Gender Differences in Learning to Use the Computer: Modeling the Paths to Computer Literacy

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Gender Differences in Learning to Use the Computer:
Modeling the Paths to Computer Literacy

Gary J. Bamossy, Vrije Universiteit, Amsterdam
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INTRODUCTION

Over the past decade, the amount of empirical and anecdotal evidence regarding the domain of "computers and gender" has grown extensively. While the media reports and scholarly studies cover a wide range of perspectives, the results allow for at least a few consistently general conclusions: Men are much more likely to initiate and carry out the decision process to buy a computer. Further, having had a typically positive history of socialization and learning experiences allows them to view computers as toys or machines to be mastered. Males are fascinated, even seduced by the technology. Women, on the other hand, just want computers to work.

Admittedly, these generalizations oversimplify the richness of research questions and findings in scholarly research, and ignore the importance of subtle but critical exceptions to the stereotypes surrounding "gender and computing." Nonetheless, one additional generalized finding in the popular and scholarly literature emerges: the attitudes, competencies, and behaviors that men and women exhibit towards computers starts to develop when they are boys and girls. "Little boys are expected to roll around in the dirt, and explore. Perfect training for learning to use computers, which often requires hours in front of the screen trying to figure out the messy arcana of a particular program. Girls get subtle messages—from society if not from their parents—that they should keep their hands clean and play with their dolls" (Kantrowitz 1994:38-39). Anecdotal evidence of adult gender differences in computing portrays similar sorts of processes at work. The "gender gap in cyberspace" has received attention in national media (Kantrowitz 1994; Silverman and Marion 1992), and there is an ongoing open forum within cyberspace itself, wherein the tone of the insightful (inciteful?) discussion often seems to focus on males' and females' differing perspectives, behaviors, and career opportunities in cyberspace (Plant 1996; see also the homepage, "Gender and Computing," http://ecw.msu.edu/~cs142/gender.html).

It has been well established that at a very early stage, boys and girls seem to "sort out objects and activities and decide which are appropriate for themselves" (Wilder, Mackie and Cooper 1988:216). Scholarly evidence of this sorting process has been substantiated for personal computers as well, with survey data suggesting that males and females view computers and video games as male activities (Wilder et al. 1988). This pattern of socialization continues beyond the realm of childhood via educational institutions, and manifests itself not only in North America, but in a number of industrialized countries. In a study
of 305 Canadian college students, Temple and Lips (1989) reported that women were just as intrigued by PCs as men, but felt inhibited from pursuing formal study of computers by uncertainty about their own abilities. These uncertainties were also reinforced by the negative attitudes of their male peers. In a study of British secondary students, Collis (1988) reports that males report more positive attitudes toward computers following a computer course relative to their male classmates who did not follow the course, while girls who followed the course reported a more negative set of attitudes relative to other female classmates who did not follow the course. In a study of 883 randomly selected Dutch school children aged 13–15 years, Crombach (1986) reports that Dutch girls were more convinced than boys that men and women had equal capacities in their ability to use computers. In another Dutch study, Bannossy and Jansen (1994) found that boys aged 11–13 enter into the introductory course to computers with less fear and a greater sense of self-efficacy regarding computers relative to girls, and tend to profit more from the computer course in terms of greater shifts in attitudes and computer mastery at both the conceptual and practical levels.

There is popular acceptance of the notion that over a lifetime of socialization experiences, men tend to see computers as “fun, and as something to be mastered” while women view computers as “interesting, convenient and useful for the job, but not worthy of obsession.” There are, however, very few empirical studies which investigate the specific cognitive and emotional processes that occur early on in life which contribute to these differing perspectives. Based on a review of the empirical and theoretical literature on socialization and learning theory, this study identifies gender based hypotheses which examine the relationships and expected gender differences in children’s computer attitudes, computer self-efficacy and computer mastery. Using a quasi-experimental design and working with longitudinal data, a structural model is proposed and tested which investigates the relationships of cognitive and affective factors which underlie the process of boys’ and girls’ feelings about, and mastery of, the computer.

