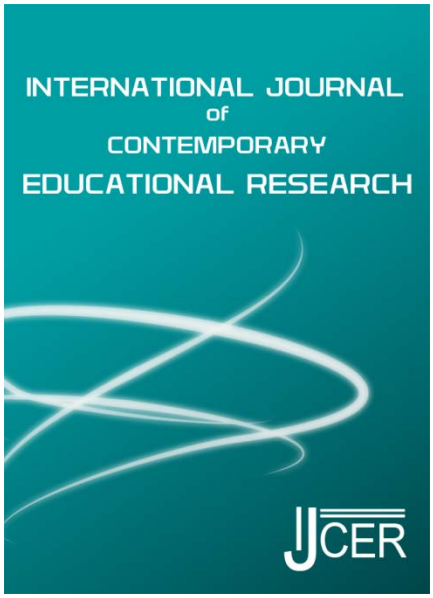

International Journal of Contemporary Educational Research (IJCER)

www.ijcer.net

An Analysis of the Secondary Education Students' Scientific Attitudes

Baris Ozden[1], Nilgun Yenice [2]
[1,2] Adnan Menderes University

To cite this article:

Ozden, B. & Yenice, N. (2014). An analysis of the secondary education students' scientific attitudes. *International Journal of Contemporary Educational Research, 1*(2), 86-97.

International Journal of Contemporary Educational Research
Volume 1, Number 2, July 2014, Page 86-97 ISSN: 2148-3868

An Analysis of the Secondary Education Students' Scientific Attitudes*

Baris Ozden[1*], Nilgun Yenice[2]
[1,2]Adnan Menderes University

Abstract

The aim of this study is to analyse the level of scientific attitude of the secondary education students. The participants of the study are a total of 634 sixth, seventh and eighth grade students attending those schools serving to the students with a lower, medium or higher socio-economic status in Aydın. Three different data collection tools were employed to gather the data of the study, namely "Scale of scientific attitude", "Scale of views about scientific knowledge" and "Personal information form". The findings of the study indicated that students have nearly positive attitudes towards science. It was found that the scientific attitude of the participants varies based on the variables of gender, grade level and family income. In addition, scores of the participants in the scale of scientific attitude are positively correlated with their academic achievement and their scores in the scale of views about scientific knowledge.

Key words: Secondary education students, scientific attitude, academic achievement.

Introduction

Scientific knowledge has been expanding through advances in science and technology. As a result these changes in 2004 Turkey adopted new educational programs nearly in all school subjects and the ultimate goal of this reform was declared to produce individuals who are science literate (Çepni, Ayvacı, & Bacanak, 2004).

Following the intoduction of the term "Science literacy" it was transferred into different domains and fields. One of its derivations is the term "Science and technology literacy". Given that the expansion of technological and scientific knowledge is fast noone can gain all the knowledge in these fields. Therefore, those individuals who are science and technology literate should be produced in order for countries to keep up with this changing process. In a similar vein, the program of science and technology course which has been implementing in Turkey aims at "Producing individuals who are science and technology literate regardless of the individual differences." (MONE, 2006). One of the dimensions covered under the term science and technology literacy is the nature of science and scientific knowledge (Kıray, 2010; Yenice & Özden, 2013; Erten, Kiray & Sen-Gumus, 2013; Lederman, Lederman, & Antink, 2013). However, Bybee (1985) argued that the term science and technology literacy is a complex entity which requires not only scientific knowledge, but also scientific skills, attitudes and values.

The dimensions of the science and technology literacy requires that individuals should possess scientific attitudes and values (MONE, 2006). Similarly, Beane (1990) argued that science and technology program also included affective points and characteristics which may occur as the students' attitudes or approaches (Yağbasan & Demirbaş, 2004). Therefore, it is safe to argue that the science and technology teaching cannot only contribute to the cognitive development of students, but also to their affective development.

The term attitude has been differently defined: "Attitude is an individual's mental position or behaviour which occurs in regard to a specific condition or event" (Harlen, 1996; cited in Türkmen, 2006). Ülgen (1997), on the other hand, defined "attitude as a biased reaction in relation to an object or an event." Turgut (1997) regards an attitude as a positive or negative reaction and behaviour of an individual in regard to an event, an object or a group of people.

---

* This study is part the Master of Arts thesis supervised by Assist. Prof. Dr. Nilgun Yenice at Science Institute of Adnan Menderes University. The thesis was supported by the Scientific Research Commission of the same university.

