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Gender issues in technology use: Perceived social support, computer self-efficacy and value beliefs, and computer use beyond school

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Abstract

In this study, we examined relations between outside school computer experiences, perceived social support for using computers, and self-efficacy and value beliefs about computer learning for 340 Greek elementary school boys and girls. Participants responded to a questionnaire about their access to computer use outside school (e.g. frequency of use and nature of activities), perceived parental and peer support, and computer self-efficacy and value beliefs. Although almost all students used computers outside school, there were significant gender differences in frequency and type of computer use. Also, boys reported more perceived support from their parents and peers to use computers and more positive computer self-efficacy and value beliefs than girls. Parental support and, to a lesser extent, peer support were the factors more strongly associated with boys' and girls' computer self-efficacy and value beliefs, while home computer access was not related to students' motivation. Our findings highlight the role of socialization in the gender gap in computing and the need for research and educational interventions that focus on the social practices that communicate gendered expectations to young boys and girls.

Keywords: Elementary education; Gender studies

1. Introduction

Research in the field of gender and education highlights a shift on the way we talk and conceive gender differences. Specifically, there is now evidence that boys and girls cope equally well with the curriculum. And even though during the 70s and the 80s one could discern noticeable patterns of girls' under-achieving in specific areas such as mathematics and science, today the media 'sound bites' reverse the story and construct boys as having difficulties. Despite current debates on gender equality, computer use seems to remain a heavily

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gendered space. Several international studies still point out significant gender differences in students' computer use at home and at school as well as in their beliefs about gender, technology, and computer learning (for a review see Volman & van Eck, 2001). Although gender differences in many cases are small and their magnitude may vary by country (Janssen Reinen & Plomp, 1997) or age (Volman, van Eck, Heemskerk, & Kuiper, 2005), a consistent pattern emerges. Female students are likely to have less positive perceptions of their computer competence (Busch, 1995; Meelissen & Drent, in press; Nelson & Cooper, 1997) and are less attracted to computers than their male peers. In addition, they appear to use computers less frequently outside school (Hakkarainen et al., 2000; Mumtaz, 2001; Volman & van Eck, 2001).

Gender differences in students' motivational beliefs about computers have drawn attention because they can add to potential interpretations of females' low participation in computer related fields (Margolis & Fisher, 2003). Motivation influences learning and academic achievement as well as future academic and career choices (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Pintrich & DeGroot, 1990). Having lower confidence in their abilities and lower interest in computers may lead female students to avoid experiences that could help them develop computer competence. This, in turn, might influence negatively their academic choices and limit their future career opportunities in information technology.

Although gender differences in motivation for computer learning (commonly conceptualized as "computer attitudes") have been documented in the literature, very few studies have attempted to explore the relative links between students' motivation to learn about computers and their outside school experiences and socialization (for example, see Meelissen & Drent, in press; Selwyn, 1998; Shashaani, 1994; van Braak, 2004). In this study, we examined possible gender differences in Greek elementary school students' motivational beliefs about computer learning. We hypothesized that, if gender differences do exist, they are not inevitable or "natural" but rather the result of different socialization experiences of boys and girls and a reflection of gendered social expectations expressed by family and peers. A large number of young students in many mainstream western schools, even at the elementary level, have nowadays computer access (Janssen Reinen & Plomp, 1997) and spend a lot of their time using computers outside school (Mumtaz, 2001). Interactions with parents, other family members, and friends are central in these outside school computer experiences (Facer, Sutherland, Furlong, & Furlong, 2001) and may have a significant impact on students' perceptions of their abilities and their beliefs about technology. Parents and peers are likely to have gender-stereotyped views and may communicate diverse expectations toward boys and girls. The purpose of this study was, therefore, to examine relations between boys' and girls' outside school computer experiences, peer and parental support, and motivation to learn about computers.

2. Literature review

Research on achievement motivation has established the role of self-efficacy and task-value beliefs in students' academic choices, learning, and school performance (Bandura, 1993; Eccles & Wigfield, 1995). Self-efficacy beliefs are students' cognitive evaluations of their ability to successfully perform tasks of a particular domain (Bandura, 1993), and task-value beliefs concern students' reason for engaging in those tasks: their beliefs about the enjoyment they will get from the task (intrinsic value), the importance (attainment value) and the usefulness of the task (utility value) (Eccles & Wigfield, 1995). Students are more likely to pursue academic activities that they consider valuable (Dickhäuser & Stiensmeier-Pelster, 2003) and within their range of perceived competence (Bandura, 1993). More importantly, both self-efficacy and task-value beliefs are significant predictors of students' future academic and career trajectories. Students with positive self-efficacy tend to engage thoughtfully (Pintrich & DeGroot, 1990) and, as a result, to succeed in current learning activities and, therefore, prepare themselves better for future academic pursuits and are able to consider more career options (Bandura et al., 2001). Similarly, female and male students pursue academic studies and careers based on their value beliefs regarding the subject matter (Dickhäuser & Stiensmeier-Pelster, 2003; Jacobs, Finken, Griffin, & Wright, 1998).