LITERATURE REVIEW

Based on comprehensive reviews by Block (1983) and Brody (1985), it appears that there are, in general, a number of conceptual and methodological difficulties to consider in attempting to study gender differences. One must, for example, find a way to distinguish an emotion from the actual expression of that emotion, as well as make a distinction between the components of emotions. Also, whether gender differences become manifest may depend on other variables such as the situational context, age, the quality of the emotion (e.g., happiness or anger), and the object of the emotion (e.g. the self, objects, or other persons). Gender differences in the expression of emotions “vary as a function of age, cognitive abilities, quality of emotion, and situational context, in accordance with culturally determined display rules” (Brody 1985: 121). As a result of these interactions, it becomes very difficult to generalize about gender differences in emotions and in emotional development. Block concludes that “Efforts to understand the psychological differences between sexes and the extent to which these differences may be influenced by gender-differentiated socialization emphases have thus far been largely empirical and unguided by theory. This empiricism has not taken on or been provided with conceptual form.” She concludes that most studies compare
only mean levels of responses for males and females, neglecting the pattern among the variables (Block 1983:1336-37). The literature review which follows offers both conceptual foundations and empirical evidence for gender related differences in the affective and cognitive processes of developing attitudes and learning about the computer.

Fear, Self-efficacy, and Learning

From a social learning theory perspective, Bandura and others set out the general relationships of self-efficacy, fear, and learning. "Perceived self-efficacy is concerned with judgments of how well one can execute courses of action, required to deal with prospective situations" (Bandura 1982:123-27). Self-efficacy is influenced by emotional arousal in that a person uses his/her perception of his/her physiological state in assessing performance capability. If a person detects feelings of fear, feelings of vulnerability arise, which have a negative impact on performance (Bandura 1977, 1986; Gist 1987).

Independent of any gender specific hypotheses, one can hypothesize that fear leads to discounting the belief in the importance or value of a task, as well as having a negative influence on actual performance. Within the context of this study, fear is hypothesized to have a negative influence on beliefs in the utility of the computer, and on the student's performance, which is operationalized as the computer literacy score.

Self-efficacy is defined as one's perceived capability to perform a specific task (Gist 1987), and one's self-beliefs are strong predictors of motivation and task performance. Increased self-efficacy (also referred to as self-confidence, or self-assurance [Eden and Kinnar 1991:77]) has been shown to be positively related to performance in many task domains (Bandura 1982; Frayne and Latham 1987; Gist 1987, 1989), as long as the efficacy measure is tailored to the specific domains. In general, those who have a strong sense of efficacy exert greater effort to master the challenges (Bandura 1986). Within the context of computer learning, we can hypothesize that high self-efficacy has a positive influence on developing computer literacy. Alternatively, low self-efficacy causes anxiety and fear in the face of challenges (Bandura 1982:136).

Important in this context is the aspect of controllability in self-efficacy, i.e. the perception of being the personal agent of causality instead of being totally passive and dependent on the events. Bandura (1982:137) quotes a number of studies which support that "perceived self-efficacy operates as a cognitive mechanism by which controllability reduces fear." Conversely, fear arises from perceived ineffectiveness. Thus, in a negative feedback loop, low self-efficacy has a negative influence on fear.

Self-efficacy is higher when performance determinants in new, unknown, unfamiliar situations are anticipated as internal, variable, or controllable (e.g. effort) than when they are perceived as external, stable, or uncontrollable (Gist and Mitchell 1992). There is evidence that women have less self-efficacy in their ability to perform unfamiliar or competitive tasks (Lenney 1977; McCarty 1986). More specific, there is evidence of gender differences in self-efficacy about personal computers (Wilder, Mackie and Cooper 1988). In that study, the mediating role of self-efficacy was clearly demonstrated: Although any previous experience with the computer makes both boys and girls more comfortable, only learning a programming language increased females' sense of computer competence. Actual computer
interaction, if unsuccessful, might soon undermine females' confidence (i.e.
self-efficacy). Also, Volman (1994)
found that girls are less self-confident
about the computer than boys. Her
explanation is that the computer has a
strong "male image" (i.e., games are
exclusively oriented toward boys; there
are almost no female characters, and
dominant activities are fighting,
shooting and kicking). Based on the
above, we can hypothesize that males'
stronger self-efficacy regarding
computers will have a more positive
effect on mastering the computer,
relative to girls.

Affect, Self-efficacy and Learning

Although self-efficacy is situation-
specific (i.e., you can be high on self-
efficacy in playing chess, and low in
riding a motorcycle), when you have
learned to master a lot of situations, you
acquire a generalized self-efficacy
This is more a general feeling of internal
control, of certainty, of confidence that
whatever situation you will be
confronted with, in the end you will
have learned to deal with it effectively.
Generalized self-efficacy pertains to
"beliefs about self-competence in
achievement situations in general"
(Eden and Kinnar 1991:771), or to "the
joy of being a cause", and to "make
things happen" (Gecas 1989:292). The
difference between self-efficacy and
competence motivation is that with the
former you strive for control, and with
the latter for competence. What helps
you to become generally self-confident
is the personal disposition of Positive
Affect-being expressive, assertive,
outgoing, i.e., having positive emotions
("liking", "being excited", "having
fun", "being enthusiastic"). As
measured in a specific, domain-oriented
context, a number of studies conclude
that "cognitive efficacy is enhanced by
positive affect, and is diminished by
negative affect. Thus, positive affect
has a positive influence on self-efficacy
and negative affect has a negative
influence on self-efficacy" (Basso,