* Corresponding Author: *Baris Ozden, barisozdn@gmail.com*

Literature on the attitudes towards science deals with the attitude towards science and scientific attitudes in different ways and makes a difference between them (Byrne & Johnstone, 1987). Because attitude towards science and scientific attitudes are two distinct patterns (Türkmen, 2006). More specifically, scientific attitudes are those to be possessed by individuals, whereas attitude towards science is one which is exhibited by individuals in regard to specific events (Türkmen, 2006).

Başaran (1976) defined scientific attitude as "Individuals' ability to interpret the events, situations and problems based on data as possible as far from their emotions." Most common characteristics of the individuals who have scientific attitude are as follows: "Being volunteer to recognise and solve the situation or problem he comes across; searching for the solutions related to the problem and juding the advantages and disadvantages of each to decide over which one is more appropriate; having trust in the solution he chooses, but also, criticising it, if necessary; using the solution without criticising it and evaluating the outcomes of his decision over the solution". Karasar (2007) argues "scientific attitude and behaviour are views which faciliate the problem-colving, producing scientific views, and practising research-related competencies." For him, those who acquired scientific attitude and behaviour are *"open-minded, skeptical and tries to find out the reason of the counter-arguments. They are independent in their views and observations, can postpone their decisions to have more evidence, they are attentive and perseverant in their studies. They can connect their current thinking to the previous thinking. They are modest and take into consideration the other possibilities in their judgement."*

Çilenti (1985) argued that in order to reach new knowledge in science people must have scientific attitude and the skills related to cognitive processes. At the same time, he defined scientific attitides as being curious, modest, skeptical, perseverant and honest. It is reported that scientific attitudes have two major dimensions: scientific dimension and affective dimension. The first dimension, scientific dimension, classifies the scientific attitude under three groups as follows: "G*eneral attitudes towards ideas and knowledge:* Such attitudes includes curiosity and being open to novice ideas, etc. *Attitudes towards the evaluation of ideas and knowledge:* Critical thinking, being neutral, data analysis are among the basic parts of these attitudes. *Deciding over scientific beliefs:* It includes the development of the relation between causes and effects (Byrne & Johnstone, 1987).

Johnston (1996) argued that scientific attitudes should be taught during the formal education process and that scientific attitudes are not only significant for science teaching and learning, but also for other fields due to the fact scientific attitudes faciliates learning in all subject matters (cited in Hamurcu, 2002). In a similar vein, Schibeci (1983) studied the relationship between science and attitudes and concluded that those students who gained scientific attitudes improved their attitudes towards science (cited in Demirbaş & Yağbasan, 2006). Therefore, it can be argued that if the scientific attitudes of basic education students are improved taking into consideration their cognitive and affective dimensions and the teaching process is planned in this regard the student learning will be significantly improved.

The review of the literature shows that studies dealing with the scientific attitudes of basic education students are rare (Pearson, 1993; Ata, 1999; Chuang & Cheng, 2002; Demirbaş & Yağbasan, 2005; Demirbaş & Yağbasan, 2006; Afacan, 2008; Duran, 2008; Yenice & Saydam, 2010; Mıhladız & Duran, 2010; Kılıç, 2011; Demirbaş & Yağbasan, 2011; Uzun, 2011). Of these studies, Pearson (1993) studied the perceptions of teachers and students in regard to scientific attitudes, their understanding of the nature of scientific knowledge and their perceptions of educational approaches. Ata (1999) deal with the development of scientific and social attitudes in secondary education students. Chuang & Cheng (2002) analysed the correlation between gender, ability in regard to biology, scientific attitudes, scientific process skills, logical thinking skills and student attitudes towards biology. Afacan (2008) studied the changes in the basic education students' perceptions about the relationship between science, technology, society and environment based on their scientific attitudes, the grade level and socio-economic environment of the school. Demirbaş & Yağbasan (2011) analysed the effects of the science and technology education program which began to be implemented in 2005 on the development of the students' scientific attitudes. Kılıç (2011) analysed the level of the scientific creativity and scientific attitudes among eighth graders and the effects of their demographical characteristics on their level of the scientific creativity and scientific attitudes.

One of the current goals of the science education is to improve student views about the nature of science and scientific knowledge. Uzun (2011) found a positive correlation between primary school students' views about scientific knowledge and their attitudes towards science. Based on this correlation, it can be argued that higher levels of views about scientific knowledge is one of the prerequisties for education individuals with positive scientific attitudes. Given that the relationship between the views about scientific knowledge and scientific

attitudes has not been extensively analysed among the secondary education students, the current study provides a new insight to the field since it deals with both.

