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An Investigation into Upper Elementary Students' Attitudes towards Science

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Abstract
Science and technology course that helps to improve cognitive aspects and enhance the creativity of the individuals is an important part of elementary school education as a core course. Students may gain scientific knowledge, scientific process skills, and attitudes during their science learning process. This study aimed to determine upper elementary students' attitudes towards *science outside school, science and technology, school and plans for the future*. A questionnaire cross-sectional survey method is used for data collection the sample of the study is 191 students selected among the population by randomly. The questionnaire was 5-point Likert-type scale, and its Cronbach Alpha reliability coefficient is 0.83. It includes 6 items regarding students' attitudes towards *science outside school*, 6 items regarding *science and technology,* 12 items regarding *school,* and 5 items regarding *plans for the future*. The data have been analyzed by using SPSS 16.0 software. Appropriate statistical methods were used for the examination of data distribution. It was found that students' mean attitude scores ($\overline{X}$ =3.96) for *science outside school*, ($\overline{X}$ =4.09) for *science and technology,* ($\overline{X}$ =3.50) for school, and ($\overline{X}$ =3.50) for *plans for the future*. It was also examined whether general attitude of the students towards *science outside school, science and technology, school and plans for the future* varied with respect to gender, grade and age variables. It was found that students' attitude scores varied with respect to gender ($p<0.05$) in favor of girls and attitude scores for only *science and technology* section. It was found out there was statistically significant difference in favor of 8th grade students for attitudes towards only *science and technology* section. Moreover, it was found out there was significant difference in favor of 15th years old students towards *science outside school, science and technology and school.*
Keywords: Attitude, science education, science outside school, plans for the future, school

Introduction

The purpose of science education is to raise science-literate individuals. According to the American Association for the Advancement of Science, (1993) science literacy is the indispensable goal of the contemporary science curriculum OR According to the American Association for the Advancement of Science, science literacy is the indispensable goal of the contemporary science curriculum (AAAS, 1993). In its most general sense, science literacy is a combination of science-related capabilities, attitudes, values, approaches and knowledge. A science-literate individual will develop skills of critical thinking, problem solving and decision making, will become lifelong learner and will maintain his/her curiosity about the world that surrounds himself/herself. A science-literate individual understands the nature of science and scientific developments; comprehends the basic science concepts, principles, laws and theories, and makes appropriate use of these; uses scientific processes for solving problems and making decisions; understands the relationship between science and technology as well as science and environment; and develops interests that makes one's life richer and more satisfactory (Köseoğlu, Atasoy, Kavak, Akkuş, Budak, Tümay, Kadayıfçı & Taşdelen, 2003).

Non-formal education has an important place in the development of science literacy, along with formal education in schools. Students have various opportunities outside school that will develop learning of science. Non-formal science education is basically the education given through various channels outside school. This education involves such activities as watching TV, reading extracurricular books, reading magazines and newspapers, and visiting museums and science centers. The characteristic feature of out-of-school science education is the ability of the

learner to control what to learn and why and when to learn (Stocklmayer & Gilbert, 2003). Research on out-of-school activities shows that such activities have positive effects on school (academic) success, the adoption of school culture, bringing out and development of leadership skills, the development of personality, social senses and morality, making efficient use of leisure time, and gaining a democratic attitude (Köse, 2003; Lave, 1988; Morrison, Smith & Dow-Ehrensberger, 1995). Non-formal learning contributes to education in class and the lifelong learning of students (Gardner, 1991). Research in the recent years has focused on how students learn science through out-of-school sources (Kavak, Tufan & Demirelli, 2006; Türkmen, 2010; Kıyıcı & Yiğit, 2010).

Both in-school and out-of-school science education is in continuous development in parallel to changing world conditions. For this reason, the creation of new teaching environments under constantly developing education programs, along with the selection of materials and methods for an effective science education and identification of interests and attitudes of students towards *science* is very important.

Research conducted by Balım, Sucuoğlu & Aydın 2009 revealed that students with a positive attitude towards science perform better in terms of academic success. Demirbaş & Yağbasan, 2004 pointed out that students' attitudes affect their success in the sciences lessons up to 27 %, and those students who combine positive, affective, and cognitive mindset can achieve success, even in an unsuitable education environment.