While it might be tempting to view
affect as one dimension along a
continuum ranging from positive to
negative, Watson and Tellegen's Mood
Models (1985) offer consistent evidence
of positive affect and negative affect as
independent orthogonal dimensions that
emerge in factor analysis after a varimax
rotation (Meyer and Shack 1989;
Watson and Tellegen 1985). In
describing these dimensions, the high
negative affect continuum is
characterized by such constructs as
"distressed, fearful, jittery, nervous,
hostile, and scornful," while the low
negative affect continuum is
characterized by constructs such as "at
rest, placid, calm, relaxed." The high
positive affect continuum loads strongly
on items such as "excited, active,
elated, enthusiastic, peppy, and
strong," while the low positive affect is
described as "drowsy, dull, sleepy, and
sluggish" (Meyer and Shack 1989:693).
While these dominant dimensions of
Positive Affect and Negative Affect
were empirically tested on American
subjects, there is also evidence of the
Positive and Negative affect structures
across cultures (Watson et al. 1984),
and across differing response formats
(Watson 1988). Within the context of
this study, it can be hypothesized that
children may hold both positive and
negative feelings toward computers,
and that these feelings serve to either
increase or reduce their sense of fear as
well as their sense of self-efficacy
toward computers.

The concept of learned helplessness,
which refers to the belief that one
cannot produce specific performances
(Seligman, 1975) allows for some
hypotheses on gender differences with
respect to learning how to use the
computer. Brody (1985) concludes in a review that girls experience and express more self-directed helplessness. Girls tend to inhibit negative affects and to turn them against themselves, a process of internalized defenses. Boys are more inclined to use externalized defenses. They turn against others or project negative feelings externally. Block (1983) also reached the conclusion that males show less evidence than females of learned helplessness in achievement situations. There is also evidence that learned helplessness is encouraged in girls by teacher-student interaction in the classroom. An important dimension of learned helplessness is the personal, or self-directed attribution of failure, which constitutes a profound sense of personal inefficacy (Brody 1985). Volman (1994) found that when making mistakes in working with the computer, girls showed more self-attribution than boys. Block (1983) concludes the same, i.e., that females "blame their failures on lack of ability more often than males." Based on this, we expect that within the context of computer learning, low self-efficacy will be more likely among girls, and have a stronger negative influence on their sense of fear for computers, relative to boys.

For boys, learning to handle a computer is a motivation in itself; it is fun in itself to play around with and eventually to master a computer. "People avoid activities that they believe exceed their coping capabilities, but they undertake and perform assuredly those that they judge themselves capable of managing" (Bandura 1982:123). Both Bamossy and Jansen (1994) and Volman (1994) found that boys had more fun in working with computers than girls. Nearly all boys in both studies had a period of "being addicted" to computer games. Given this, there is no need for an external reward. But girls played with the computer only if they "really had nothing better to do." Based on this, Volman (1994) suggested emphasizing the real-world, practical utility of the computer to girls, instead of presenting the computer as an abstract machine. This line of reasoning suggests that for girls, computer literacy may be mediated by their set of beliefs in the computer's utility, and to become a computer literate, it is necessary to see the general utility of what you are doing. In this respect, girls are much more externally motivated and oriented. Thus, we can hypothesize different paths during the process of becoming computer literate: For boys, self-efficacy may improve their beliefs in the computer's utility, but it is hypothesized that there is also a direct relationship between self-efficacy and computer literacy. For girls, the path from self-efficacy to computer literacy is not likely to be direct, but instead is mediated by their utility beliefs.