As stated earlier, scientific attitudes faciliate the student learning and contribute to the development of their critical thinking and problem-solving skills. Therefore, having information about the levels of scientific attitudes and the factors affecting these attitudes is crucial for reaching the vision of the educational program. Thus, it is significant and necessary to reveal the factors affecting the scientific attitudes of secondary education students and the correlation between their levels of scientific attitudes and their views about scientific knowledge.

Aim of This Study

The aim of this study is to analyse the level of scientific attitude of the secondary education students and the correlation between the level of scientific attitude, their academic achievement and their views about scientific knowledge. In parallel to this aim, the study tries to answer the following research questions:

- What is the level of the secondary education students' scientific attitudes?
- Do their scores from the scientific attitudes scale significantly vary based on the variables of gender, grade level and famiy income?
- Is there any statistically significant correlation between the participants' scores in the scientific attitudes scale and their academic achivement and their views about scientific knowledge?

Method

Design of This Study

The study, which is a descriptive research, has the model of relational scanning. Relational scanning models attempt to identify the change that occurs among variables and/or to determine the level of change that takes place (Karasar, 2007).

Sample and Environments

The participants of the study are a total of 634 sixth, seventh and eighth grade students from four different basic education schools in Aydın. The schools were selected following purposive stratified sampling method. Before the selection process, all the schools in Aydın were categorized based on the socio-economic status of the students they serve. The data on socio-economic status of the students were taken from Aydın provincial education directorate. Two schools from those serving the students with lower socio-economic status were selected randomly. For those schools serving the students with medium and higher socio-economic status, one school was chosen randomly for each category. Purposive stratified sampling method is mostly used to indicate, describe the characteristics of lower socio-economic groups and make comparisons among them (Büyüköztürk, 2008). Demographical characteristics of the participants are given in Table 1.

Table 1. Demographical Characteristics of The Participants

Gender	***f***	***%***
Male	306	48,3
Female	328	51,7
Grade Level	***f***	***%***
6.grade	212	33,4
7.grade	206	32,5
8.grade	216	34,1
Income Level of Their Families	***f***	***%***
High level	278	43,8
Medium level	159	25,1
Lower level	197	31,1

Data Collection Tools

The data of the study were collected through the use of two scales, namely "Scale of Scientific Attitudes" and "Scale of Views about Scientific Knowledge". Academic achievement of the students is used as their grades in the course of technology and science in the fall semester of the school year of 2011-2012. Data on the demographical characteristic of the students are gathered with the use of "Demographical Form".

The scale of scientific attitudes (SSA) was developed by Moore & Foy (1997) in order to identify the secondary students' scientific attitudes. The scale was adapted into Turkish by Demirbaş & Yağbasan (2006). The scale is made up of forty items and six sub-dimensions. Five of the sub-dimensions are about nature of science and working process of scientists. The other sub-dimension is about the views of students about science. In the original study, the Cronbach Alpha coefficient of the scale was found to be .76. In the current study, it was found to be.72.

The scale of views about scientific knowledge was developed by Çoban ve Ergin (2008). It is consisted of 16 items and three dimensions. Answers to the items are given using a Likert type scale. The dimensions and the items involved in each dimension are as follows: Dimension I "Scientific knowledge is closed" (items 1, 5, 8, 9, 10, 12, 15, 16), Dimension 2 "Scientific knowledge is justified" (items 2, 6, 11, 13, 14) and Dimension 3 "Scientific knowledge may change" (items 3, 4, 7). The Cronbach Alpha coefficient in the original study was found to be .72 for Dimension I, .69 for Dimension 2, and .66 for Dimension 3. Its overall Cronbach alpha coefficient was found to be .83. In the current study the following values were found: .70 for Dimension I, .66 for Dimension 2, and .60 for Dimension 3. Its overall Cronbach alpha coefficient was found to be .78.

Data analysis

The data collected were analyzed through the use of SPSS 17.0. The data were firstly analyzed with descriptive statistical techniques (frequency, arithmetical means, standard deviation and percentage).

In order to use t-tests and ANOVA for independent samples, the scores of dependent variable scores should distribute normally and variance should be homogeneous (Büyüköztürk, 2008). For this requirement, the scores of the students in two tools were analyzed in terms of normality. The results of the analysis showed that the scores did not distribute normally ($p<.05$).

In addition to descriptive statistics the Mann Whitney U-test and Kruskal Wallis H-test are employed in the data analysis. The Kruskal Wallis H-test indicated the statistically significant differences between groups. The Mann Whitney U-test was used to see the source of these differences. The level of statistically significance was set at .0167. The Spearman Brown range difference correlation was employed to identify the relationship between scientific attitudes, academic achievement and the students' views about scientific knowledge.