Attitudes are related to coping with and controlling the emotions that arise during learning, and thus have an important role in determining human behavior. Attitude can be defined as the tendency to react positively or negatively to other individuals, places, events or ideas (Simpson, 1994). Developing an attitude toward a lesson involves such behaviors as the desire to be part of the lesson, being satisfied with responding to it, accepting that it has a value and supporting its acceptance as a value (Özçelik, 1998). Positivity or negativity of attitudes that arise in connection to a value and belief system directly affect the learning process and shape the future lives of individuals (Seferoğlu, 2004; Sünbül, Afyon, Yağız & Aslan, 2004; Hendrickson, 1997) states that attitude is the best estimator of student success. Pintrich and Schunk, 1996 put forth that the planning, organization and implementation of activities are important in order for students to develop more positive attitudes.

A great deal of research has been conducted on identifying students' attitudes toward science lessons (Mattern & Schau, 2002; Kind, James & Barmby, 2007; Kaya & Böyük, 2011). In these researches, generally students' attitudes toward science lessons and science laboratories in school environments were surveyed. The findings of the researches, both national and international, show that students' success in science lessons is lower compared to other fields.

Purpose of the Study

The purpose of this research is to examine the attitudes of students studying at upper elementary schools in Kayseri provincial center toward *science outside school, science and technology, school,* and *plans for the future.* Since no research on student attitude toward *science outside school, science and technology school,* and *plans for the future* could be found; this research is deemed necessary. Based on these purposes the following research questions are investigated:

1. What are the attitudes of students in Elementary School upper elementary school with regard to *science outside school, science and technology, school, and plans for the future?*
2. What is the relationship between attitude ratings and parameters of gender, grade level and age?

Methodology

This is a descriptive research conducted using the questionnaire cross-sectional survey method. The questionnaire is designed to find out the attitudes of students in elementary schools in Kayseri provincial center towards *science outside school, science and technology, school,* and *plans for the future*.

Population and Sample

The working population of the research is pupils studying in elementary schools of Ministry of National Education in Kayseri provincial center in the autumn term of 2011-2012 academic years. Since it was quite difficult to reach the population, a sample was drawn. The sample of the survey consists of 191 students randomly selected from nine different school among 6th grade (n=66, 34.5%), 7th grade (n=58, 30.4 %) and 8th grade (n=67, 35.1%) students. *Assumptions of the study*

-Sample of the research represents the population.
-Opinion scales of the students show their level of positive opinions regarding *science outside school, science and technology, school, and plans for the future*.

Instrument

During the process of deciding the attitude scale to be used first previous studies were examined. Of these studies, a five-level Likert scale with a reliability coefficient of the Cronbach Alfa 0.83, developed by Barmby et al. (2005) for surveying the interest and attitudes of students toward *science outside school, science and technology, school,* and *plans for the future* were selected. The scale was translated into Turkish by the author, and the validity of translation was examined with consultation to English and Turkish language experts. When the Turkish scale took its final form, a lecturer in the English Teaching Department was asked to translate the items in the scale back into English. At the end of this process, it was seen that the translation of scale items from Turkish into English largely matched the original English form. Later, an expert in Turkish Language Education was asked to examine and rate each item in the scale in terms of compliance with Turkish grammar and intelligibility. In the next phase, the Turkish scale was given its final form by taking into consideration the advice of an expert in science education. Thus, the translation and linguistic validity of the scale were ensured.

The translated scale was piloted with 80 upper elementary school students studying at different grades in nine elementary schools of the Ministry of National Education in Kayseri provincial center. The final corrections were made on the scale according to the feedback taken from piloting. Then the survey was conducted on 191 students.

The scale includes two sections. The first section consists of multiple-choice questions querying parameters of gender, grade and age. The second section consists of a total of 29 attitude items*, six of these are related to science outside school, six about ideas on science and technology, and twelve about school, and five related to plans for the future.* For each positive item on the scale, students' responses were rated as [(1) strongly disagree (SD), (2) disagree (D), (3) neither agree nor disagree (N), (4) agree (A), (5) strongly agree (SA)], while each negative item on the scale was rated as [(1) SA, (2) A, (3) N, (4) D, (5) SA]. Before making statistical analysis, in total 28 scales was eliminated because they were either incomplete or arbitrary filled in. 191 valid scales were used for statistical analysis.

Data Analysis

Data was analyzed using the SPSS 16.0 software package. In these analyses, first of all descriptive statistics (frequency, percentage, average, and standard deviation) were calculated to

set forth the characteristics of the distribution. In order to identify the attitudes of students toward *science outside school, science and technology, school,* and *plans for the future,* the level of agreement for each item was calculated. For this purpose, the scale range (4/5=0.80) was calculated and 0.80 was defined as the limit of the agreement level. According to this, the values of arithmetic averages between 1.00-1.79 were assigned to *"SD"*, the values between 1.80-2.59 to *"D"*, the values between 2.60-3.39 to *"N"*, the values between 3.40-4.19 to *"A"* and the values between 4.19-5.00 to "*SA*". This rating not included in the scale developed by Barmby et al. (2005) was developed by the author.