Taken together, the above literature provides both theoretical and empirical support for the case that attitudes (both positive and negative), fear, self-efficacy, and beliefs in the utility of the computer will both directly and indirectly influence the process of mastering the computer. With respect to gender differences in learning to use the computer, we can now hypothesize the following sets of relationships: For boys, the process of learning would start with a positive affect and a sense of (over)confidence about computers, leading to a high sense of self-efficacy. Approaching the computer is an open, playful situation (such as the classroom), they make gains in self-efficacy, which serves to further reduce their fear. As an additional outcome, the self-efficacy leads to both higher beliefs in the utility of the computer as well as directly influencing their mastery of the computer. For girls, the path to literacy would look different: Girls tend to enter into the computer learning situation with greater negative affect, and without a sense of open playfulness—conditions which enhance
fear and inhibit learning. While the paths between positive and negative affect, fear, and self-efficacy are expected to be the same for boys and girls, we would expect the magnitude of those relationships to differ. Also, for girls we would not expect a direct path from self-efficacy to computer literacy, but a path from self-efficacy to utility beliefs, to literacy. These gender based path differences are presented in Figure 1, and the results section offers the findings of structural equation analyses which test the causal paths of the models.

METHODOLOGY

The sampling frame for this study consisted of 17 middle level schools (equivalent to junior high) from all regions of The Netherlands. Based on an original inventory of 130 schools, these 17 were selected for the following reasons: (1) they used exclusively one of two distinct types of computer operating systems for their computer courses (Macintosh, or MS-DOS systems); (2) their courses were of identical lengths (ten weeks, one hour per week); and (3) their course objectives were similar—introduction to the general uses and workings of computers (including its operating system), and the basics of word processing.

A variety of data collection techniques were employed in this study. Principal researchers interviewed instructors from each course to understand their approaches and goals in the course, and to collect copies of their course handbooks for subsequent content analysis. During the first week of the course, the researchers introduced themselves to the students, and self-administered questionnaires were passed out and completed in a 50 minute session, and then collected. Measurements included:

(1) A 33 item battery of attitude questions taken from the Minnesota Computer Literacy and Awareness Assessment Scale (1979—a scale which has been translated, adapted, and validated for Dutch students by Crombach [1988])

(2) The standardized measure of computer literacy, which measures students' conceptual and practical understanding of the computer

(3) Measures of students' previous experiences with computers before coming to this course, including number of hours on the keyboard, and sources of information about computers, such as family and friends and media

(4) Demographic information.

Finally, in order to have some measure of the student's innate abilities with computers, the Differential Aptitude Test for Spatial Abilities (Fokkema and Dirkzwager 1960) was administered, and used as a covariate in subsequent analyses. Since administration of these measures took the entire 50 minutes, researchers were invited to stay for additional classes which were not participating in the study (if any), in order to simply observe how students interacted with the computer, and between themselves.

In the tenth and final week of the course, researchers again visited the schools, and re-administered the attitude battery, the computer literacy test, and asked the instructor for a grade of the student’s performance in the class, using a 10 point scale (the common grading measure in The Netherlands). During week one, 655 questionnaires were completed in 29 classes at the 17 different schools. Due to drop-outs and illness during the day of data collection in week 10, a total of 607 students
remained in the study. In the majority of data collection sessions, the research teams were comprised of one male and one female researcher, so the potential bias of interviewer-interviewee interactions based on gender should have been minimal.

FINDINGS

General Descriptive Findings

While the course work was the students' first formal introduction to the computer, 55% of them reported having had at least one experience with a personal computer in the past. While there were no gender differences in having had at least one experience with the PC, boys were significantly higher in self-reporting the number of hours on the keyboard. Subsequent questions relating to types of programs used (i.e., word processors, data bases, math programs) showed extremely low usage rates for the entire sample, and no differences between boys and girls on type of application. The major explanation for differences between boys and girls in computer experiences prior to the formal course work comes from boys having more experience at playing computer games.

Boys self reported a higher incidence of having a PC at home (60% vs. 45%), a finding which is likely an example of over-reporting for both sexes, since market penetration for personal computers in the home is approximately 30% in The Netherlands. Boys also report having more family discussions about the possibility of getting a PC for the home, and self-reported higher incidence of reading books and magazines which specialize in computers relative to girls. In more general terms, there are also gender differences in preferences for school subjects, with boys more often preferring math and "hard" sciences, and girls reporting higher preferences for language courses, drawing, and music (all differences at p<.05).

Finally, boys score on average about 10% higher on the Spatial Abilities test (t=2.72, p<.01), a common finding for subjects in this age group. The final sample was comprised of 326 boys and 281 girls from all regions of the country, with an average age of 14.3 years (s.d. of 2.2 years).