The scores of the participants in the scientific attitudes scale are used to reveal the level of their scientific attitudes. The related score ranges of the participants are given in Table 2.

Table 2. Score ranges of the participants in the scientific attitudes scale

Level of Scientific Attitude	Range
Low	40.00- 93.33
Average	93.34- 146.67
High	146.68- 200.00

Findings

As stated above, the first research question is "What is the level of the secondary education students' scientific attitudes?". In order to answer this question arithmetical means (X), standard deviation (SD) and minimum and maximum values of the students' scores in the scientific attitudes scale were found and are given in Table 3 below:

Table 3. Mean scores of the students in the dimensions of the scientific attitude scale and their total mean scores

Dimensions of The Scientific Attitude Scale and Means of Total Scores	N	X	SD	Min	Max
The Nature of Scientific Laws and Theories	634	18.6	2.54	8.00	30.00
The Nature of Science and Approaching Towards Events	634	22.5	3.31	11.00	30.00
Exhibition of Scientific Behaviour	634	21.8	3.24	14.00	30.00
The Nature and Aim of Science	634	18.9	2.16	12.00	26.00
The Place and Significance of Science in Society	634	21.2	3.33	7.00	30.00
Being Volunteer to Take Part in Scientific Research	634	36.9	6.17	16.00	50.00
Total	634	139.7	11.66	107.00	172.00

Table 3 shows that the total mean score of the participants for the sub-dimension of the nature of scientific laws and theories is X=18.6. It is found to be X=22.5 for the sub-dimension of the nature of science and approaching towards events. The total mean score for the sub-dimension of the exhibition of scientific behavior is found to be X=21.8. for the sub-dimension of the nature and aim of science the total score of the participants was found to be X=18.9. It was X=21.2 for the sub-dimension of the place and significance of science in society. It was found that the mean score for the sub-dimension of being volunteer to take part in scientific research is X=36.9. As a whole, it is seen that the students' scientific attitude is at the average level based on these total mean scores from the sub-dimension of the scale. The total mean score for the scale as a whole was found to be X=139.7. Again, this mean score indicates that the participants have scientific attitudes at the level of average as can be seen from the score ranges given in Table 2.

As mentioned above, the second research question of the study is as follows: "Do the scores of the students from the scientific attitudes scale significantly vary based on the variables of gender, grade level and famiy income?" The results of the analyses related to the second research question are given as follows:

In order to answer to this question and to reveal whether or not gender has a significant effect on the participants' total score and scores in the sub-dimensions of the scientific attitudes scale the Mann Whitney U-Test was employed. The results are given in Table 4 below:

Table 4. The results of the Mann Whitney U- Test in regard to the effects of Gender on the participants' total mean scores and scores in the sub-dimensions of the scientific attitudes scale

Dimensions of The Scientific Attitude Scale and Means of Total Scores	Gender	N	*Mean of ranks*	*Total rank*	*U*	*p*
The Nature of Scientific Laws and Theories	Male	306	317.48	97147.50	50176.50	.997
	Female	328	317.52	104147.50		
The Nature of Science and Approaching Towards Events	Male	306	326.65	99955.50	47383.50	.222
	Female	328	308.96	101339.50		
Exhibition of Scientific Behaviour	Male	306	322.61	98718.50	48620.50	.496
	Female	328	312.73	102576.50		
The Nature and Aim of Science	Male	306	302.08	92435.00	45464.00	.038*
	Female	328	331.89	108860.00		
The Place and Significance of Science in Society	Male	306	320.19	97979.00	49360.00	.719
	Female	328	314.99	103316.00		
Being Volunteer to Take Part in Scientific Research	Male	306	325.59	99630.00	47709.00	.282
	Female	328	309.95	101665.00		
Total	Male	306	322.69	98744.00	48595.00	.490
	Female	328	312.66	102551.00		

Table 4 indicates that of six dimensions of the scientific attitudes scale the scores for five were not found to be affected by the gender of the participants. These five sub-dimensions and the related mean scores are given

as follows: the nature of scientific laws and theories (U=50176.50, *p*>.05); the nature of science and approaching towards events (U=47383.50, *p*>.05), the exhibition of scientific behavior (U=48620.50, *p*>.05), the place and significance of science in society (U=49360.00, *p*>.05) and being volunteer to take part in scientific research (U=47709.00 *p*>.05). In addition, the total mean score for the scientific attitudes scale as a whole was found not to significantly differ based on the gender of the participants and it was found to be U=48595.00 (*p*>.05). Only the scores of the participants in the sub-dimension of the nature and aim of science was found to differ based on the gender of the participants. Its mean score is U=45464.00 (*p*<.05). In this sub-dimension, it is further found that girls (331.89) have much more positive scientific attitudes in contrast to boys (302.08).