As a result of these ratings, the significant difference level was tested at the level of $p<0.05$ using independent sample t-test and variance analysis. Tukey and Dunnett's C tests were conducted when needed as post-hoc tests. An independent sample t-test was conducted to find out if there was a significant difference between averages of double variable properties, and a one-way variance analysis (ANOVA) was conducted for cases involving more than two variables.

Findings

Findings concerning gender, grade and age characteristics of students

The distribution of students participating in the survey by their gender is provided in Figure 1. When the distribution of students by gender is examined, it is found that 83 of them (43.5 %) are *girls*, and 108 of them (56.5 %) are b*oys*.
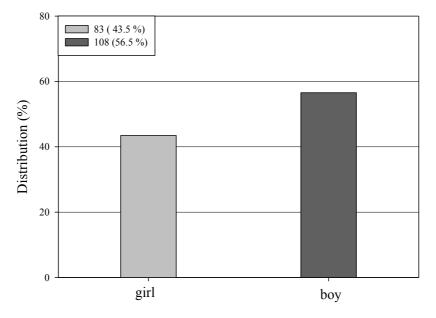

Figure 1. Gender distribution of the students

The distribution of students according to the grade is shown in Figure 2. As seen in Figure 2, 66 (34.5 %) of the students are in the 6th grade, 58 (30.45%) are in the 7th grade, and 67 (35.1 %) are in the 8th grade.
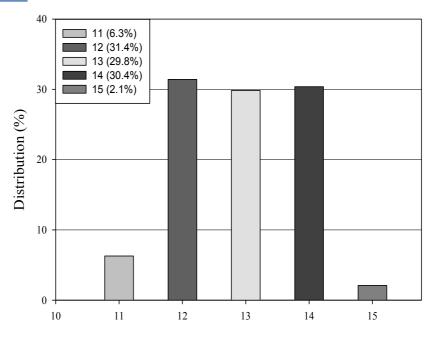
Figure 3. Age distribution of the students

The distribution of students according to their ages is given in Figure 3. When Figure 3 is examined, it is found that 12 of them (6.3 %) are 11 years old, 60 of them (31.4 %) are 12 years old, 57 of them (29.8 %) are 13 years old, 58 of them (30.4 %) are 14 years old and four of them (2.1 %) are 15 years old.
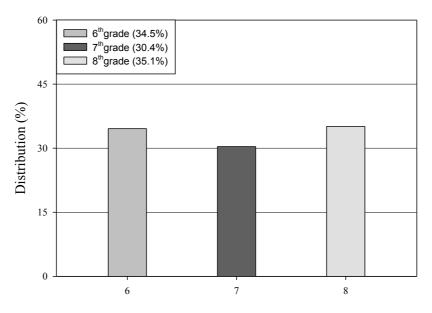

Figure 2. Grade-level distribution of the student

Students' attitudes towards science outside school

The frequency and average attitude ratings of the respondents toward ***science outside school*** are outlined in Table 1. As seen in Table 1, students provided answers with high attitude ratings like those given in items 2, 5 and 6, which were "*I like watching scientific programs on TV*" ($\overline{x}$ =4.05), "*I enjoy reading scientific magazines and books*" ($\overline{x}$ =4.10), and "*New developments in science and technology excite me*" ($\overline{x}$ =4.13).

The responses of students to each attitude item resulted in average attitude ratings of minimum 3.66 and maximum 4.13. It is seen that the average attitude rating ($\overline{x}$=3.96) of students is at the *"I agree"* level (3.40-4.19). According to these results, it is understood that students have a positive attitude toward *science outside school*.