Attitude Structure and Change

In order to assess the dimensions of the students' attitude structure towards computers prior to the course work, principal components factor analysis with varimax rotation was conducted on the 33 attitude questions. This resulted in five significant factors, accounting for 40% of the variance in the data set. Factor loadings and Cronbach alphas for the attitude items are given in Table 1. In order of explained variance, the five factors comprised items which could be described as the dimensions of fear, self-efficacy, negative affect, positive affect, and utility beliefs. Four of the five factors are similar in dimensions to Crombach's 1986 study, and the additional factor in these data is explained by the two dimensions of affect, as opposed to Crombach's one affective dimension. Formed as linear composites, these items served as multiple measures of the constructs, and a path analysis approach was used to test the hypothesized models.

The second wave of data collection in week 10 also involved responding to the 33 attitude questions, and while the Cronbach alphas varied slightly between weeks one and ten, the structure of the factors remained the same. Finally, the Computer Literacy Test Score (CLT) was also taken in week ten (as in week one), and this construct serves as the outcome variable
in the structural models that follow. During week ten, the student's grade in the course was also collected from the instructor, with the intention of using this measure as a second outcome variable. Unfortunately, there was a skewed distribution of grades at all schools in the sample, and little discrimination between students. An introductory computer course is seen as a course in skill development, and not as a "hard" core course. Apparently, computer teachers share a philosophy that there should not be any "below average" grades for this kind of course.

Generally, the analyses of mean differences shows that relative to girls, the boys enter into the computer classroom with significantly lower levels of fear and negative affect, and higher levels of self-efficacy, positive affect, utility beliefs, and CLT scores. Following the ten week course, it is clear that boys tend to profit the most from the experience, with the same pattern of differences once again emerging. Full details of mean differences between boys and girls and between pre-course and post-course measures with respect to these six constructs are reported in Bamossy and Jansen (1994).

Model Tests on Gender Differences in the Process of Learning

While the mean differences in both gender and pre-post scores are revealing, the focus of this analysis is to test for gender differences in the hypothesized relationships of cognitive and affective factors which underlie the process of children's feelings about, and mastery of the computer. Figure 1 sets out the hypothesized paths of relationships, based on the preceding literature review, and Table 2 reports the test of the relationships, based on the measures taken in week one. Results of this model test do not take into account the effects of 10 weeks of computer lessons, but do provide a useful perspective on the relationships between the constructs at the start of the student's formal computer training.

Results of the trimmed model, showing only significant paths (p<.05) between constructs at week one are given in Figure 2. Figure 3, and Table 3 present the results of model testing on the post-course measures at week ten, and provide the basis for a comparative discussion of the impact of the lessons on both boys and girls.

Test of the Hypothesized Model at Week One

Prior to course work, the pattern of significant relationships between Positive Affect, Negative Affect, Self-Efficacy, Fear, and Beliefs in the Utility of the Computer are the same for boys and girls, although the magnitude of those relationships differs (see Figure 2, and Table 2). For boys, the positive relationship between Positive Affect and Self-Efficacy is stronger, while for girls, the negative relationship between Positive Affect and Self-Efficacy is stronger. While Negative Affect reduces Self-Efficacy for both boys and girls, it seems to have a greater impact on girls. Likewise, while Self-Efficacy reduces Fear, the results suggest that the higher Self-Efficacy of boys leads to lower levels of fear, relative to girls. Contrary to expectations, Self-Efficacy had no direct influence on Computer Literacy for either boys or girls. Finally, in terms of similarities, both boys and girls have a significant path from Self-Efficacy to Utility Beliefs, although this path is much stronger for boys than it is for girls.

It is in the relationships between Fear, Utility, and Computer Literacy that differences begin to emerge. First, boys have a significant and positive path between Fear and Utility Beliefs,
while it was originally hypothesized that this relationship would be negative. For girls, there is no significant path. This result suggests that for boys higher levels of fear lead to more positive beliefs in the utility of the computer. Perhaps because of their higher levels of anxiety, boys want to believe that the computer is useful. Second, Fear has a direct and negative impact on Computer Literacy for boys, a finding consistent with the hypothesized relationship, while the girls' results show no direct path at all. Instead, the girls' path follows the hypothesized route of Self-Efficacy to Utility Beliefs to Computer Literacy.

**Test of the Hypothesized Model at Week Ten**

Following the ten weeks of the computer course, the identical measures were taken on all subjects, and the hypothesized model was tested again. An overview of those findings is given in Table 3, and Figure 3 portrays the model for boys and girls in terms of significant paths.