In the relevant ICT literature the above constructs have been conceptualized in a variety of ways. Specifically, some researchers used computer attitude scales, which included components that tap computer competence and value beliefs, such as *computer confidence* and *computer liking* (Mumtaz, 2001), *perceived control* and *perceived usefulness* (Selwyn, 1998) or *relevance* and *enjoyment* (Janssen Reinen & Plomp, 1997. Other

researchers developed scales that focus exclusively on self-efficacy beliefs (for a review see Cassidy & Eachus, 2002). Despite the inconsistence that characterizes the way students' computer beliefs have been investigated so far, there are common themes in the results of the various studies. Male students tend to have more confidence in their computer abilities than their female peers, and this pattern is quite consistent from the elementary school (Meelissen & Drent, in press; Mumtaz, 2001; Nelson & Cooper, 1997) to university (Busch, 1995; Cassidy & Eachus, 2002), and across international borders (Busch, 1995; in Norway; Durndell & Haag, 2002; in Romania; Makrakis & Sawada, 1996; in Sweden and Japan; van Braak, 2004; in Belgium; Meelissen & Drent, in press; in The Netherlands). Studies with elementary students in Canada (D'Amico, Bason, & Sissons, 1995) and the US (Nelson & Cooper, 1997; Voyles & Williams, 2004) showed that girls were more likely than boys to attribute successful computer performance to luck, an unstable and uncontrollable factor, and failure to ability, which shows that girls tend to underestimate their ability and the control of their learning. Results regarding students' perceived usefulness, enjoyment, and interest in computers at the elementary (Janssen Reinen & Plomp, 1997; Meelissen & Drent, in press; Todman & Dick, 1993) and secondary school level Janssen Reinen & Plomp, 1997; Makrakis & Sawada, 1996) are equivocal but no studies reported more positive beliefs for girls.

Research has documented significant gender differences in students' computer access and activity choices outside school, which may account for the above differences in computer self-efficacy and value beliefs. From the elementary years, male students are more likely than females to have access to a home computer (Janssen Reinen & Plomp, 1997; Nelson & Cooper, 1997), to use computers more frequently (Hakkarainen et al., 2000; Nelson & Cooper, 1997), and to play games (Hakkarainen et al., 2000; Mumtaz, 2001). As they become more experienced in secondary school, they are also more likely to engage in "high-tech" computer activities such as programming and internet surfing (Papastergiou & Solomonidou, 2005; Selwyn, 1998; Volman et al., 2005). These differences are important, because out of school computer experience (Bovée, Voogt, & Meelissen, 2007) and frequency of computer use (Meelissen & Drent, in press) were found to be significantly related to students' computer attitudes from the elementary school years. Similarly, research with older students shows that those who had access to and used a computer at home had more positive computer attitudes (Selwyn, 1998) and self-efficacy (van Braak, 2004).

It is also likely that gender differences in computer attitudes and beliefs are related to differences in the support that boys and girls receive from their family and peers. A recent review on the role of parental beliefs and involvement by Gonzalez-DeHass, Willems, and Holbein (2005) shows that when parents are involved in their children's school-related and extracurricular activities, provide encouragement and praise, and express positive values and expectations, children are more likely to have positive self-efficacy beliefs and intrinsic motivation for school learning. Low social economic status (SES) parents tend to place high value on education and have aspirations for their children, however, they do not always have the educational experiences and the resources which would help them enact parenting practices to foster their children's motivation and learning (Becker, 2000; Spera, 2005). Students from low SES families are less likely to have access to a home computer (Bovée et al., 2007), to be exposed to wide range of computer applications, and to have parents who are knowledgeable about computers (Becker, 2000). These factors may explain why students from low SES families tend to have less positive computer beliefs compared to their peers from middle and high SES families (Meelissen & Drent, in press; Shashaani, 1994; Todman & Dick, 1993).

In addition, many parents hold gender-stereotyped views about the abilities of men and women in gender-typed domains (Eccles, Adler, & Kaczala, 1982; Tenenbaum & Leaper, 2003). They are, in consequence, likely to communicate gendered expectations when they interact with their children in the context of learning activities (Tenenbaum & Leaper, 2003). Shashaani (1994) found that perceived parental stereotypes about ICT were related to fathers' and mothers' SES, and that SES correlated positively with the support that girls perceived to receive from their fathers and mothers for computer learning. In turn, parental beliefs and behavior influence children's motivation, learning, and academic aspirations (Gonzalez-DeHass et al., 2005). In a recent study, Bleeker and Jacobs (2004) found that mothers' stereotyped beliefs and perceptions of their children's ability in math and science in sixth-grade were significant predictors of their children's self-efficacy in math and science two years after their high school graduation.

Peer support has been less investigated, although it may exert a strong influence on young people's attitudes toward learning and schooling (Wentzel, 1998). Peer support 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 science activities and to aspire a career in science, mathematics, and technology (Jacobs et al., 1998; Zeldin & Pajares, 2000). Conversely, girls are likely not to choose a career in science if they think that their friends will disapprove of their decision (Baker & Leary, 1995).