In order to reveal whether or not grade level has a significant effect on the participants' total score and scores in the sub-dimensions of the scientific attitudes scale the Kruskal Wallis H-Test was used. The results obtained are given in Table 5 below.

Table 5. The results of the Kruskal Wallis H-Test in regard to the effects of grade level on the participants' total mean scores and scores in the sub-dimensions of the scientific attitudes scale

Dimensions of The Scientific Attitude Scale and Means of Total Scores	Grade Level	N	Means of rank	*sd*	χ^2	*p*	Difference (p<,0167)
The Nature of Scientific Laws and Theories	6.grade	212	323.15	2	.546	.761	-
	7.grade	206	310.24				
	8.grade	216	318.88				
The Nature of Science and Approaching Towards Events	6.grade	212	324.36	2	5.796	.055	-
	7.grade	206	293.03				
	8.grade	216	334.10				
Exhibition of Scientific Behaviour	6.grade	212	285.17	2	12.427	.002*	6-8
	7.grade	206	319.60				
	8.grade	216	347.23				
The Nature and Aim of Science	6.grade	212	312.86	2	6.633	.036*	7-8
	7.grade	206	342.71				
	8.grade	216	298.01				
The Place and Significance of Science in Society	6.grade	212	318.30	2	.322	.851	-
	7.grade	206	322.21				
	8.grade	216	312.23				
Being Volunteer to Take Part in Scientific Research	6.grade	212	340.94	2	21.399	.000*	6-8, 7-8
	7.grade	206	342.39				
	8.grade	216	270.76				
Total	6.grade	212	324.82	2	3.108	.211	-
	7.grade	206	328.53				
	8.grade	216	299.79				

*p<.05

As can be seen in Table 5, grade level do not have any statistically significant effect on the students' scores in three sub-dimension of the scientific attitudes scale and on their total mean score. These three sub-dimensions and the related mean scores are given as follows: the nature of scientific laws and theories ($\chi^2_{(2)}$= .546, *p*>.05), the nature of science and approaching towards events ($\chi^2_{(2)}$= 5.796, *p*>.05) and the place and significance of science in society ($\chi^2_{(2)}$= .322, *p*>.05). It was also found that the total mean score of the participants in the scientific attitudes scale was not significantly affected by the grade level ($\chi^2_{(2)}$= 3.108, *p*>.05).

The scores of the participants in the remaining three sub-dimensions of the scientific attitudes scale were found to significantly differ based on grade level. These three sub-dimensions and the related mean scores are given as follows: the exhibition of scientific behavior ($\chi^2_{(2)}$= 12.427, *p*<.05), the nature and aim of science ($\chi^2_{(2)}$= 6.633,

p<.05) and being volunteer to take part in scientific research ($\chi^2_{(2)}$= 21.399, p<.05). In order to identify which groups are the causes for the significant difference the Mann Whitney-U test was employed. The results showed that the scores of the sixth and eightht graders are significantly different in the sub-dimension of the the exhibition of scientific behavior. It was further found that this difference was in favor of the latter group. The other sub-simension of which the mean scores of the participants were found to vary based on grade level is the nature and aim of science. In this sub-dimension there is a statistically significant mean score differences between that of the seventh graders and that of the eightht grade and it was in favor of the former group. As mentioned above, the mean scores in the sub-dimension of being volunteer to take part in scientific research was also found to significantly differ based on grade level. In this sub-dimension, mean scores of all three grade level groups significantly differed and it was in favor of the sixth and seventh graders.

In order to reveal whether or not the income of the participants' families has a significant effect on the participants' total score and scores in the sub-dimensions of the scientific attitudes scale the Kruskal Wallis H-Test was used. The results obtained are given in Table 6 below.