Here again, there is a strong pattern of similarities for both boys and girls in the relationships between Positive and Negative Affect and Self-Efficacy, and Self-Efficacy and Fear. However, the magnitude of the relationships is now different relative to the model test in week one. In week ten, the path from Positive Affect to Self-Efficacy is much stronger for girls, relative to week one, and this path is even stronger than the boys' path, an opposite finding relative to ten weeks prior. This may be due to a possible ceiling effect among boys, who came into the class with more favorable attitudes than girls, or it may also be the case that girls' positive attitudes have shifted after ten weeks of experience with the computer, and this has enhanced their self-efficacy. A different interpretation can be found in the relationship between negative affect and self-efficacy: Here again, both boys and girls have significant paths, but in week one girls had a strong negative relationship, while in week ten, it is the boys who show a stronger path. While increases in Positive Affect and decreases in Negative Affect both have a positive impact on Self-Efficacy, the girls' greatest gains seem to come from a strengthening of the relationship between Positive Affect and Self-Efficacy, while the boys' greatest gains in Self-Efficacy come from a lowering of Negative Affect. Finally, in an examination of the error residuals matrix from testing the hypothesized model in week ten, the data suggest freeing the parameter from Negative Affect to Beliefs in the Utility of the computer. This negative relationship was unexpected, but significant for both boys and girls, suggesting that as their Negative Affect toward the computer goes down, this leads to gains in their beliefs about the Utility of the computer.

Just as in week one, gender differences emerge in the relationships between Fear, Utility Beliefs, and Computer Literacy, although in week ten the pattern of differences is not only between genders, but also within gender. For boys, the significant negative relationship between Fear and Utility Beliefs is gone following ten weeks of course work, and a new path emerges between Utility Beliefs and Computer Literacy, a finding consistent with the hypothesized model. Computer anxiety no longer influences their Utility Beliefs, but Utility Beliefs have a positive impact on Computer Literacy.

For girls, a number of important changes in the relationships between Self Efficacy, Utility Beliefs, Fear, and Computer Literacy seem to have taken place. Following ten weeks of computer experiences in the classroom,
the significant positive relationship between Self Efficacy and Utility Beliefs is gone, and a direct negative path from Fear to Computer Literacy is established (although at the .10 level). In examining the residual matrix of the girls' hypothesized model, the data suggest that a parameter should be freed which offers an opposite relationship from the hypothesized model: a significant path from Computer Literacy to Utility Beliefs. This result is unexpected, and would argue that as girls become more computer proficient, their beliefs in the utility of the computer are increased.

In reviewing the two model tests for boys, the following summary observations can be made: Positive and Negative Affect work in the predicted ways with respect to Self-Efficacy and Fear, and over a period of ten weeks, reductions in Negative Affect increase Beliefs in the Utility of the computer. Perhaps more importantly, over the ten weeks of classroom experience, Fear no longer negatively impacts their Beliefs in the Utility of the computer. Positive Affect enhances Self-Efficacy, which has a positive relationship on Utility Beliefs, and following ten weeks of computer lessons, the link between Utility Beliefs and Computer Literacy becomes significant and positive for boys. Taken together, the boys' findings provide strong support for the hypothesized model. Of special note is the mediating role of Utility Beliefs on Self-Efficacy and Computer Literacy, and the lack of a direct link between Self-Efficacy and Computer Literacy.

For girls, the important differences are in the relationships between Self-Efficacy, Fear, Utility Beliefs, and Computer Literacy. Based on this study's results, the conclusion would be that ten weeks of computer lesson in the classroom reduces girls' positive relationship between Self-Efficacy and Utility Beliefs, and introduces a negative relationship between Fear and Computer Literacy. Furthermore, the results suggest that Fear now mediates between Negative Affect and Computer Literacy, and that higher levels of Computer Literacy have a positive impact on their Beliefs in the Utility of the computer--a finding opposite to the hypothesized relationship based on Learning Theory, and a finding opposite to the anecdotal evidence in popular media regarding women and computers.