*Table 1. Attitude distribution of participating students' towards **science outside school***

	Science outside School	SD	D	N	A	SA	AS
		%	%	%	%	%	$\overline{X}$
1	I would like to join a science club.	12.0	4.7	23.6	24.1	35.6	3.66
2	I like watching science programs on TV.	4.7	6.8	9.4	36.6	42.4	4.05
3	I like to visit science museums.	6.3	12.6	16.2	23.6	41.4	3.81
4	I would like to do more science activities outside school.	1.6	10.5	16.2	31.4	40.3	3.98
5	I like reading science magazines and books.	4.7	5.2	13.1	23.3	47. 6	4.10
6	It is exciting to learn about new things happening in science.	2.6	3.7	18.3	28.8	46.6	4.13

SD; *Strongly disagree,* **D:** *Disagree,* **N:** *Neither agree nor disagree,*
A: *Agree, S: Strongly agree,* **AS**; *Average attitude scores*

Students' attitudes towards science and technology

Table 2 shows that responses of students concerning *science and technology*. It can be seen from Table 2 that students were in high agreement with all opinions except the fourth attitude item. Students responded to statements 1 and 2 with high average attitude ratings falling in the range of "I strongly agree" (4.20-5.00), which were "*Science and technology is important for society*" ($\overline{x}$=4.63) and "S*cience and technology ensures that we maintain an easier and more comfortable life*" ($\overline{x}$=4.55). It was found that students responded in the undecided range (2.60-3.39) to the opinion "*Science and technology helps the poor*" ($\overline{x}$=2.75).

*Table 2. Attitude distribution of the respondents towards **science and technology***

	My views about science and technology do you agree these views?	SD	D	N	A	SA	AS
		%	%	%	%	%	$\overline{X}$
1	Science and technology is important for society.	0.5	0.5	5.8	22.0	71.2	4.63
2	Science and technology makes our lives easer and more comfortable.	0.5	3.7	6.3	19.4	70.2	4.55
3	The benefits of science are greater than the harmful effects.	0.5	5.2	15.7	27.7	50.8	4.23
4	Science and technology are helping the poor.	27.2	9.9	34.6	17.3	11.0	2.75
5	There are many exiting things happening in science and technology.	3.1	3.7	6.3	27.7	59.2	4.36
6	Scientists are having exciting jobs.	3.7	8.4	17.8	21.5	48.7	4.03

Students' attitude toward school

To figure out the student's attitudes towards *school,* they were asked to respond in total 12 items. Table 3 shows the distribution of percentage and average attitude ratings concerning the respondent's attitudes toward s *school.*

*Table 3. Attitude distribution of participating students towards **school***

My school do you agree these views?	SD	D	N	A	SA	AS
	%	%	%	%	%	$\overline{X}$
1 I really like school.	8.9	5.2	9.9	19.4	56.5	4.09
2 I would recommend this school.	2.6	8.9	12.6	21.5	54.5	4.16
3 I find school boring.	33.0	24.6	12.0	15.2	15.2	2.55
4 I feel that I belong in this school.	6.3	10.5	18.8	25.1	39.3	3.81
5 Most of the time I wish I wasn't in school at all.	30.4	20.4	15.7	17.8	15.7	2.68
6 Most lessons are dull.	20.4	25.7	16.8	14.7	22.5	2.93
7 I like reading.	16.2	18.8	18.3	19.4	27.2	3.23
8 I like writing.	16.8	12.6	13.1	23.0	34.6	3.46
9 I get on well with most of my teachers.	8.9	12.0	11.0	26.7	41.4	3.80
10 I like science.	11.0	9.4	11.5	27.7	40.3	3.77
11 I am happy when I am in school.	6.8	5.8	23.0	25.7	38.7	3.84
12 I work as hard as I can in school.	8.4	11.5	14.7	30.9	34.6	3.72

As seen in Table 3, students participating in the study responded to items 1, 2, 4, 9 and 11 with relatively high average attitude ratings, which were "*I like my school very much*" ($\overline{x}$=4.09), "*I would recommend my school*" ($\overline{x}$=4.16), "*I feel I belong to my school*" ($\overline{x}$=3.81), *"I generally get along with my teachers well"* ($\overline{x}$=3.80), and "*I am generally happy at school*" ($\overline{x}$=3.84), while statements in items 5, 6 and 7 received average ratings in the undecided range, which were "*I do not want to spend most of my time at school*" ($\overline{x}$=2.68), "*I find the lessons boring*" ($\overline{x}$=2.93), *"I like reading"* ($\overline{x}$=3.23). Students responded to the negative attitude item of "*I find my school boring*" with an average rating of $\overline{x}$=2.55 that corresponds to the "*I disagree*" range. According to these results, it is understood that students have a positive attitude toward *school* in general.

Students' plans for the future

The percentage and average ratings of the respondents to items that aim to find out their opinions regarding their *plans for the future* are provided in Table 4.