Table 6. The results of the Kruskal Wallis H-Test in regard to Income Level of The Students' Families total mean scores and scores in the sub-dimensions of the scientific attitudes scale

Dimensions of The Scientific Attitude Scale and Means of Total Scores	**Income Level of The Students' Families**	**N**	**Means of rank**	***sd***	χ^2	***p***	**Difference (p<,0167)**
The Nature of Scientific Laws and Theories	1.High	278	329.56	2	2.426	.297	-
	2.Medium	159	302.73				
	3.Lower	197	312.41				
The Nature of Science and Approaching Towards Events	1.High	278	353.36	2	20.937	.000*	1-2,1-3
	2.Medium	159	303.92				
	3.Lower	197	277.86				
Exhibition of Scientific Behaviour	1.High	278	391.31	2	81.724	.000*	1-2,1-3
	2.Medium	159	268.57				
	3.Lower	197	252.83				
The Nature and Aim of Science	1.High	278	341.36	2	9.001	.011*	1-3
	2.Medium	159	305.69				
	3.Lower	197	293.36				
The Place and Significance of Science in Society	1.High	278	349.45	2	16.159	.000*	1-2,1-3
	2.Medium	159	303.10				
	3.Lower	197	284.04				
Being Volunteer to Take Part in Scientific Research	1.High	278	353.87	2	20.102	.000*	1-2,1-3
	2.Medium	159	296.91				
	3.Lower	197	282.79				
Total	1.High	278	384.46	2	68.190	.000*	1-2,1-3
	2.Medium	159	280.36				
	3.Lower	197	252.98				

*p<.05

As can be seen in Table 6, the income of family has statistically significant effects on five out of six sub-dimensions as well as on total mean scores of the participants in the scientific attitudes scale. The only sub-dimension of which mean score was not affected by the family income was found to be the nature of scientific laws and theories ($\chi^2_{(2)}$= 2.426, p>.05). Those sub-dimensions of which mean scores were significantly affected from the family income and related mean scores are as follows: the nature of science and approaching towards events ($\chi^2_{(2)}$= 20.937, p<.05), the exhibition of scientific behavior ($\chi^2_{(2)}$= 81.724, p<.05), the nature of scientific laws and theories ($\chi^2_{(2)}$= 9.001, p<.05), the place and significance of science in society ($\chi^2_{(2)}$= 16.159, p<.05) and being volunteer to take part in scientific research ($\chi^2_{(2)}$= 20.102, p<.05). As stated earlier, the total mean score for the scientific attitudes scale was also affected by the family income ($\chi^2_{(2)}$= 68.190, p<.05). In order to identify which groups are the causes for the significant difference the Mann Whitney-U test was employed. The

results showed that the mean scores of the participants in the sub-dimensions of the nature of science and approaching towards events, the exhibition of scientific behavior, the place and significance of science in society and and their total mean score in the scientific attitudes scale significantly differ among those from higher socio-economic status, those from medium socio-economic status and those from lower socio-economic status. It was also found that this difference was in favor of those from higher socio-economic status. In the sub-dimension of the nature and aim of science the mean scores significantly differ between those from higher socio-economic status and those from lower socio-economic status. This difference was found to be in favor of those from higher socio-economic status.

The third research question, as stated above, is "Is there any statistically significant correlation between the participants' scores in the scientific attitudes scale and their academic achivement and their views about scientific knowledge?". The Sperman Brown range differences correlation was used to see whether or not the participants' scores in the scientific attitudes scale and in its sub-dimensions were correlated with their academic achievement and their total scores in the scale of views about scientific knowledge. The results are given in Table 7 below.

Table 7. The results of the correlation concerning the relationship between the participants' scores in the scientific attitudes scale and their academic achievement and their views about scientific knowledge

Dimensions of The Scientific Attitude Scale	**Academic Achievement**			**BBYG Total**		
	N	**(rho)**	**p**	**N**	**(rho)**	**p**
The Nature of Scientific Laws And Theories	634	.055	.167	634	.128**	.001
The Nature of Science and Approaching Towards Events		.288***	.000		.404***	.000
Exhibition of Scientific Behaviour		.398***	.000		.393***	.000
The Nature and Aim of Science		.044	.273		.014	.730
The Place and Significance of Science in Society		.282***	.000		.235***	.000
Being Volunteer to Take Part in Scientific Research		.331***	.000		.228***	.000
Total		.475***	.000		.433***	.000

**p<.01, *** p < .001

Table 7 shows that there is an average, positive and statistically significant correlation between the total mean scores of the participants in the scientific attitudes scale and their academic achievement (r=.475, p<.001) and between their total mean scores in the scale of views about scientific knowledge and their academic achievement (r=.433, p<.001).

It was found that there is an average, positive and statistically significant correlation between the academic achievement of the participants and their scores in the sub-dimension of the exhibition of scientific behavior (r=.398, p<.001) and between their academic achievement and their scores in the sub-dimension of the being volunteer to take part in scientific research (r=.331, p<.001). It was also found that there is a low, positive and statistically significant correlation between the academic achievement of the participants and their scores in the sub-dimension of the nature of science and approaching towards events (r=.288, p<.001) and between their academic achievement and their scores in the sub-dimension of the place and significance of science in society (r=.282, p<.001). However, the academic achievement of the participants was found not to have any significant effect on their scores in the subdimensions of the nature of scientific laws and theories (r=.055, p>.001) and the nature and aim of science (r=.044, p>.05).