The role of social support coming through parents and peers in the development of young people's beliefs and attitudes about information technology has been researched very little. Studies with elementary (Meelissen & Drent, in press) and secondary students (Shashaani, 1994) showed that parental encouragement was strongly related to students' own computer attitudes, however, female students perceived less support for computer learning from their parents (Janssen Reinen & Plomp, 1997; Meelissen & Drent, in press; Shashaani, 1994) and peers (Busch, 1995) compared to males.

3. Focus of present study

Previous research has documented small but significant differences in female and male students' motivation for computer learning. In our study, we hypothesized that these differences in girls' and boys' computer value and self-efficacy beliefs are related to the social support they receive for using computer activities and to the quality of computer experiences outside the school context. We examined possible gender differences in access and frequency of computer use outside school as well as in the types of computer activities in which Greek elementary school boys and girls engaged at home. We also examined gender differences in students' perceptions of parental and peer support: whether their parents expressed encouragement, high expectations for their computer abilities and positive beliefs about the value of computer learning, and whether boys and girls had friends interested in computers, used computers with friends, discussed their computer interests with friends, and helped each other to learn about computers. Unlike much of previous research, we focused on elementary school students. Children of this age have already begun to use computers outside school and are exposed to family and peer socialization experiences. We expected to find differences in girls' and boys' social support and computer experiences as well as significant relations between these factors and children's computer self-efficacy and value beliefs.

4. Methodology

4.1. Participants

Participants were 340 fifth and sixth-grade students (174 boys and 166 girls) from seven elementary public schools that serve two large metropolitan areas in Greece. Of these students only 58.5% were using ICT at school during the year of data collection. Although all schools were equipped with computer rooms, only some of the teachers were using ICT in their teaching. Students could use computers either during their regular school program or during an optional afternoon program offered for working families. Students came from diverse family backgrounds; 23.5% from upper-middle, 29.1% from middle and 47.4% from low SES families, based on father's occupation and education. Parental SES was coded as follows: upper-middle SES = professionals with higher education degrees; middle SES = white-color employees or merchants with secondary and postsecondary degrees; and low SES = manual workers with elementary and/or secondary education.

4.2. Materials

Each student completed a self-report questionnaire that included two sections. The first focused on students' experiences and beliefs about computers and the second on math beliefs. In this article we report results from students' answers to the following questions of the computer section: (a) 6 multiple-choice questions about students' experience with computers; their access to computers and the internet outside school, their friends' access to a home computer, and the frequency and type of their computer activities outside school and (b) 17 Likert-type questions (1 = strongly disagree, 5 = strongly agree) that addressed their *computer self-efficacy* and *computer value beliefs* as well as their *perceptions of parental* and *peer support* for using computers (see Appendix for the list of all questions that were included in this study). A sample question was pro-

vided to introduce the Likert items, which were presented in mixed order. On the last page of the survey we included questions that requested demographic information (name, gender, school, country of birth and mother tongue, mothers' and father's occupation and education).

4.3. Procedures

Students completed the questionnaire in their regular classrooms. Sessions lasted approximately 35–40 min. In the beginning students were given information about the content and general purpose of the survey as well as instructions on how to complete the multiple-choice and Likert items. Also, students were told that the questionnaire was not a test, that there were no right or wrong answers to the questions and that everything they said was going to be useful and important for our research. Finally, it was explained to them that all recorded information would remain confidential.

5. Results

5.1. Gender differences in motivational beliefs, perceptions of parental and peer support, and computer access and experiences outside school

Analysis showed that the large majority of students (90.3%) used computers outside school. About two thirds of the students (69.2%) had access to a computer at home and many (42.6%) had a computer in their own room. Also, about half of the students (47.3%) had access to the internet from home. It appears that students used computers in a variety of contexts (see Table 1), as several reported that they used computers not only at home but also at their friends' (18.2%) or relatives' homes (16.5%) or even at internet cafes (21.2%).

More girls (13.3%) than boys (6.3%) said that they did not use computers, 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, $p < .005$. As Table 1 shows, there were also some gender differences in the type of computer and internet access outside school. Boys and girls were equally likely to have a computer at home or in their own room, but more boys (32.2%) than girls (9.6%) reported using computers at internet cafes, x^2 (1, $N = 340$) = 25.86, $p < .001$. Also, boys and girls were equally likely to have access to the internet from home or from their own room, but more boys (30.5%) than girls (7.2%) used the internet at internet cafes, x^2 (1, $N = 340$) = 29.65, $p < .001$.

Boys (79.9%) and girls (74.6%) were equally likely to report that almost all or many of their friends had access to a home computer, x^2 (4, $N = 340$) = 3.86, $p = .425$. More than half of the students reported that they used computers regularly, either everyday (36.1%) or 2–3 times week (28.7%), but girls appeared to use computers less frequently than boys (see Table 2). Specifically, 47.1% of boys reported that they used computers every day compared to only 24.4% of girls, x^2 (1, $N = 340$) = 22.06, $p < .001$.