Table 4. *Attitude distribution of participating students towards* **plans for the future**

	My plans for the future	SD %	D %	N %	A %	SA %	AS $\overline{X}$
1	I would like to study more science in the future.	2.1	5.8	18.3	33.5	40.3	4.04
2	I would like to study science at the university.	4.2	11.0	22.5	21.5	40.8	3.84
3	I would like to have a job working with science.	7.3	11.0	27.2	24.6	29.8	3.59
4	I would like to become a science teacher.	13.1	21.5	18.8	13.1	33.5	3.32
5	I would like to become a scientist.	5.2	5.8	16.2	18.8	53.9	4.10

As seen in Table 4, "*I would like to make more scientific studies in the future*" has an average attitude rating of $\overline{x}$=4.04, "*I would like to study Science and Technology at the university*" has a rating of $\overline{x}$=3.84, "*I would like to have a science and technology related job*" has a rating of $\overline{x}$=3.59, "*I would like to become a Science and Technology teacher" has a rating of $\overline{x}$=3.32, and "*I would like to become a scientist*" has a rating of $\overline{x}$=4.10. The average rating of responses of students to all attitude items related to their plans for the future was calculated as $\overline{x}$=3.78. While participating students responded to the opinion "*I would like to become a scientist*" with the highest rating ($\overline{x}$=4.10), their responses to "*I would like to become a Science and Technology teacher*" was in the undecided range (2.60-3.39) with an attitude rating of $\overline{x}$=3.32.

Evaluation of students' attitudes according to different variables

A statistical analysis was conducted to find out if average attitude rating of students' responses to *science outside school, science and technology, school,* and *plans for the future,* vary by gender, grade and age variables. The analysis revealed that the data show normal distribution, and the variances are homogenous, which was followed by an independent sample t-test (relationship between the attitude rating and gender) for groups with two variables and a one-way variance analysis (ANOVA) (relationship between the attitude rating and grade & age) aimed at identifying the differences between more than two groups.

The results of the independent sample t-test conducted with the aim of determining the influence of the gender variable with against the attitude ratings of science and technology lessons, and science experiments are given in Table 5.

Table 5. *Students' average attitude scores according to gender and t-test results*

Section	Gender	N	$\overline{X}$	SS	Sd	t	p
Science outside School	Girl	108	4.02	4.14	189	1.294	0.197
	Boy	83	3.88	4.65			
Science and technology	Girl	108	4.24	3.87	189	2.720	0.006
	Boy	83	3.86	3.29			
School	Girl	108	3.52	6.23	189	0.443	0.659
	Boy	83	3,48	6,02			
Plans for the future	Girl	108	3.85	4.32	189	1.265	0.207
	Boy	83	3.67	4.55			

As seen in Table 5, attitude points toward opinions in sections of *science outside school, school,* and *plans for the future* vary in the range $\overline{X}$=3.48 and $\overline{X}$=4.24 and there is no significant difference with respect to gender (p>0.05). But there is a significant difference [t = 2.720, p< 0.05] between attitude ratings of girls and boys in favor of girls in terms of average attitude ratings toward *science and technology*.

A one-way variance analysis (ANOVA) was conducted to find out the influence of a grade variable with more than two groups on the attitude rating. The results derived are provided in Table 6.

Table 6. *Students' attitude scores according to grade and ANOVA results*

Section	Variance Source	Sum of Squares	Sd	Mean Squares	F	p
Science outside School	Between groups	38.20	2	19.10	0.998	0.371
	Within groups	3598.23	188	19.14		
Science and technology	Between groups	73.72	2	36.86	2.757	0.026
	Within groups	2513.56	188	13.37		
School	Between groups	111.29	2	55.64	1.491	0.228
	Within groups	7016.53	188	37.32		
Plans for the future	Between groups	2.12	2	1.06	.053	0.948
	Within groups	3721.79	188	19.80		

The variation analysis results in Table 6 shows that there is no significant difference (p>0.05) between attitude ratings of students toward *science outside school, plans for the future and school* by grade levels. However, the average attitude ratings of students toward *Science and technology* show a significant difference [$F_{(2-188)}$ = 2.757, p< .05] by grade level. This significant difference was found to be in favor of students in the 8th grade among all grades. In other words, it was found that the 7th grade has a higher attitude rating compared to the 6th grade, while the 8th grade has higher attitude points compared to both 6th and 7th grades.

A one-way variance analysis (ANOVA) was conducted to find out the influence of the age variable on the attitude rating. The results derived are provided in Table 7.

