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Elementary students' self-efficacy beliefs in science: Role of grade level, gender, and socio-economic status

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Abstract

This study examined grade level and gender difference with respect to elementary students' science and technology self-efficacy. Additionally, relationship between socio-economic status (SES) and self-efficacy was examined. A total of 145 elementary students participated in the study. Self efficacy towards Science and Technology Scale was used to collect the data. While results showed that there was no significant difference across grade level and gender, positive relationships were found between number of books in home, frequency of buying a daily newspaper, and income as indicators of SES and self-efficacy.

Key words: *Self-efficacy, Grade level, Gender, Socio-economic status*

Introduction

Self efficacy is defined as "*beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situations "(*Bandura, 1997, p.2). Self efficacy emphasizes one's ability to perform a task successfully and focuses on people's judgments about their abilities (Hoy, 2004). Bandura (1977) points out that people who are suspicious in their capabilities diminish their efforts or give up quickly. On the other hand, people who believe their abilities show strong commitment to accomplishment of the tasks and they do not give up even if they fail to perform the task and also these people having high self efficacy beliefs do not hesitate taking responsibilities. Briefly, self efficacy influence individuals' success on a task (Bandura, 1977). The self efficacy literature indicated that students' self efficacy or their belief to accomplish science courses, tasks or activities have an impact on their choices of science related activities and the effort they spend on these activities and also on their determination when they encounter difficulties (Bandura, 1997; Zeldin & Pajares, 2000). Students who have strong beliefs about their ability in science tasks and activities tend to select such task and activities and put more effort forth to succeed on these tasks. On the other hand, students who don't believe they will be successful in science are likely to avoid science activities and spend less effort for these activities (Britner & Pajares, 2006). Indeed, many studies revealed a significant relationship between self efficacy, science achievement and science related choices across grade level (Andrew, 1998). However, relevant literature demonstrated that students' self-efficacy tend to decline across grade levels. For example, in their study examining middle school students' motivational beliefs, Gungoren and Sungur (2009) found that there was a significant difference among

sixth, seventh and eighth grade students with respect to motivation in science. More specifically, it was found that 6th grade students had higher levels of science self efficacy than 7th and 8th grade students. Additionally, Guvercin (2008) reported a decrease in students self efficacy beliefs from 6th grade level to 8th grade level. This study indicated that 6th grade students had higher levels of self efficacy beliefs than 8th grade students. Results also indicated that girls were more self-efficacious in science compared to boys. Similarly, Britner and Pajares (2001) showed that science self efficacy beliefs were the only motivational variable predicting students' science achievement and girls were found to have higher levels of science self efficacy than boys. On the other hand, in another study conducted by Anderman and Young (1994) middle school boys were reported to be more efficacious in science compared to girls. Therefore, although the abovementioned studies suggest a decline in students' self-efficacy across grade levels, research on gender difference yields different results. In the present study, grade level and gender differences with respect to students' self-efficacy in science and technology will be examined. Students' previous semester grades will be used as covariate since students rely heavily on their previous accomplishments in judging their efficacy (Bandura, 1993).

Furthermore, some studies showed that socioeconomic status of family such as parents' educational level, occupation income, and home resources may influence students' academic achievement through its effect on motivational beliefs. More specifically, these studies suggested that such parental influences on achievement are mediated by their direct and indirect effect on students' motivational beliefs including self-efficacy (Eccles, 2005; Lytton & Pyryt, 1998). Providing a support for this proposition, Senler & Sungur (2009) reported that mother educational level contributed to middle school students' science achievement through its effect on the self-efficacy beliefs. Considering the aforementioned literature, current study also aims at examining the relationship between socio-economic status and self efficacy. Although there is a considerable research examining grade level and gender differences in students' self-efficacy, the research on self-efficacy in relation to socio-economic status is relatively rare. Therefore, this study has potential to make contribution to relevant literature by examining the role of socio-economic status as well as gender and grade level in students' science self-efficacy.

Method
Sample
Participants were 145 students (83 girls and 62 boys) in an urban elementary school in Ankara, Turkey. The students were from Grade 5 (*n*=44), Grade 6 (*n*=29), Grade 7 (*n*=39), and Grade 8 (*n*=30). Students' age ranged from 10 to 15 years. The mean of participants' previous semester grade, used as indication of their prior achievement, was 3.95 over 5.00 (*SD*=.95). While Grade 5 students had the highest mean semester grade (*M* = 4.45), Grade 7 students had the lowest mean (*M* = 3.36). The mean semester grade of Grade 8 students (*M*=3.77) was comparable to those in Grade 7 and the mean semester grade of Grade 6 students (*M* = 4.17) was comparable to those in Grade 5. The students in different grade levels were taught by different science and technology teachers. The sample was obtained through convenience sampling.