Table 1
Student access to a computer and the internet outside school by type of access and gender

Type of access	Computer access (%)			Internet access (%)		
	Boys	Girls	All (%)	Boys	Girls	All (%)
Nowhere	6.3[c]	13.3[c]	9.7	16.1[b]	28.3[b]	22.8
In their own room	45.4	39.8	42.6	25.3	21.7	23.4
At home	71.8	66.9	69.2	51.7	44.0	47.3
At friends' home	20.7	15.7	18.2	16.1	10.8	13.1
At relatives' home	14.4	18.7	16.5	12.6	13.3	12.5
At internet cafes	32.2[a]	9.6[a]	21.2	30.5[a]	7.2[a]	18.8
Elsewhere	9.8	6.6	8.2	9.2[c]	3.6[c]	6.3

[a] $p < .001$.
[b] $p < .005$.
[c] $p < .05$.

Table 2
Frequency of students' computer use outside school by gender

Frequency of use	Boys	Girls	All (%)
Almost everyday	47.1*	24.4*	36.1
2–3 times a week	27.0	30.5	28.7
About once a week	8.0	11.0	9.5
1–2 times a month	2.9	6.1	4.4
Rarely	8.6	15.2	11.8

* $p < .001$.

Table 3
Students' type of computer activity outside school by gender

Frequency of use	Boys	Girls	All (%)
Drawing	46.6[b]	61.4[b]	53.8
Writing	60.9	57.2	59.1
Game playing	87.9[c]	77.7[c]	82.9
Internet search	64.4[a]	45.2[a]	55.0
Schoolwork	24.1	21.7	22.9
Learning with educational software	29.5	37.3	33.3
Programming	24.1[d]	16.3[d]	20.3
E-mail	21.8	16.3	19.1

[a] $p < .001$.
[b] $p < .005$.
[c] $p < .01$.
[d] $p < .05$.

Game playing was the most frequently reported computer activity for both boys and girls (see Table 3). The next two more popular activities were drawing and writing for girls and internet search and writing for boys. About half of the students (55.0%) used the internet to search for information. 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 (1, $N = 340$) = 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, $p < .05$.

A new variable was created to measure the variety of students' computer activities outside school, by calculating the number of activities that each student reported on the questionnaire. There were no significant differences in boys' ($M = 3.67$, SD = 1.97) and girls' ($M = 3.42$, SD = 1.95) variety of computer activities (see Table 4), which shows that, although girls were less likely than boys to engage in certain computer activities such as programming, gaming, or internet surfing, their overall computer experience was characterized by the same variety as that of boys'.

There were gender differences in students' beliefs regarding computer learning and their perceived parental and peer support. As Table 4 shows, although both boys and girls expressed positive self-efficacy ($M = 3.84$,

Table 4
Gender differences in computer self-efficacy and value beliefs, in computer activities, and in perceived parental and peer support to learn about computers

Student beliefs, social support, and computer activities	M (SD)		*t*-test	*p* value
	Boys	Girls		
Computer self-efficacy	3.84 (.69)	3.51 (.87)	−3.716	.000
Computer value	4.13 (.66)	3.91 (.85)	−2.524	.012
Perceived parental support	3.70 (.74)	3.53 (.77)	−2.085	.038
Perceived peer support	3.65 (.75)	3.44 (.78)	−2.641	.009
Computer activity variety	3.67 (1.97)	3.42 (1.95)	−1.190	.231

SD = .69 and $M = 3.51$, SD = .87, respectively) and positive beliefs about the value of computers ($M = 4.13$, SD = .66 and $M = 3.91$, SD = .85, respectively), boys expressed somewhat more positive views compared to girls. Also, boys perceived more support from their parents to use computers ($M = 3.70$, SD = .74) and were more likely to use and to talk about computers with their peers ($M = 3.65$, SD = .75) than girls ($M = 3.53$, SD = .77 and $M = 3.44$, SD = .78, respectively for parental and peer support). All of these differences were small but statistically significant (see Table 4).

5.2. Relationships between motivational beliefs, perceptions of parental and peer support, and computer access and experiences outside school

As a next step in our analysis we examined relations among students' motivational beliefs, social support, and their computer experiences. As Table 5 shows, we found significant positive correlations between students' motivational beliefs and their social support and experiences. Students who thought that their parents encouraged them to use computers or whose friends supported their efforts to learn and shared their interest in computers were also more confident about their computer abilities, had more positive views about the value of computer learning, and tended to engage in a variety of computer activities. Students who had positive self-efficacy beliefs were also likely to think that computer learning was valuable to them. Finally, students who had positive self-efficacy and value beliefs were also likely to use computers for a large variety of tasks. In general, the patterns in these relationships were similar for boys and girls.

