9

Primary boys and girls' math and computer self-efficacy beliefs and their relation to students' socialization experiences beyond school

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Introduction

According to many international studies, girls report lower self-efficacy for male-typed academic domains, such as maths and technology, compared to boys (Hanna, 1996, Jacobs et al., 2002; Janssen Reinen & Pomp, 1997; Volman & van Eck, 2001). These gender differences have drawn attention because they can add to potential interpretations of females' low participation in math- and technology-related fields: self-efficacy beliefs influence not only the quality of students' learning but also their future academic and career choices (Bandura, etal., 2001).

Several studies have attempted to explain these gender differences by examining the nature of boys and girls' socialization experiences. Specifically, gender differences in students' math self-efficacy have been linked to gender differences in parental expectations and involvement in children's math learning. Many parents hold gender-stereotyped views about maths (Jacobs et al., 2005) and *are* likely to communicate gendered expectations to their children. Such messages communicated from parents, teachers, peers and the mass media appear to influence young people, as many boys and girls seem to espouse dominant stereotypes about gender-appropriate behaviours and abilities relevant to maths and technology (Oosterwegel, et al., 2004). Another factor that might be related to self-efficacy is peer support, which appears to be very important for girls who are interested in male-typed domains. Girls who have support from their peers are more likely to get involved in extracurricular activities and to aspire to a career in science, mathematics, and technology (Jacobs et al., 1998; Zeldin & Pajares, 2000). Gender differences in students' attitudes and beliefs about' computers were also found to parallel differences in boys and girls' computer experiences outside school. Boys are more likely to have access to a home computer, to use computers more frequently and to engage in "high-tech" activities (Janssen Reinen & Plomp, 1997; Volman & van Eck, 2001).

Although the evidence so far suggests that students' math and technology socialization experiences may account for gender differences in self-efficacy, few studies have attempted to explore the relative contribution of different socialization parameters to the development of boys and girls' self-efficacy beliefs for maths and computers. The aim of this study was, therefore, to examine possible links between students' self-efficacy, gender stereotyping, perceived parental and peer support, and math and computer experiences outside school for Greek primary boys and girls.

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Methodology

The participants were 340 fifth and sixth grade students (174 boys and 166 girls) from seven urban primary public schools in Greece. Students came from diverse family backgrounds; 23,5% from upper-middle, 29,1% from middle and 47,4% from low class families, based on the father's occupation and education. Each student completed a self-report questionnaire including:

a. multiple choice questions about his/her: access tp computers and the internet and to math educational materials outside school; computer and math activities outside school; and frequency of computer activities outside school, and
b. Likert-type questions (l=strongly disagree, 5=strongly agree) on his/her:
    - perceived peersupportfor computer (4 items, alpha=0.67) and math learning (4 items, alpha=0.73)
    - perceived parental support for computers (5 items, alpha=7.1°) and maths (4 items, alpha=7.91)
    - computer self-efficacy (3 items, alpha=0.66) and math self-efficacy beliefs (3 items, alpha=0.74)
    - gender-stereotyped beliefs about computers (3 items, alpha=0.79) and maths (3 items, alpha=0.74).

Results

We found statistically significant gender differences in students' access, frequency, and type of computer use, but no gender differences in their math activities or access to math educational materials at home. Specifically, more girls (13.3%) than boys (6.3%) did not use computers outside school, x^2 (1, N=340) = 4.65, $p < .05$, and more girls (28.3%) than boys (16.1%) did not use the internet outside school, x^2 (1, N=340) = 7.38, $p < .005$. The boys (71.8%) and girls (66.9%) were equally likely to have a computer at home or in their own room (45.4% and 39.8% respectively), but more boys (32.2%) than girl's (9.6%) reported using computers at Internet Cafes, x^2 (1, N = 340) = 25.86, $p <.001$. More girls than boys used the computer for drawing, x^2 (1, N = 340) = 7.58, $p < .005$, and more boys than girls used the computer for playing games, x^2 (l, N = 340) = 6.27, $p < .01$, for searching the internet, x^2 (1, N = 340) = 12.63, $p < .001$, and for programming, x^2 (1, N = 340) = 3.25, $p < .05$. However, there were no significant gender differences in the number of activities that students reported on the questionnaire (see Table 1), which shows that, although the girls were less likely than boys to engage in certain computer activities, their overall computer experience was characterized by the same variety as that of the boys'.

