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The examination of primary school students' attitudes toward science course and experiments in terms of some variables

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Abstract

The purpose of this study was to determine the effects of gender, grade and type of school variables on the primary school students' attitudes toward science and technology course and science experiments. The study group is 247 students in 4th, 5th and 6th grades from three public schools and one private school in Istanbul in the semester of 2012-2013. Attitudes toward science and technology course and science experiments scale was used as a data collection instrument within the scope of this study. The scale was developed by Barmby et al (2005) and adapted to Turkish by Kaya and Böyük (2011). The data obtained were analyzed quantitatively using SPSS 16.00. T-test and One Way Anova test, and Kruskal -Wallis test for students' scores for attitudes toward science experiments were employed. In this study, it was found that students' attitudes toward science course didn't differ by gender and school type; however, there was a significant difference in terms of grade in favor of 6th grade. It was also found that students' attitudes toward science experiments didn't differ by gender and grade, however, there was a significant difference in terms of school type in favor of private school. As a result, the difference in favor of private school brings to mind the question "how and how often is science taught using experiments in state schools?" In this study, it is also recommended that pre-service science teachers should be taught the importance of making science experiments.

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1. Introduction

Science course is one of the important courses that will help students cope with the problems they encounter in daily life and understand nature. By science literacy, which is one of the most

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important goals of science course, individuals understand the nature of science and scientific knowledge, learn to solve problems based on basic principles, concepts, laws and theories of science and technology and to use scientific methods (Kenar and Balcı, 2012). Indeed, it was intended to raise all citizens as science and technology literates in science and technology course curriculum published in 2006 as well as in science course curriculum published in 2013. However, it is also expected in common and main purposes created that the students develop curiosity about, attitudes toward and interest in science [Ministry of National Education (MEB), 2006; MEB, 2013]. Focus in science course should be not only scientific knowledge but also improving students' current scientific knowledge, skills, perspectives and attitudes (Bilgin and Geban, 2004). In parallel with the rapid advancement in science and technology, importance given to science education have increased all over the world and studies conducted in the field of education revealed the role of concepts such as attitudes and motives in the learning process (Altınok, 2004). When the literature of science teaching is examined, it is clear that the importance of academic learning products as well as of affective learning products, and accordingly the ineffectiveness of science teaching are frequently verbalized. The affective learning product which is emphasized the most is attitudes toward science and science courses (Altınok and Ün Açıkgöz, 2006).

Since the importance of developing positive attitudes toward science was realized, specific activities that can be performed to improve students' attitudes toward science were carried out by many educators and researchers in a wider framework (Papanastasio and Papanastasio, 2004). The importance of students' attitudes in learning science has attracted researchers for the last 30 years (Hong, Lin and Lawrenz, 2008).

Previous research reported that students' positive attitudes toward science and hence science courses improve their academic performance and meaningful learning levels, and it is an important factor influencing understanding of science (Azizoğlu and Çetin, 2009; Erdem, Yılmaz, Atav and Gücüm, 2004; Hong and Lin, 2011). Attitude influences students' decisions and behaviors so it plays an important role in the realization of learning (Altınok and Ün Açıkgöz, 2006; George, 2006).

In studies conducted about attitudes toward science conducted with different age groups, it was established that attitudes toward science courses vary by gender, performance status, father's education level and family's economic status (Akgün, Aydın and Öner Sünkür, 2007), that they are affected by students' education readiness, desire and school conditions (Papanastasio and Papanastasio, 2004), do not show significant difference by gender (Kaya and Büyük, 2011; Altınok, 2004), and show significant difference by grade level and age (Kaya and Büyük, 2011).

In studies related to teaching methods and techniques influencing attitude toward science, multiple intelligences theory (Özyılmaz Akamca and Hamurcu, 2005) and collaborative and individual concept mapping (Altınok and Ün Açıkgöz, 2006) were found to have no significant effect on students' attitudes toward science, whereas delivering performance-based activities during evaluation process (Önal Çalışkan and Kaptan, 2012), guided questioning approach (Köksal and Berberoğlu, 2014), an education setting in which science and social events are incorporated and discussed (Hong, Lin, Wang, Chen and Yang, 2013), science-technology-social approach (Lee and Erdoğan, 2007), drama technique (Sağırlı and Gürdal, 2002), experiments made using simple materials (Koç and Büyük, 2012) and cooperative learning (Bilgin and Karaduman, 2005) were found to have positive effects on students' attitudes toward science course.