We conducted regression analyses to examine the independent contribution of computer experiences and social support to boys' and girls' motivation for computer learning. We used self-efficacy and value beliefs as dependent variables. Access to a home computer, frequency of use, and activity variety represented students' outside school computer experiences. Parental and peer support represented students' social support for learning about computers. Socioeconomic status (SES) was also included as a predictor to control for the possibility that any relationship found between students' experiences and beliefs or between parental support and beliefs was actually due to students' SES, as previous research has showed that family SES is related to students' computer experiences and to parental practices. Variables were grouped and entered in three blocks. First we entered SES to remove from the analysis any variability related to SES. The second block included the variables that represented students' out-of-school computer experiences, and the third block the social support variables. We entered the last two blocks of variables separately because we wanted to examine the contribution of computer experience variables before and after controlling for the social support variables. We conducted separate analyses for boys and girls, to identify the factors that were significantly related to girls' beliefs and those factors that were important for boys. Home computer access and frequency

Table 5
Intercorrelations between self-efficacy beliefs, computer value beliefs, variety of computer activities, and perceived parental and peer support for boys and girls

	1	2	3	4	5
Girls (n = 166)					
1 Parental support		.431**	.555**	.720**	.385**
2 Peer support		–	.466**	.481**	.359**
3 Self-efficacy			–	.585**	.432**
4 Computer value				–	.453**
5 Activity variety					–
Boys (n = 174)					
1 Parental support	–	.500**	.536**	.612**	.387**
2 Peer support		–	.406**	.496**	.227**
3 Self-efficacy			–	.602**	.414**
4 Computer value				–	.172*
5 Activity Variety					–

* Significance at the .05 level.
** Significance at the .01 level.

Table 6
Summary of hierarchical regression analysis for variables predicting boys' ($n = 174$) and girls' ($n = 166$) computer self-efficacy beliefs

Variable	Boys			Girls		
	B	SE *B*	β	*B*	SE *B*	β
Step 1						
SES1	−.235	.133	−.170[e]	−.162	.171	−.092
SES2	−.105	.148	−.069	−.035	.185	−.018
Step 2						
SES1	−.012	.127	−.009	−.086	.153	−.049
SES2	−.075	.134	−.049	.150	.166	.079
Home access	.147	.131	.095	.137	.152	.074
Frequency of use	.300	.130	.190[d]	.408	.141	.233[b]
Activity variety	.114	.026	.324[a]	.137	.037	.306[a]
Step 3						
SES1	.096	.114	.069	−.111	.133	−.063
SES2	.016	.120	.010	.147	.145	.077
Home access	.209	.118	.136	.094	.133	.051
Frequency of use	.145	.119	.092	.247	.125	.141[e]
Activity variety	.066	.025	.186[c]	.065	.034	.145[e]
Peer support	.163	.066	.176[d]	.263	.076	.236[b]
Parental support	.320	.070	.341[a]	.385	.080	.339[a]

Note: For boys: $R^2 = .019$ for step 1; $\Delta R^2 = .205$ for step 2; $\Delta R^2 = .169$ for step 3. For girls: $R^2 = .007$ for step 1; $\Delta R^2 = .249$ for step 2; $\Delta R^2 = .185$ for step 3.

[a] $p < .000$.
[b] $p < .005$.
[c] $p < 0.01$.
[d] $p < .05$.
[e] $p < .10$.

Table 7
Summary of hierarchical regression analysis for variables predicting boys' ($n = 174$) and girls' ($n = 166$) computer value beliefs

Variable	Boys			Girls		
	B	SE *B*	β	*B*	SE *B*	β
Step 1						
SES1	−.262	.125	−.200[c]	.046	.165	.027
SES2	−.315	.139	−.216[c]	−.183	.179	−.099
Step2						
SES1	−.180	.131	−.137	.091	.147	.053
SES2	−.318	.138	−.218[c]	−.027	.160	−.015
Home access	.066	.135	.045	−.001	.147	−.001
Frequency of use	.249	.134	. 166[d]	.448	.136	.264[b]
Activity variety	.030	.027	.090	.141	.036	.325[a]
Step 3						
SES1	−.028	.103	−.022	.070	.111	.041
SES2	−.191	.108	−.131	−.010	.120	−.006
Home access	.156	.107	.106	−.078	.111	−.043
Frequency of use	.030	.108	.020	.215	.104	.126[c]
Activity variety	−.038	.022	−.112	.059	.028	135[c]
Peer support	.236	.060	.269[a]	.183	.063	.169[b]
Parental support	.440	.063	.494[a]	.614	.067	.559[a]

Note: For boys: $R^2 = .033$ for step 1; $\Delta R^2 = .053$ for step 2; $\Delta R^2 = .366$ for step 3. For girls: $R^2 = .014$ for step 1; $\Delta R^2 = .249$ for step 2; $\Delta R^2 = .328$ for step 3.