It was found that there is an average, positive and statistically significant correlation between the scores in the sub-dimension of the exhibition of scientific behavior and their total scores in the scale of views about scientific knowledge (r=.393, p<.001) and between the scores in the sub-dimension of the nature of science and its approach towards events and their total scores in the scale of views about scientific knowledge (r=.404, p<.001). It was also found that the total scores of the students in the scale of views about scientific knowledge has a low, positive and significant correlation with their scores in the sub-dimensions of being volunteer to take part in scientific research (r=.228, p<.001), the place and significance of science in society (r=.235, p<.001) and the nature of scientific laws and theories (r=.128, p<.01). However, their scores in the sub-dimension of the nature and aim of science (r=.014, p>.05) is not significantly correlated with the total scores of the students in the scale of views about scientific knowledge.

Discussion And Conclusion

In the study, it was found that the secondary education students have scientific attitudes at the average level. In other words, they have nearly positive scientific attitudes. Ata (1999) also deal with the scientific and social attitudes of the secondary education students and found that they have average or higher levels of such attitudes based on their reports. Demirbaş & Yağbasan (2005; 2011), again, studied the scientific attitudes of the secondary education students and concluded that they have positive scientific attitudes. Afacan (2008) also found that students have positive scientific attitudes. Kılıç (2011) concluded that the scientific attitudes of the eighth graders is at the average level, indicating that they have positive scientific attitudes. All these findings support the present finding of the study. Based on these findings and other findings it can be stated that the basic education science and technology education program which has been in use nearly for seven years is not very influential in providing the secondary education students with scientific attitudes and values.

In the study it is found that the gender of the participants does not have any statistically significant effect on their scores in the total mean score of the scientific attitudes scale and in the scores of the following sub-dimensions of the scale: the nature of scientific laws and theories, the nature of science and approaching towards events, the exhibition of scientific behaviour, the place and significance of science in society and being volunteer to take part in scientific research. On the other hand, the scores in the sub-dimension of the nature and aim of science is found to vary in favor of girls. Based on these findings it can be suggested that not all dimensions of the scientific attitudes differ based on gender and that only the sub-dimension of the nature and aim of science varies based on gender, being in favor of girls. There are studies which reveal no correlation between the total scores of the students in the scientific attitudes scale and their gender (Mıhladız & Duran, 2010; Demirbaş & Yağbasan, 2011). Therefore, it is safe to argue that the related finding of the study is supported by all these findings. On the other hand, there are other studies suggesting that the total scientific attitude scores of girls are significantly much higher than boys (Pearson, 1993; Chuang & Cheng, 2002; Kılıç, 2011; Uzun, 2011). The reason for the contradiction between this finding and previous findings given above seems to stem from the fact that the different participants and different measurement tools were used.

The grade level of the participants is found to have statistically significant correlation with their scores of the following sub-dimensions of the scientific attitudes scale: the exhibition of scientific behaviour, the nature and aim of science and being volunteer to take part in scientific research. However, no such correlation is found for the total mean score in the scientific attitudes scale and in the scores of the following sub-dimensions of the scientific attitudes scale: the nature of scientific laws and theories, the nature of science and its approach towards events and the place and significance of science in society. There are studies suggesting that the total scientific attitude scores of the students do not significantly differ based on their grade level (Afacan, 2008; Akdur, 2002). However, there are other studies suggesting that there is a statistically significant difference between the students' scientific attitudes and the grade level. For instance, Demirbaş & Yağbasan (2005) found that grade level has statistically significant effects on the students' scores in the following sub-dimensions of the scientific attitudes scale as well as on the total mean score: the nature of scientific laws and theories, the nature of science and its approach towards events, and the exhibition of scientific behaviour. The scores in other sub-dimensions were found not to significantly differ based on grade level. It is possible to argue that these findings are partly in parallel to the current findings. Mıhladız & Duran (2010) also concluded that seventh graders have much more positive scientific attitudes in contrast to others from different grade levels.