One of the most important methods used in science course is experiment method. Through science experiments, students will be able to reflect on the events that occur in nature and develop activities that will enhance their cognitive skills. Students are also thought to exhibit positive or negative attitudes toward science experiments (Yeşilyurt, Kurt and Temur, 2005), which have a core importance in learning science (Hofstein, Kipnis and Kind, 2008; Hofstein and Lunetta, 2004; Demirbaş and Pektaş, 2010). Accordingly, it was aimed to investigate whether students' attitudes toward science course as well as science experiments vary by gender, grade level and type of school they attend. For this purpose, the sub-problems below were established:

1.1. Do primary school students' scores for attitudes toward science courses and science experiments vary by gender?

- 1.2. Do primary school students’ scores for attitudes toward science courses and science experiments vary by grade level?
- 1.3. Do primary school students’ scores for attitudes toward science courses and science experiments vary by whether the school they attend is a private school or a state school?

2. Method

2.1. Research Model

In this study, screening model was used to determine whether primary school students' attitudes toward science courses and science experiments vary by gender, grade level, and type of school they attend.

2.2. Sample of the Study

The sample of the study was 247 students from 4th, 5th and 6th grades of three different primary schools selected randomly among primary schools in the province of Istanbul during the 2012-2013 academic year. Distribution of participants by gender and grade is shown in Table 1.

Table 1. Characteristics of sample group

Grade	Female	Male	Total
4	8	9	17
5	36	43	79
6	69	82	151
Total	113	134	247

2.3. Data Collection Instrument

In the study, “Attitudes Toward Science Courses and Science Experiments (ATSCSES) Scale”, which is a translation into Turkish created and developed by Kaya and Büyük (2011) of a 5-point Likert attitude scale with a reliability coefficient of Cronbach Alfa 0.76, originally developed by Barmby et al. (2005) to investigate students’ attitudes toward science and technology courses and science experiments, was employed to collect to data. This scale was chosen because it collects data related to attitudes toward science course and experiments, and it was developed in an updated manner. The statements in ASTSCSE used in the study were evaluated using a five-step Likert-type rating scale as follows: strongly agree (5), agree (4), neither agree nor disagree (3), disagree (2), strongly disagree (1). The scale consists of two parts. The scale consists of a total of 21 items and its first part includes 13 attitude items related to science and technology courses aiming to reveal students’ attitudes, and its second part includes 8 attitude items regarding science experiments.

2.4. Data Analysis

First, in order to determine which test methods to use in the study, distribution and homogeneity of data were analyzed. Fitness of the research data for normal distribution was determined using Single- Sample Kolmogorov- Smirnov test.

- Factor 1: Attitude toward Science Courses
- Factor 2: Attitude toward Science Experiments

Table 2. Results of Kolmogorov Smirnov Test

	Factor 1	Factor 2
N	247	247
Mean	53.93	36.10
Kolmogorov Smirnov Z	1.266	3.184
Assymp Sig	.081	.000

Factor 1 value on line Assymp.Sig. (Significance) from Table 2 is larger than 0.05, which is considered as a limit value in statistical significance calculations, indicating that factor 1 data were normally distributed, however, Factor 2 value on line Assymp.Sig. (Significance) in the same table is smaller than 0.05, indicating that factor 2 data were not normally distributed. Moreover, for homogeneity of the data, One-way ANOVA test was performed.

Table 3. Homogeneity results of the values

	Levene Statistic	df1	df2	p
F1	.001	1	245	.976
F2	4.807			.029

In Table 3, p values of Factor 1 are larger than 0.05, which indicates that factor 1 distributions are homogenous, whereas, p values of Factor 2 in the same table are smaller than 0.05, which indicates that factor 2 distributions are not homogenous. Therefore, it was deemed appropriate to use parametric test methods in analysis of Factor 1 and non-parametric test methods in analysis of factor 2.

t-test and One Way ANOVA test were used for students' total scores for attitudes toward science courses. Kruskal-Wallis test, an alternative technique to one-way variance analysis, which does not require the assumptions of normal distribution and equality of variances, was used for the scores for attitudes toward science experiments.

3. Findings

In this section, distributions of 247 primary school students included in the study sample by gender, grade level and type of school they attend were determined, and the results regarding whether students' scores for attitudes toward science courses and science experiments vary by gender, grade level, and type of school they attend are given.