Instruments
Self efficacy towards Science and Technology Scale developed by Tatar, Yildiz, Akpinar & Ergin, (2009) was used to measure students self efficacy beliefs towards science and technology. The scale consists of 27 items scored on a five point Likert scale from 1 (strongly agree) and 5 (strongly disagree). The factor analyses conducted during its

development revealed 3-factor structure namely, confidence in science and technology ability (CST), coping with difficulties in science and technology (CPD) and confidence in performing science and technology tasks (CPS). Although, there are several instruments available in the literature to assess students' self-efficacy, this instruments was designed to assess specifically students' science and technology self-efficacy. Thus, in the present study, considering the good psychometric properties of the instrument and scope of the study, Self efficacy towards Science and Technology Scale was used to measure students' self-efficacy in science and technology. Table 1 displays sample items and Cronbach's alpha coefficients found for each sub-scale in the present study.

Table 1. Sub-scale reliabilities and sample items

Sub-scale	Sample Item	Reliability Coefficient
Confidence in science and technology ability (CST)	I believe that I will understand even the most difficult matter which will be taught by science and technology teacher	.92
Coping with difficulties in science and technology (CPD)	Problems relevant to science and technology lesson disconcert me	.72
Confidence in performing science and technology tasks (CPS)	I cannot make science and technology homework by myself	.77

Moreover, students answered the questions about their background characteristics. There were 14 items that investigated students' background characteristics such as age, gender, grade level, previous semester grade, number of sibling, employment status and educational level of parents, number of reading materials in home, frequency of buying a daily newspaper, presence of a separate room at home, computer and parents' income.

Results
Characteristics of Sample
The data concerning parents' educational level, parents' employment status, number of siblings, number of reading materials, presence of a separate study room and a computer with internet connection, frequency of buying a daily newspaper, and income were used as indicators of socio-economic status. Results showed that majority of fathers graduated from high school and below (95%), and majority of mothers graduated from secondary school and below (88.9%). While fathers were mostly employed (86.9%), majority of mothers were unemployed (89%). Nearly 37 % of students reported that they had only 1 sibling and 26 % had 2 siblings. Less than half of the students (44 %) had 11-25 books in their home and about one-fourth (26.9 %) had books ranging from 26 to 100. Only 6.9 % of students had more than 200 books in their homes. Nearly 55 % of students indicated that they had a separate study room and 40% of them reported that they had a computer with internet connection. Nearly 42 % of students were from families with monthly income of 500-1000 TL. More than half of the students (68.3 %) reported that they sometimes buy daily newspapers.

Descriptive Statistics
Descriptive statistics concerning students' confidence in science and technology ability (CST), coping with difficulties in science and technology (CPD) and confidence in performing science and technology tasks (CPS) with respect to grade level and gender is presented in Table 2.

Table 2. Descriptive statistics for science and technology self-efficacy sub-scale scores with respect to grade level and gender

		5th Grade		6th Grade		7th Grade		8th Grade		Total	
		M	SD	M	SD	M	SD	M	SD	M	SD
CST	Boys	4.29	.52	4.22	.47	4.1	.95	3.20	1.02	3.40	.88
	Girls	4.21	.62	4.02	1.06	4.02	.54	3.93	.62	4.07	.73
	Total	4.24	.57	4.08	.92	4.06	.76	3.57	.91	4.03	.79
CPD	Boys	2.93	.90	3.38	.66	3.39	.76	3.40	.73	3.22	.80
	Girls	3.51	1.1	3.71	.83	3.21	.90	3.02	.67	3.39	.93
	Total	3.26	1.03	3.62	.79	3.29	.83	3.23	.72	3.32	.88
CPS	Boys	3.79	1.11	4.00	.79	3.95	.86	4.13	.57	3.93	.87
	Girls	4.21	.95	4.67	.36	4.15	.71	4.12	.73	4.25	.78
	Total	4.03	1.03	4.47	.60	4.06	.78	4.12	.64	4.12	.83

As shown in the table, the mean scores suggested that girls tend to be more self-efficacious on all dimension of science self-efficacy compared to boys. Additionally, the mean scores indicated a general decline in students' confidence in their science and technology ability across grade levels.