[a] $p < .000$.
[b] $p < .005$.
[c] $p < .05$.
[d] $p < .10$.

of computer use were used as dichotomous variables, each with two levels: access and no access to a computer at home; and frequent (at least 2–3 times a week) and infrequent (once a week or less) computer use. SES was transformed into two dichotomous variables: SES1 was coded 1 for low SES and 0 for middle or high SES; SES2 was coded 1 for middle SES and 0 for low or upper-middle SES (therefore an upper-middle SES student would get 0 for each of the above two variables).

When we used self-efficacy as the dependent variable, SES was marginally related to boys' self-efficacy only (see Table 6). Specifically, low SES was negatively related to boys' self-efficacy beliefs. When we entered student's computer experiences, the effects of SES diminished and only frequency of use and activity variety were significant. However, when the social support variables were added to the model, the effects of the computer experience variables decreased and parental support was the variable more strongly associated with self-efficacy for both boys and girls. Peer support was significant for boys and girls, frequency of computer use was marginally associated with girls' self-efficacy and activity variety was significant for both boys and girls. Interestingly, home computer access did not emerge as a significant variable for either boys or girls.

Similar patterns emerged when we used computer value beliefs as the dependent variable (see Table 7). SES was related to boys' value beliefs but its effects were overshadowed by the social support variables. Parental support and, to a lesser extend, peer support emerged as the most important variables for both boys and girls. None of the computer experience variables made a significant contribution to boys' computer value beliefs, however, frequency of use and activity variety were related to girls' beliefs. Again, home access was significant neither for boys nor for girls.

6. Discussion

Computer technologies seem to permeate the everyday lives of Greek students, even from the elementary years. About two thirds of the students who participated in our study had a computer at home and nearly half of the students had a computer in their own room and used computers on a regular basis, at least 2–3 times a week. Students reported using computers not only at home but in a variety of social contexts, for example, when they visited their friends or relatives, or even at internet cafes. Computer use was one of the topics they discussed with their friends and provided a context for peer recreational activities outside school. Game playing emerged as the most popular activity for both boys and girls, but both groups reported various uses of computers. For example, many students used computers for drawing and writing as well as for learning with educational software and doing their schoolwork. About half of the students also had access to the internet and reported using the internet to search for information and, to a lesser extend, for e-mail.

Different patterns characterized the computer experiences of boys and girls. Computers played an important or even central part in most boys' out-of-school activities. Boys tended to use computers on a regular basis and were more likely to use computers in public places such as internet cafes or to talk about and to use computers when they met with their friends. Boys had more positive self-efficacy and value beliefs about computers compared to girls, and were more likely to engage in "hard-core" computer activities such as programming and internet search. Girls had overall positive self-efficacy beliefs, they appreciated the value of computer learning, and, although they expressed different computer activity preferences, they engaged in a variety of tasks on the computer, equal to that of boys. However, it appeared that computers were less important in their everyday activities. Although girls were equally likely to have a computer at home or in their own room, they used computers less often compared to boys and only a very small number of them visited internet cafes to use computers.

In our study, we examined relations between boys' and girls' computer experiences, social support for using computers, and motivational beliefs, to explore possible causes of gender differences in students' self-efficacy and value beliefs. In previous research, home computer experience and frequency of computer use were found to be significantly related to both elementary (Bovée et al., 2007; Meelissen & Drent, in press), secondary (Selwyn, 1998), and university (van Braak, 2004) students' computer attitudes. In our study, when home computer access, frequency of use, and activity variety were considered together with perceived parental and peer support in regression analysis, they were marginally or not related to students' self-efficacy and value beliefs. Parental support emerged as the most important factor for both boys and girls. This suggests that the encouragement and expectations that parents express to their children are more important predictors of children's

self-efficacy and value beliefs than children's own computer activities. This finding is consistent with previous longitudinal studies (Bleeker & Jacobs, 2004; Gonzalez-DeHass et al., 2005) showing that parents' expectations and beliefs about their children's abilities have a very strong influence on children's motivation to learn, and are more significant predictors of children's academic goals than children's own achievement and involvement in extracurricular activities (Jacobs et al., 1998). In other words, what parents communicate to their children about their children's abilities and activities has a more powerful influence on children's beliefs about their own learning than what children actually do or are able to do.

The above finding has at least two implications. First, it highlights the effect of socialization on the gender gap in computing. As research has showed (Eccles et al., 1982; Jacobs et al., 1998; Shashaani, 1994; Tenenbaum & Leaper, 2003), parents hold stereotypes about the abilities of males and females in male-typed domains and communicate different ability and behavior 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 and the value of their learning. More importantly, the expectations that parents communicate to their children can have long-term consequences (Bleeker & Jacobs, 2004) as they have a strong effect on children's future self-efficacy beliefs, academic choices and career plans. In our study we found gender differences in the support that students perceived to have from their parents and friends to learn about computers. Although elementary school girls had overall positive self-efficacy and value beliefs, they might gradually lose their interest in computers if the messages they receive from their social environment discourage them from engaging with information technology. Having positive and rich computer experiences is necessary but not sufficient by itself to maintain girls' motivation as, according to our data, positive computer experiences were marginally related to motivation compared to parental support. The hypothesis that females develop positive computer beliefs when they begin to use computers but gradually lose their confidence and interest in computers because they are not sufficiently supported by their social environment may explain why very few female students end up choosing to study information technology when they finish secondary school or even drop out from computer science courses (Margolis & Fisher, 2003)