3.1. Do students' scores for attitudes toward science courses and science experiments vary by gender?

a. t test was conducted to determine whether students' scores for attitudes toward science courses vary significantly by gender.

Table 4. t-test results of students' scores for attitudes toward science courses by gender

Gender	N	X	S	sd	t	p
Female	113	54.83	7.53			
Male	134	53.18	7.75	245	1.684	.094

As seen in Table 4, no significant difference was found between female and male students ($t_{(245)}=1,684$, $p>.05$).

b. Kruskal-Wallis test was conducted to determine whether students' scores for attitudes toward science experiments vary significantly by gender.

Table 5. Kruskal-Wallis test results of students' scores for attitudes toward science experiments by gender

Gender	N	Average of Rows	sd	χ^2	p
Female	113	129.33			
Male	134	119.50	1	1.179	.277

As seen in Table 5, no significant difference was found between female and male students ($\chi^2_{(1)}=1,179$, $p>.05$).

3.2. Do students’ scores for attitudes toward science courses and science experiments vary by grade level?

a. One Way ANOVA test was conducted to determine whether students’ scores for attitudes toward science courses vary significantly by grade level. As shown in Table 6, a significant difference was found between the grades ($F_{(2-244)}=3,405, p<.05$). According to the results of Scheffe test conducted to find between which grades a difference exists, 6th grade students’ scores($X=54,93$) for attitudes toward science courses were demonstrated to be more positive than 5th grade students’ scores($X=49,80$) for attitudes toward science courses.

Table 6. t-test results of students' scores for attitudes toward science courses by grade level

Variance Source	Sum of Squares	sd	Mean of Squares	F	p	Significant Difference
Between-group	393.911	2	196.956	3.405	0.035	5-6
Within-group	14114.178	244	57.845			
Total	14508.089	246				

b. Kruskal-Wallis test was conducted to determine whether students’ scores for attitudes toward science experiments vary significantly by grade level.

Table 7. Kruskal-Wallis test results of students' scores for attitudes toward science experiments by grade level

Grade	N	Average of Rows	sd	χ^2	p
4	17	119.91	2	.468	.791
5	79	128.42			
6	151	122.15			

It is evident from Table 7 that no significant difference was found between grade levels ($\chi^2_{(2)}=.468, p>.05$).

3.3. Do students’ scores for attitudes toward science courses and science experiments vary by educational institutions they attend?

a. t test was conducted to determine whether students’ total scores for attitudes toward science courses vary significantly by type of school.

Table 8. t-test results of students' scores for attitudes toward science courses by type of school

School Type	N	X	S	sd	t	p
State	173	53.8035	7.81	245	.424	.672
Private	74	54.2568	7.39			

As shown in Table 8, no significant difference was found between groups for attitudes toward science courses by school type ($t_{(245)} = 4.24, p > .05$).

b. Kruskal-Wallis test was conducted to determine whether students' scores for attitudes toward science experiments vary significantly by school type.

Table 9. Kruskal-Wallis test results of students' scores for attitudes toward science experiments by school type

School Type	N	Average of Rows	sd	χ^2	p
State	173	117.32	1	5.126	.024
Private	74	139.61			

A significant difference in favor of private schools ($X=139,61$) was found between state and private schools, as shown in Table 9 ($\chi^2_{(1)}=5,126, p < .05$).

4. Results and Discussion

This study was conducted to investigate whether primary school students' attitudes toward science course as well as science experiments vary by gender, grade level and type of school they attend. The results were presented in line with data obtained according to these variables.

In the study, when the effect of gender variable on students' attitudes toward science course is considered, attitude scores were found to show no significant difference by gender factor. Although this result is not comparable to the results of several previous studies (Çakır et al. 2000, Yenice 2003, Çakır K. et al. 2007, Kozcu Çakır and Şenler 2007, Avcı Erduran and Darçın Selcan 2008, Kaya and Büyük 2011), it is comparable to some other studies (Weinburgh 1995, Bilgin and Karaduman 2005, Tekbiyik and İpek 2007).