Inferential Statistics
Examination of grade level and gender difference in self-efficacy
In order to examine whether there is a difference in students' self-efficacy in science and technology courses across grade levels and gender, controlling for their prior achievement, two-way MANCOVA was conducted. In the analysis, sub-scale scores for Self efficacy Beliefs towards Science and Technology Scale i.e., confidence in science and technology ability, coping with difficulties in science and technology, and confidence in performing science and technology tasks were used as dependent variables while grade level and gender were used as independent variables. Results showed that there was no significant interaction between grade level and gender with respect to the collective dependent variables, $\lambda = .85$, $F(9, 228.92) = 1.73$, $p > .05$. Moreover, no significant grade level ($\lambda = .90$, $F(9, 228.92) = 1.17$, $p > .05$) and gender ($\lambda = .98$, $F(3,94) = .53$, $p > .05$) differences were found. On the other hand, the relationship between prior achievement and collective dependent variables were found to be significant (($\lambda = .80$, $F(3,94) = .53$, $p < .000$)

Examination of the relationship between socio-economic status and self-efficacy
Canonical correlation analysis was conducted to investigate the relationship between students' socio-economic status and their self-efficacy in science and technology courses. The first canonical correlation was .51 (26 % overlapping variance). With a cutoff correlation of .3, the first canonical variate was positively correlated with number of books in home (.49), frequency of buying a daily newspaper (.43), and income (.60) however, negatively correlated with presence of presence of a separate study room (-.71), presence of a computer with an internet connection (-.41). Concerning the self-efficacy variables set, confidence in science and technology ability (.46), coping with difficulties in science and technology (.68), and confidence in performing science and technology tasks (.96) positively correlated with the first canonical variate (see Figure 1). The first pair of canonical variates demonstrated that students who had more reading materials at home, higher frequency of buying a daily newspaper, higher levels of income were likely to be more self-efficacious in science and technology courses. On the other hand, students who had a separate study room and a computer with internet connection appeared to have lower levels of self-efficacy.
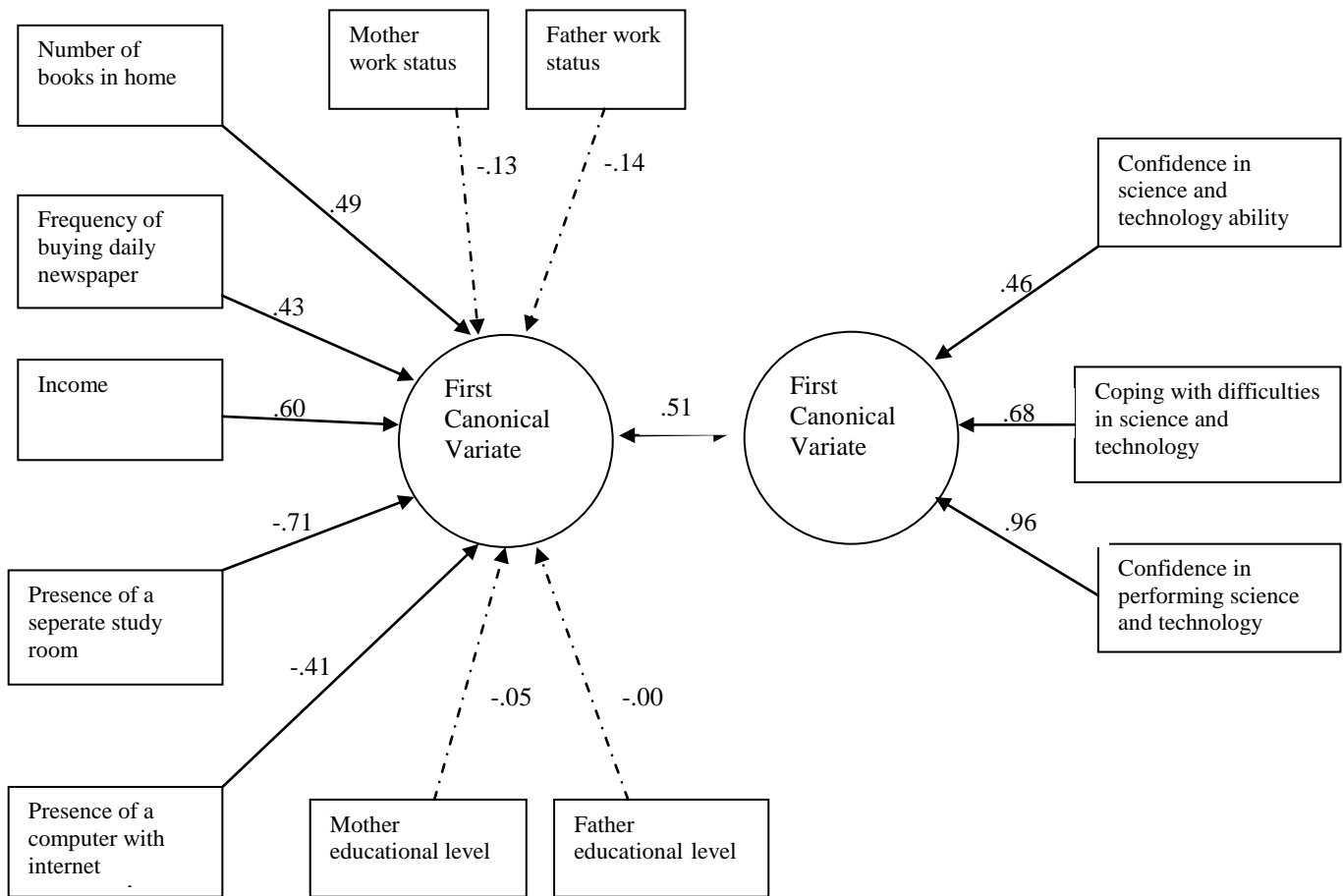
Figure 1. Relationship between socio-economic status and self-efficacy (Dashed lines are not significant)