Second, our findings provide another perspective for thinking about the digital divide. Research on the digital divide focuses on issues of access and use of new technologies (Becker, 2000) and policy efforts aim at improving access to technology resources (Judge, Puckett, & Cabuk, 2004). In our study, home computer access, frequency of use, and activity variety were less significant predictors of boys' and girls' motivational beliefs compared to perceived social support. These findings show that although providing young people with access to new technologies and with quality technology experiences is important, it may not by itself decrease gender differences in attitudes towards technology. Gender stereotypes, communicated by parents, peers, and teachers, may work against institutional interventions that aim at providing equal opportunities to boys and girls.

So far, research on the gender gap concerning 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 we found that significant differences in boys' and girls' beliefs about their computer competence and the value of computer learning co-occurred with gender differences in students' socialization experiences. Girls are exposed to different social expectations when they start using computers, before they even begin to think about their academic and career plans. Future studies need to examine the nature of cultural stereotypes about gender and technology and the way they are communicated to girls and boys through family and school practices. Also, apart from improving access to technology for all, efforts to diminish the gender gap need to also increase social awareness about issues of gender equity and the ways our cultural practices may reproduce gender inequities.

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Appendix A. Multiple-choice questionnaire items assessing computer experiences

1. Do you use a computer outside school? Circle the right answer. YES NO
   If you answered NO, skip questions 2-5

2. Where is the computer that you use? Circle everything that applies to you.
   In my room At home At my friends' home At my relatives' home
   At internet cafes Elsewhere (where?) ……..

3. Where do you have access to the internet outside school? Circle everything that applies to you.
   Nowhere In my room At home At my friends' home At my relatives' home
   At internet cafes Elsewhere (where?) ……

4. How often do you use computers outside school? Circle the answer that applies to you.
   Almost everyday About 2-3 times a week About once a week 1-2 times a month Rarely

5. What kinds of things do you do with the computer? Put an X to everything that applies to you.
   - ❑ I draw
   - ❑ I write
   - ❑ I play games
   - ❑ I search for information on the internet
   - ❑ I use educational software to learn new things
   - ❑ I do programming
   - ❑ I use e-mail
   - ❑ Else: ……

6. Do your friends have a computer at home? Circle the answer that applies to you.
   Almost all of them Many Some None I don't know

Appendix B. Likert-type questionnaire items assessing motivational beliefs and social support

Computer self-efficacy beliefs (alpha coefficient = 0.66)
Compared to other kids of my age I know enough about computers.
In general I am good at computers.
When I do something new on the computer, I am confident that I can do well.

Computer value beliefs (alpha coefficient = 0.76)
It is useful to me to have computer skills.
I enjoy so much doing things with the computer that sometimes it is difficult for me to stop.
It is important to me to be good at computers.
It is important to me to improve my computer skills.
Most professions in the future will require computer skills.

Perceived parental support (alpha coefficient = 0.72)
My parents encourage me to use computers.
My parents think that being good at computers is useful for my future.
My parents think that I can do well at computers.
My parents are happy with my computer progress.
My parents get involved when I use the computer.

Perceived peer support (alpha coefficient = 0.67)
My friends are interested in computers.
When my friends and I get together, we enjoy doing things on the computer.
My friends and I like to help each other on the computer.
My friends and I enjoy talking about computers.

References

Baker, D., & Leary, R. (1995). Letting girls speak out about science. *Journal of Research in Science Teaching, 32*(1), 3–27.
Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*(2), 117–148.
Bandura, A., Barbaranelli, C., Caprara, G. V., & Pastorelli, C. (2001). Self-efficacy beliefs as shapers of children's aspirations and career trajectories. *Child Development, 72*(1), 187–206.
Becker, H. J. (2000). Who's wired and who's not: Children's access to and use of computer technology. *The Future of Children, 10*(2), 44–75.
Bleeker, M. M., & Jacobs, J. E. (2004). Achievement in math and science: Do mothers' beliefs matter 12 years later? *Journal of Educational Psychology, 96*(1), 97–109.
Bovée, C., Voogt, J., & Meelissen, M. (2007). Computer attitudes of primary and secondary students in South Africa. *Computers in Human Behavior, 23*(4), 1762–1776.
Busch, T. (1995). Gender differences in self-efficacy and attitudes towards computers. *Journal of Educational Computing Research, 12*(2), 147–158.
Cassidy, S., & Eachus, P. (2002). Developing the computer user self-efficacy (CUSE) scale: Investigating the relationship between computer self-efficacy, gender and experience with computers. *Journal of Educational Computing Research, 26*(2), 133–153.
D'Amico, M., Bason, L. J., & Sissons, M –A. (1995). Gender differences in attributions about microcomputer learning in elementary school. *Sex Roles, 33*(5/6), 353–385.
Dickhäuser, O., & Stiensmeier-Pelster, J. (2003). Gender differences in the choice of computer courses: Applying the expectancy-value model. *Social Psychology of Education, 6*(3), 173–189.
Durndell, A., & Haag, Z. (2002). Computer self-efficacy, computer anxiety, attitudes towards the internet and reported experience with the internet, by gender, in an East European sample. *Computers in Human Behavior, 18*(5), 521–535.
Eccles, J. S., Adler, T., & Kaczala, C. (1982). Socialization of achievement attitudes and beliefs: Parental influences. *Child Development, 53*(2), 310–321.
Eccles, J. S., & Wigfield, A. (1995). In the mind of the actor: The structure of adolescents' achievement task values and expectancy-related beliefs. *Personality and Social Psychology Bulletin, 21*(3), 215–225.

