time of initial submission of this paper, results are being compiled. However, several conclusions have been drawn as a result of the background research on gender differences in computer related usage and behavior and also on the "boy crisis." For example, there are differing views about the boy crisis. One side asserts that a problem exists with boys and the education that they are receiving, but differs on how to resolve the problem. While another side views the boy crisis more as an inconvenience than a problem. While the researcher takes no side on the issue, it is important to acknowledge the differing views. A second conclusion drawn by the researcher suggests that traditional educational training approaches need to be re-evaluated to ensure that the computing needs and usage styles of both girls and boys are being met. Finally, more studies need to be conducted to better understand how the beliefs of boys and girls hold about their computing and their computing capabilities impact their decisions to use technology and impact their attitudes about technology.

7. Conclusion

7.1 Implications for computing education and society

The work does not seek to explain why the "boy crisis" exists, but it merely suggests a framework in which to gain better insights about the perceptions that students hold about their computing capabilities. It posits that if a vicarious learning experience can be used to increase the computer self-efficacy level of females and their performance level, then a similar approach could be used to influence the perceptions that boys hold about their own capabilities. In the academic domain, the research impacts educators at all levels, who are interested in improving the achievement of both boys and girls. More specifically it can help educators to understand how incorporating a more interactive vicarious experience into the computing curricula can increase student computer self-efficacy and hence impact computing performance. Additionally, it brings forth a dialog between educators and designers of educational software to re-evaluate current instruction aides to ensure that the computing needs of students are being met. Finally, by understanding the perceptions that all students hold about their capabilities, we can secure a future where the economy and society are stable because the educational needs of both boys and girls are being met.

7. 2 Limitations

The present study has certain limitations. One limitation of the research is the differing views on the "boy crisis" topic and also on how the subject should be approached. This issue will continue to be debated and examined. A limitation of the study 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 sixty-minute time frame and within one sitting. The sixty-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.

7.3 Concluding thoughts

There are several recommendations for the extension of this work and for future research. One recommendation is to redesign the study so that the training conditions could be administered across more than two groups. Another recommendation is to extend the target audience and the CAPS application to include elementary and high school level students. Since is has been suggested that the achievement gap is widening between boys and girls in these age ranges, it would be interesting to investigate the influence of a peer-modeling software application on these age-level students. A final recommendation is to alter the vicarious learning experience. There are several modes of influence and in the current work, only social modeling was researched.

The research began as an attempt to understand more about the "boy crisis" and how this issue impacts the gender gap that exists between males and females as it relates to computer-related usage and behavior. The work examined how a peer-modeling software application that had been used previously to influence the computer self-efficacy level and computing performance level of females could also be used to influence computer self-efficacy and computing performance for male students. As educators and researchers, it is important that we continue to examine this topic and to also suggest ways in which to help boys succeed. But more importantly, it is critical for us to remember that if we embrace our differences and help both boys and girls succeed, then as a society, we all succeed.

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