REFERENCES


<table>
<thead>
<tr>
<th>ITEMS IN FACTOR ONE (Fear)</th>
<th>factor loading</th>
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<tbody>
<tr>
<td>The strange words and symbols used in computers frighten me.</td>
<td>.62</td>
</tr>
<tr>
<td>I feel nervous when I'm sitting in front of a computer.</td>
<td>.70</td>
</tr>
<tr>
<td>Computers remain a mysterious thing to me.</td>
<td>.59</td>
</tr>
<tr>
<td>I'm afraid to push a wrong key on the computer.</td>
<td>.68</td>
</tr>
<tr>
<td>Computers frighten me.</td>
<td>.49</td>
</tr>
<tr>
<td>I get nervous if I see a computer.</td>
<td>.56</td>
</tr>
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<td>% of variance explained</td>
<td>9%</td>
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<td>.74</td>
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<th>ITEMS IN FACTOR TWO (Self Efficacy)</th>
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<tr>
<td>I think I'll learn quickly how to use a computer.</td>
<td>.76</td>
</tr>
<tr>
<td>I'll easily learn how to use a computer.</td>
<td>.81</td>
</tr>
<tr>
<td>I think I'll get a good grade in my computer class.</td>
<td>.40</td>
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<tr>
<td>I feel ready to use computers.</td>
<td>.44</td>
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<tr>
<td>% of variance explained</td>
<td>8%</td>
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<td>Cronbach α</td>
<td>.74</td>
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<th>ITEMS IN FACTOR THREE (Negative Affect)</th>
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<tr>
<td>I don't want to take computer lessons at school.</td>
<td>.70</td>
</tr>
<tr>
<td>I'm not prepared to work with a computer.</td>
<td>.55</td>
</tr>
<tr>
<td>I've got something against computers.</td>
<td>.63</td>
</tr>
<tr>
<td>Computers have very little use to me.</td>
<td>.60</td>
</tr>
<tr>
<td>I think it will be boring to use a computer in class.</td>
<td>.60</td>
</tr>
<tr>
<td>% of variance explained</td>
<td>8%</td>
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<tr>
<td>Cronbach α</td>
<td>.76</td>
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Table 1 (continued)

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<th>ITEMS IN FACTOR FOUR (Positive Affect)</th>
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<tbody>
<tr>
<td>I always stop in front of a store window displaying computers.</td>
<td>.71</td>
</tr>
<tr>
<td>I'd like to take a computer class in my free time.</td>
<td>.60</td>
</tr>
<tr>
<td>I feel relaxed in using a computer.</td>
<td>.54</td>
</tr>
<tr>
<td>I like to read about computers.</td>
<td>.71</td>
</tr>
</tbody>
</table>

% of variance explained: 8%
Cronbach α: .74

<table>
<thead>
<tr>
<th>ITEMS IN FACTOR FIVE (Utility Beliefs)</th>
<th>eigenvalue</th>
<th>% of variance explained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers play an important role in our daily lives.</td>
<td>.53</td>
<td>7%</td>
</tr>
<tr>
<td>I think it's important for everyone to know about computers.</td>
<td>.61</td>
<td>7%</td>
</tr>
<tr>
<td>All students should know what roles computers play in our world.</td>
<td>.59</td>
<td>7%</td>
</tr>
<tr>
<td>Computers have more disadvantages than advantages.</td>
<td>.53</td>
<td>7%</td>
</tr>
<tr>
<td>Learning how to get on with computers is important for my future.</td>
<td>.64</td>
<td>7%</td>
</tr>
</tbody>
</table>

eigenvalue/o/ % of variance explained: 7%
Cronbach α: .62
<table>
<thead>
<tr>
<th>CONSTRUCT</th>
<th>PARAMETER</th>
<th>T-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Girls</td>
</tr>
<tr>
<td><strong>POSITIVE AFFECT</strong></td>
<td>$\gamma_{11}$</td>
<td>3.78</td>
</tr>
<tr>
<td></td>
<td>$\gamma_{21}$</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>NEGATIVE AFFECT</strong></td>
<td>$\gamma_{12}$</td>
<td>-4.33</td>
</tr>
<tr>
<td></td>
<td>$\gamma_{22}$</td>
<td>2.58</td>
</tr>
<tr>
<td><strong>SELF EFFICACY</strong></td>
<td>$\beta_{21}$</td>
<td>-3.41</td>
</tr>
<tr>
<td></td>
<td>$\beta_{31}$</td>
<td>2.73</td>
</tr>
<tr>
<td></td>
<td>$\beta_{41}$</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>FEAR</strong></td>
<td>$\beta_{32}$</td>
<td>n.s.</td>
</tr>
<tr>
<td></td>
<td>$\beta_{42}$</td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>UTILITY BELIEFS</strong></td>
<td>$\beta_{43}$</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Model Fit Statistics For Girls: $\chi^2 = 8.38$ (4 d.f., p. = .08); AGFI = .86
Model Fit Statistics for Boys: $\chi^2 = 7.59$ (4 d.f., p. = .11); AGFI = .87
Table 3
RESULTS OF TESTING THE REVISED MODEL
BASED ON POST-COURSE MEASURES