Facer, K., Sutherland, R., Furlong, R., & Furlong, J. (2001). What's the point of using computers? The development of young people's computer expertise in the home. *New Media and Society, 3*(2), 199–219.

Gonzalez-DeHass, A. R., Willems, P. P., & Holbein, M. F. D. (2005). Examining the relationship between parental involvement and student motivation. *Educational Psychology Review, 17*(2), 99–123.

Hakkarainen, K., Ilömaki, L., Lipponen, L., Muukkonen, H., Rahikainen, M., Tuominen, T., et al. (2000). Students' skills and practices of using ICT: Results of a national assessment in Finland. *Computers and Education, 34*(2), 103–117.

Jacobs, J. E., Finken, L. L., Griffin, N. L., & Wright, J. D. (1998). The career plans of science-talented rural adolescent girls. *American Educational Research Journal, 35*(4), 681–704.

Janssen Reinen, I. J., & Plomp, T. (1997). Information technology and gender equality: A contradiction in terminis? *Computers and Education, 28*(2), 65–78.

Judge, S., Puckett, K., & Cabuk, B. (2004). Digital equity: New findings from the early childhood longitudinal study. *Journal of Research on Technology in Education, 36*(4), 383–396.

Makrakis, V., & Sawada, T. (1996). Gender, computers and other school subjects among Japanese and Swedish students. *Computers and Education, 26*(4), 225–231.

Margolis, J., & Fisher, A. (2003). *Unlocking the clubhouse: Women in computing*. Cambridge, MA: The MIT Press.

Meelissen, M. R. M., & Drent, M. (2007). Gender differences in computer attitudes: Does the school matter? *Computers in Human Behavior*. doi:10.1016/j.chb.2007.03.001.

Mumtaz, S. (2001). Children's enjoyment and perception of computer use in the home and the school. *Computers and Education, 36*(4), 347–362.

Nelson, L. J., & Cooper, J. (1997). Gender differences in children's reactions to success and failure with computers. *Computers in Human Behavior, 13*(2), 247–267.

Papastergiou, M., & Solomonidou, C. (2005). Gender issues in internet access and favourite internet activities among Greek high school pupils inside and outside school. *Computers and Education, 44*(4), 377–393.

Pintrich, P. R., & DeGroot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33–40.

Selwyn, N. (1998). The effect of using a home computer on students' educational use of IT. *Computers and Education, 31*(2), 211–277.

Shashaani, L. (1994). Socioeconomic status, parents' sex role stereotypes, and the gender gap in computing. *Journal of Research on Computing in Education, 26*(4), 433–451.

Spera, C. (2005). A review of the relationship among parenting practices, parenting styles, and adolescent school achievement. *Educational Psychology Review, 17*(2), 125–145.

Tenenbaum, H. R., & Leaper, C. (2003). Parent–child conversations about science: The socialization of gender inequities? *Developmental Psychology, 39*(1), 34–47.

Todman, J., & Dick, G. (1993). Primary children and teachers' attitudes to computers. *Computers and Education, 20*(2), 199–2003.

van Braak, J. P. (2004). Domains and determinants of university students' self-perceived computer competence. *Computers and Education, 43*(3), 299–312.

Volman, M., & van Eck, E. (2001). Gender equity and information technology in education: The second decade. *Review of Educational Research, 71*(4), 613–634.

Volman, M., van Eck, E., Heemskerk, I., & Kuiper, E. (2005). New technologies, new differences. Gender and ethnic differences in pupils' use of ICT in primary and secondary education. *Computers and Education, 24*(1), 35–55.

Voyles, M., & Williams, A. (2004). Gender differences in attributions and behavior in a technology classroom. *Journal of Computers in Mathematics and Science Teaching, 23*(3), 233–256.

Wentzel, K. R. (1998). Social relationships and motivation in middle school: The role of parents, teachers and peers. *Journal of Educational Psychology, 90*(2), 2002–2009.

Zeldin, A. L., & Pajares, F. (2000). Against the odds: Self-efficacy beliefs of women in mathematical, scientific, and technological careers. *American Educational Research Journal, 37*(1), 215–246.

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