In the study, when the effect of gender variable on students' attitudes toward science experiments is considered, attitude scores were found to show no significant difference by gender factor. Although this result is not supported by the result found by Yıldız et al. (2006), it is supported by previous studies which investigated attitudes toward science experiments (Bernardez 1998, Kaya and Büyük 2011, Yeşilyurt et al. 2005), attitudes toward physics experiments (Taşlıdere and Korur 2012), attitudes toward chemistry experiments (Cheung 2009) and attitudes toward biology experiments (Erdoğan et al. 2009), which are disciplines covered by the science course. In a study by Greenfield (1997), which evaluated interest and participation in science laboratory, it was observed that female students actively participated in science laboratory, set up pendulum and balance mechanisms, prepared mixtures related to chemicals, just like male students, and that male students counted the number of swings of the pendulum, took readings of the weights of objects in balance, just like female students, which also support this study, suggesting that gender has no influence on attitudes toward science experiments.

Another result of this study was that primary school students' scores for attitudes toward science course did not vary in terms of school type variable. There are studies in the literature reporting that attitudes toward science course vary by school type (Novick and Duvdvanı 1976, Banu 1986, Mutlu 2006). There are also studies which concluded that private school students' attitudes toward science course are at the top (Kiraz and Omağ, 2013). However, the results of this study are also supported by previous studies suggesting that attitudes toward science course do not vary by school type (Craker, 2006). With the results obtained from this study, it may not be entirely accurate to say that school type has no significant effect on attitudes toward science course. Private school students only comprise 34% of the sample of this study, which may not be adequate to measure the difference between attitudes by school type.

As a result of the analysis conducted to determine whether participating primary school students' scores for attitudes toward science experiments vary by educational institution they attend to, it was concluded that their attitudes toward science experiments varied in favor of private schools by

school type. In a study by Bozdoğan and Yalçın (2005) which investigated attitude scores of primary school students grouped according to different education-teaching and different number of teachers-students, and in a study by Temel et al. which investigated attitude scores of students from faculty of science & literature and faculty of education, in which physical conditions and tools-equipment were either arranged well or not, it was concluded that those who had limited laboratory facilities could not conduct most of the experiments, resulting in reduced student attitudes toward science experiments. Özdemir and Azar (2004), and Yıldız et al. (2006) compared attitudes toward the purposes of science experiments of teachers who have science laboratory in their school and of those who don't, and identified a significant difference in favor of teachers who have science laboratory in their school. Feyzioğlu et al. (2011) determined that physical conditions of a laboratory causes significant difference in perceptions of teachers toward the laboratory. The results obtained from these investigations conducted with students and science teachers from different levels of education are consistent with the conclusion of this study that the attitudes toward science experiments vary in favor of private schools, which have better equipped laboratories. Effective use of laboratories by science teachers depends on whether teachers exhibit a positive attitude toward laboratory use as well as on whether laboratory conditions in their schools are suitable for work. Teachers' positive attitudes toward laboratories may also encourage students to adopt positive attitudes toward science experiments.

In the study, it was concluded that attitudes toward science course varied significantly by grade level in favor of 6th grade, among 5th and 6th grades, however, attitudes toward science experiments did not vary by grade level. There are research studies which demonstrated that students' scores for attitudes toward science course decreased with increasing grade level (Greenfield 1997, Bozdoğan and Yalçın 2005, Murphy et al. 2006), and that such decline is significant for especially 8th grade, compared to other levels (Akpınar et al. 2009). Weinburgh and Englehard (1994) observed that students from lower grades participate in experiments in the laboratory more actively than those from higher grades. According to Rice et al. (2013), students who receive social support from their parents, friends and teachers for mathematics and science courses have more positive attitudes toward mathematics and science courses, and their qualifications in these courses are in a sense higher. The findings of this study that attitudes toward science experiments do not vary by grade level, whereas attitudes toward science course vary in favor of 6th grade, among 5th and 6th grades, may have arisen from perceptions regarding science teachers, motivations regarding the course, of students constituting attitudes toward science course, their friends' and parents' attitudes and laboratory or classroom setting, as suggested by Osborne et al. (2003).

5. Suggestions

It is important for effective use of laboratories, which are indispensable for science and technology lessons, that laboratories are rearranged in accordance with the goals of the course in all schools.

Professional development with respect to laboratory practices of teachers, knowingly or unknowingly playing an important role in students' developing positive attitudes toward science experiments, should be supported.

Considering that positive attitudes toward science course can also affect the students' course selections in the next stage of their education and their career choices in the future, science classrooms should be arranged in such a way as to attract students' attention, increase their interest and curiosity so that they have positive attitudes toward science course.

In-service training should be provided to teachers so that science courses, as a course by which students can develop their manual skills as well as their creativity and thinking styles, and laboratory practices indispensable for the course are conducted with activities that will encourage participation of students.

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