Discussion

Purpose of this study was twofold: first, to examine grade level and gender difference with respect to science and technology self-efficacy and second, to investigate the relationship between socio-economic status and self-efficacy. Parents' educational level, parents' employment status, number of siblings, number of reading materials, presence of a separate study room and a computer with internet connection, frequency of buying a daily newspaper, and income were used as indicators of socio-economic status. Results showed that there was no significant grade level and gender difference concerning students' science and technology self-efficacy. Examination of mean scores, on the other hand, revealed that there was a general decline only in students' confidence in science and technology ability (CST) and girls appeared to be more self-efficacious. However, these observed differences in means did not reach statistical significance. When the relevant literature is considered, the studies, demonstrated that as grade level increases, students become less self-efficacious (Gungoren & Sungur, 2009; Guvercin, 2008). Additionally, regarding gender difference, while in some studies girls were found have higher levels of science self-efficacy (Guvercin, 2008), in other studies boys were found have higher levels of science efficacy (Anderman & Young, 1994). Therefore, concerning gender difference, related literature revealed mixed results and needs

further investigation. Moreover, results of the present study related to non-significant grade level difference should be elaborated through the use of qualitative data collection procedures in order to understand the reason behind this finding which does not fully support the findings in the relevant literature. However, at this point it is necessary to note that in the present study the sample size was small. Therefore, one possible reason for the observed non-significant grade level difference may be the low sample size. In order to increase the generalizability of the findings, the current study should be replicated with larger representative samples.

Besides, in the present study, a significant relationship was found between elementary students' previous semester grade and science and technology self-efficacy. This finding implied that students with higher levels of prior achievement tend to have higher levels of self-efficacy in science. Indeed, as suggested by Bandura (1993) students' self-efficacy beliefs are strongly influenced by their prior performances. However, it is worth mentioning that students' interpretations of their prior performances are of importance in the development of self-efficacy beliefs. Therefore, it may not be appropriate to use actual performance measures as a source of self-efficacy beliefs (Usher & Pajares, 2008). Accordingly, it is suggested that future studies utilize instruments developed to reveal the meaning that students make of their prior performances in order to make a more accurate representation of its relationship with self-efficacy beliefs.

In addition, in this study, the relationship between socioeconomic status and science self efficacy was investigated. Results revealed that number of books at home, frequency of buying a daily newspaper, and income were positively linked to science and technology self-efficacy. In congruence with this finding, Snow, Burns and Griffin (1998, as cited in Swalander & Taube, 2007) suggested that many books and a daily newspaper at home positively influences students' judgments of their own abilities to perform well and effectively at school. Moreover, parental income, as an indicator of socioeconomic status, reflects both social and economic resources that are present for students (Sirin, 2005). Related research showed that high SES families tend to provide resources stimulating students' cognitive development at their homes. Such cognitively stimulating home environment was found to be directly linked to student motivation including their self-efficacy (Gottfried, Fleming, & Gottfried, 1998; Pintrich & Schunk, 2002). On the other hand, in the current study, among SES variables, presence of a separate study room and a computer with internet connection were found to be negatively associated with self-efficacy. These findings may suggest that students use computer and internet for entertainment purposes rather than for educational purposes. However, the abovementioned explanation is speculative and there is need for investigating for which purposes students tend to use computers and internet. Accordingly, new items assessing for which purposes students use computer and internet at their home can be added to the questionnaire.

Overall, the findings of the current study obtained can have practical implications for parents and science teachers. Firstly, since number of books in home, frequency of buying daily newspapers, and income are found to be positively linked to elementary students' science self-efficacy, it is suggested that students are provided with cognitively stimulating home environments where they can access various resources. Accordingly, programs can be developed to increase parents' awareness about importance of creating home environments that stimulate their children's thinking and to help parents create such supportive home environments providing rich learning materials and experiences for their children (Gottfried et al, 1998; Pintrich & Schunk, 2002) Secondly, since prior achievement was found to be positively related to students' science and technology self-efficacy, as suggested by Britner

and Pajares (2006), science teachers should scaffold authentic inquiry-based science activities to maximize students' success leading to higher levels of self-efficacy. Additionally, implementation of science activities that help students realize the link between their efforts and accomplishments can enhance students' self-efficacy.

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