Table 7. *Students' attitude scores according to age and ANOVA results*

Section	Variance Source	Sum of Squares	Sd	Mean Squares	F	p
Science outside School	Between groups	38.20	4	45.114	2.428	0.037
	Within groups	3598.23	186	18.581		
Science and technology	Between groups	73.72	4	46.006	3.561	0.008
	Within groups	2513.56	186	12.921		
School	Between groups	111.29	4	121.506	3.403	0.010
	Within groups	7016.53	186	35.709		
Plans for the future	Between groups	2.12	4	6.996	.352	0.842
	Within groups	3721.79	186	19.871		

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Results and Discussion

This survey was conducted with the purpose of finding out the interest and attitudes of upper elementary students in Kayseri provincial center toward *science outside school, science, technology and school, and plans for the future* in the autumn term of 2011-2012 academic years. At the end of the survey, it was found that students have a positive interest and attitude toward *science outside school* ($\bar{x}$=3.96). It is understood from the responses of students to attitude items in the *science and technology* section that a great majority of them (93.2%, $\bar{x}$=4.63) think that *science and technology is important for society*, and 89.6 % of them ($\bar{x}$=4.63) think s*cience and technology ensures that we maintain an easier and more comfortable life*. To the attitude items about *school* in the survey, 75 % of the students responded that *they like school very much* ($\bar{x}$=4.09), and that *they would recommend their school* ($\bar{x}$=4.16). It was found that 57.6 % of the students disagreed with the attitude item "*I find my school boring*" ($\bar{x}$=2.55). It is understood from the responses of students to attitude items in the *plans for the future* section that a great majority of them (73.8%, $\bar{x}$=4.04) *would like to make more scientific studies* in the future, and 72.7 % of them ($\bar{x}$=4.10) would like to *become a scientist* in the future.

It was also investigated if the average attitude ratings of students varied with parameters of gender, grade and age for all sections of the scale. The results of the analysis showed that only in the *science and technology* section of the scale a significant difference [t = 2.720, p< .05] by gender exists. For other sections of the scale, no significant difference by gender could be detected. The research by Azizoğlu and Çetin (2009) investigated the learning styles, attitudes towards science lessons, and motivations of 6th and 7th grade students found that boys ($\bar{x}$=77.3, SS=9.8) have higher attitude ratings than girls ($\bar{x}$=74.4, SS=8.8). Research by Yeşilyurt et al. (2005), Ünal and Ergin (2006), Kaya and Böyük (2011), Yalvaç and Sungur (2000), and Okur and Kapucu (2010) also found that there is no significant difference between attitudes towards science by gender. The findings of this research, then, are similar to results of the above-mentioned studies. Therefore, it can be said that gender is not a defining factor in determining the attitudes of students toward science.

Attitude ratings were examined by grade for responses of students to each section of the scale and a significant difference [$F_{(2-188)}$ = 2.757, p< .05] in favor of 8th grade students was found with respect to attitude ratings toward *science and technology*. It was also found that there is no significant difference by grade parameter in other sections of the scale. Research by Çakır et al. (2007) which studied the attitudes of upper elementary students towards science found that higher-grade students have a more negative attitude than lower grade students. Azizoğlu and Çetin (2009) found no statistically significant difference between the attitude of 6th and 7th grade students toward science. As a result of the scale they implemented via the Internet, Karakoyun and Kavak (2008) found a significant difference between the attitudes of students studying at grades 1, 2, 3, 4, and 5 of the physics education department of Dicle University Ziya Gökalp Education Faculty towards physics lessons by the grade they were studying at. A MWU test was conducted to identify the direction of the difference, and it was found that students have more positive attitude towards physics lesson as the grade level rises. Kaya and Böyük (2011) surveyed the attitudes of grades 9, 10 and 11 students studying at secondary schools in Kayseri provincial center toward physics lessons and physics experiments. The survey revealed that students in the 10th grade have more positive attitudes compared to other grades. Bozdoğan and Yalçın (2005) studied statistically the attitudes of students in grades 6, 7 and 8 of elementary schools in Kırşehir provincial center toward physics subjects in science lessons and a significant difference in favor of lower grades was observed. When examined according to age difference, a significant difference (p<0.05) was found between attitudes toward *science outside school, plans for the future and school*, and this difference was in favor of students at the age of 15 for all sections. Research by Kaya and Böyük (2011) investigated the attitudes of students toward

physics lessons for students of 14-19 years of age, and found that students at the age of 16 have higher attitude ratings compared to other age groups. Obtained results in this research are similar with the results obtained by above researchers.

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