Student beliefs and perceptions	Maths		Computers	
	Boys	Gir	DVS	Girls
Self-efficacy beliefs	3.81 (.79)b	3.62 (.83)b	3.84 (.69) a	3.51 (.87) a
Perceived parental support	4.42 (.66)	4.48 (.67)	3.70 (.74) c	3.53 *[77]* c
Perceived peer support	3.06 (.89)	3.1 1 (.85)	3.65 (.75) b	3.44 (.78) b
Activity Variety	3.09(1.75)	3.02(1.53)	3.67(1,97)	3.42(1.95)
Gender Stereofypes	2.5 (.93) a	1.62(.68)a	3.39 (1.05) a	1.82 (.88) a

[3] $p < .000$. [b] $p <01$. *$p < .05$.

Table I Means (and Standard Deviations) of Boys' and Girls' Self-Efficacy and Gender Stereotyped Beliefs, Activity Variety, and Perceptions of Parental and Peer Support to Learn About Maths and Computers.

Finally, the girls appeared to use computers less frequently: 47.1 % of boys used computers every day compared to only 24.4% of girls, x^2(I, N=340)=22.06, p^.001.

There were significant gender differences in students' computer self-efficacy and in perceived social support from parents and peers to use computers, favouring boys (see Table 1). We did not find significant gender differences in the students' perceived parental and peer support for math, however, the girls reported lower math self-efficacy than the boys. Finally, the boys endorsed stereotypical statements about gender, math, and computers.

We conducted regression analyses to examine which factors were related to boys' and girls' self-efficacy for computers and math. We included SES, computer and math out-of-school experiences (computer access and frequency of use, variety of math and computer activities), socialization factors (perceived parental and peer support) and gender stereotyping as independent variables in the math and computer self-efficacy models. As Tables 2 and 3 show, perceived parental and, to a lesser extend, peer support were the factors more strongly associated with the students' self-efficacy for both math and computers. Frequency of computer use and activity variety were also related to computer self-efficacy. Gender stereotyping was related to math self-efficacy for the boys.

Discussion

So far, the research on the gender gap in computer use has mainly focused on gender differences in computer attitudes, thus emphasizing cognitive differences between males and females and overlooking their socialization experiences that are associated'with these differences. In our study, the gids were found to have lower self-efficacy for computers compared to the boys and these differences co-occurred with gender differences in the

	Boy			Girls		
Variable	B	SEB	3	B	SE B	3
Parental Support	.474	.081	.393"	.627	.085	.506°
Peer Support	.296	.056	.331"	.196	.063	,202^b
Stereotypes	.149	.053	.174 ^{b}	-.050	.081	-.041
Activity variety	.051	.030	**.112**	.017	.035	.031
SES	.086	.115	.045	.180	**.121**	.094

° p < .001. " p < .005. R^3 = .416 for boys, R^J=.406 for girls.

Table 2 Regression Analysis for Variables Predicting Boys' (n= 174) and Girls' (n=166) Math Self-Efficacy

	Boys			Girls		
Variables	B	SEB	B	B	SEB	3
Parental support	314	.071	.328°	.357	.085	.310°
Peer support	151	.066	. 162'	.257	.078	.233 =
Stereotypes	036	.039	.056	-.006	.058	-.006
Activity variety	066	.025	.188"	.054	.034	.122
Frequency	151	.121	.096	.270	.126	.154'
Home access	192	.119	.124	.112	.135	.060
SES	047	.057	,053	.055	.067	.051

= p< .001. ^{b}p< .01.^{c}p< .05. R^2 = .385 for boys, R^2=.414 for girls.

Table 3 Regression Analysis for Variables Predicting Boys' (n=174) and Girls' (n=!66) Computer Self-Efficacy students' socialization experiences.

The relationship between self-efficacy and socialization experiences was less straightforward for maths. The girls had lower math efficacy compared to their male peers, although they reported similar degree of involvement in out-of-school math activities, and the same degree of support from their parents and peers for their math learning. Although social stereotypes about the girls and math appeared to decline and the girls were equally likely with the boys to be supported by their environment to engage in maths, gender differences in math stereotypes were significant and these differences seem to parallel differences in math self-efficacy.

Our findings show a strong link between students' self-efficacy for math and computer learning with their socialization experiences outside school and, particularly, with the support they receive from their parents and peers. Surprisingly, home computer access, frequency of use, and activity variety were less significant predictors of boys and girls' self-efficacy. As research has showed (Jacobs et al., 1998; Shashaani, 1994), parents hold gender stereotypes and communicate different expectations to their sons and daughters. Parental involvement guides students' interpretations of their own learning experiences and shapes their beliefs about their ability to learn.

The above findings show that although it is important to provide young people with access to new technologies and with quality technology and math experiences, it may not by itself decrease gender differences in our attitudes towards maths and technology. Educators and policy makers need to increase parental awareness about gender equity issues as well as to provide opportunities for extracurricular activities that help students develop social networks and incorporate technology and maths into their social activities.

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