<table>
<thead>
<tr>
<th>CONSTRUCT</th>
<th>PARAMETER</th>
<th>T-VALUE</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Girls</td>
<td>Boys</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.45</td>
<td>7.15</td>
<td></td>
</tr>
<tr>
<td>POSITIVE AFFECT</td>
<td>γ11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>γ21</td>
<td>n.s.</td>
<td>n.s.</td>
<td></td>
</tr>
<tr>
<td>NEGATIVE AFFECT</td>
<td>γ12</td>
<td>-5.08</td>
<td>-6.86</td>
<td></td>
</tr>
<tr>
<td></td>
<td>γ22</td>
<td>4.46</td>
<td>3.43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>γ32</td>
<td>-5.16</td>
<td>-4.20</td>
<td></td>
</tr>
<tr>
<td>SELF EFFICACY</td>
<td>β21</td>
<td>-3.46</td>
<td>-6.09</td>
<td></td>
</tr>
<tr>
<td></td>
<td>β31</td>
<td>n.s.</td>
<td>2.21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>β41</td>
<td>n.s.</td>
<td>n.s.</td>
<td></td>
</tr>
<tr>
<td>FEAR</td>
<td>β32</td>
<td>n.s.</td>
<td>n.s.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>β42</td>
<td>-1.42</td>
<td>-1.70</td>
<td></td>
</tr>
<tr>
<td>UTILITY BELIEFS</td>
<td>β43</td>
<td>n.s.</td>
<td>2.34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>β34</td>
<td>2.95</td>
<td>n.s.</td>
<td></td>
</tr>
</tbody>
</table>

Model Fit Statistics For Girls: $\chi^2 = 5.60$ (2 d.f., p = .08); AGFI = .99
Model Fit Statistics for Boys: $\chi^2 = 7.59$ (3 d.f., p = .06); AGFI = .93
Figure One
Hypothesized Model

Positive Affect $x_1$

Self-Efficacy $y_1$

Negative Affect $x_2$

Fear $y_2$

$\phi$

$\gamma_{11}$

$\gamma_{21}$

$\gamma_{12}$

$\gamma_{22}$

$\beta_{11}$

$\beta_{21}$

$\beta_{32}$

$\beta_{41}$

$\beta_{42}$
Figure Two: Girls
Trimmed Model Based on Pre-Course Measures

Positive Affect $x_1$ → $\gamma_{11}$ Self-Efficacy $y_1$ → $\beta_{11}$+

Negative Affect $x_2$ → $\gamma_{12}$ Self-Efficacy $y_1$ → $- \beta_{21}$-

Self-Efficacy $y_1$ → $\beta_{11}$+

Fear $y_2$ → $\gamma_{22}$

Positive Affect $x_1$ → $\gamma_{11}$ Self-Efficacy $y_1$ → $\beta_{11}$+

Negative Affect $x_2$ → $\gamma_{12}$ Self-Efficacy $y_1$ → $- \beta_{21}$-

Self-Efficacy $y_1$ → $\beta_{11}$+

Fear $y_2$ → $\gamma_{22}$
Figure Two: Boys
Trimmed Model Based on Pre-Course Measures

\[ \begin{align*}
\text{Positive Affect } x_1 & \rightarrow \gamma_{11} \rightarrow \gamma_{12} \rightarrow \gamma_{22} \rightarrow \text{Fear } y_2 \\
\text{Self-Efficacy } y_1 & \rightarrow \beta_{31} \rightarrow \beta_{32} \rightarrow \text{Fear } y_2 \\
\text{Negative Affect } x_2 & \rightarrow \gamma_{12} \rightarrow \gamma_{22} \rightarrow \text{Fear } y_2
\end{align*} \]
Figure Three: Girls Trimmed Model Based on Post-Course Measures

\[ \begin{align*}
\text{Positive Affect } x_1 & \rightarrow \text{Self-Efficacy } y_1 \\
\text{Negative Affect } x_2 & \rightarrow \text{Fear } y_2
\end{align*} \

\begin{align*}
\gamma_{11} \quad + \\
\gamma_{12} \quad - \\
\gamma_{22} \quad + \\
\beta_{21} \quad - \\
\gamma_{32} \quad - \\
(0.10) \quad - \\
\beta_{42}
\end{align*}
Figure Three: Boys Trimmed Model Based on Post-Course Measures

- Positive Affect $x_1$ 
  \[ \gamma_{11} + \quad \gamma_{12} - \]

- Negative Affect $x_2$ 
  \[ \gamma_{22} + \]

- Self-Efficacy $y_1$ 
  \[ \beta_{21} - \quad \gamma_{11} + \quad \gamma_{12} - \quad \gamma_{32} - \quad \beta_{31} + \]

- Fear $y_2$ 
  \[ \beta_{42} - \]

- Other Variables