The family income was found to have significant effects in the students' scores in all sub-dimensions of the scientific attitudes scale except for the sub-dimension of the nature of scientific laws and theories. The same was also observed for the total mean score for the scale as a whole. More specifically, those students from higher socio-economic status families were found to have much more positive scientific attitudes in contrast to those from medium or lower socio-economic status families. Based on this finding it is possible to argue that higher socio-economic status families can provide their children with rich learning environment and therefore, encourage them to make research and scientific activities. In turn, such activities seem to improve the scientific attitudes of children. In the related literature there are studies which suggest that the students' scientific attitudes significantly differ based on family income (Çokadar & Külçe, 2008; Kavak; 2008; Mıhladız & Duran, 2010; Kılıç, 2011; Uzun, 2011). Uzun (2011) found that students from higher income families have much more positive attitudes towards science in contrast to those from other families. Kılıç (2011) found that the students from the families with more than 1500 TL monthly income have much more positive attitudes towards science in contrast to those from the families with a monthly income of 1001-1550 TL. These findings are in parallel to the current finding. However, Mıhladız & Duran (2010) found that basic education students from the medium socio-economic status families have much more positive attitudes towards science in contrast to those from

other socio-economic status. Kavak (2008) reached a similar conclusion and found that basic education students from families with a monthly income of lower than 1200 TL have much more positive attitudes towards science in contrast to those from families with a monthly income of higher than 1200 TL. The both findings given above contradict with the present findings. It may be a result of the fact that the samples used and the measurement tools used are different in the studies mentioned above and in the current study.

In the study it was also found that there is a medium, positive and significant correlation between the total scientific attitude scores of the participants and their total scores in the scale of the views about scientific knowledge and their academic achievement. Therefore, the higher the students' scores in the scientific attitudes scale the higher their scores in the scale of the views about scientific knowledge and higher their academic achievement. The review of the related literature shows that there are studies which indicates that the students' scientific attitudes are closely related to their academic achievement (Gürkan & Gökçe, 2001; Alkan, 2006; Turhan, Aydoğdu, Şensoy & Yıldırım, 2008; Demirbaş & Yağbasan, 2011; Kılıç, 2011; Şişman, Acat, Aypay, & Karadağ, 2011; Uzun, 2011). There is no study dealing with the relationship between the scientific attitudes of secondary education students and their views about scientific knowledge. Therefore, the present findings provide new insights into the topic.
In short, the participants of the study have medium and positive scientific attitudes and their scientific attitudes vary based on gender, grade level and family income in some dimensions. On the other hand, their scientific attitudes, their views about scientific knowledge and their academic achievement are positively correlated at an average level.

Suggestions

Based on the findings obtained in the study the following suggestions have been developed for teachers and researchers:

- Not only in science and technology courses but also in other courses activities to improve the students' scientific attitudes should be carried out (for instance, activities which include the steps used by scientists, etc.).
- Given that both views about scientific knowledge and academic achievement positively contribute to the students' scientific attitudes, teachers should carry out specific activities to improve their views about scientific knowledge.
- In the current study the scientific attitudes of the students were quantatively analysed in relation to such variables as gender, grade level and family income. In future studies this correlation may be studied adopting both quantative and qualitative approaches to reveal it in a more detailed way.

References

Akdur, E. T. (2002). *The Development of Some Components of Scientific Literacy in Basic Education*. Unpublished PhD Thesis, The Graduate School of Social Sciences of Middle East Technical University, Ankara.

Alkan, A. (2006). *İlköğretim Öğrencilerinin Fen Bilgisine Karşı Tutumları*. Yayımlanmamış Yüksek Lisans Tezi, Afyon Kocatepe Üniversitesi, Sosyal Bilimler Enstitüsü, Afyon.

Afacan, Ö. (2008). *İlköğretim Öğrencilerinin Fen-Teknoloji-Toplum-Çevre (FTTÇ) İlişkisini Algılama Düzeyleri ve Bilimsel Tutumlarının Tespiti (Kırşehir İli Örneği).* Yayımlanmamış Doktora Tezi, Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Ankara.

Ata, E. (1999). *İlköğretimde Bilimsel ve Sosyal Tutum Adapazarı Örneği.* Yayımlanmamış Yüksek Lisans Tezi, Sakarya Üniversitesi, Sosyal Bilimler Enstitüsü, Adapazarı.

Başaran, İ. E. (1976). *Eğitim Psikolojisi*. Ankara: Güneş Matbaacılık.

Binbaşıoğlu, C. (1995). *Eğitim Psikolojisi.* Ankara: Binbaşıoğlu Yayınları.

Büyüköztürk, Ş. (2008). *Sosyal Bilimler İçin Veri Analizi.* Ankara: Pegem Akademi Yayıncılık.

Büyüköztürk, Ş. (2008a). Bilimsel Araştırma Yöntemleri. Ankara: Pegem Akademi Yayıncılık.

Bybee, R. W. (1985). *The Sisyphean Question in Science Education: What Should Scientifically and Technologically Literate Person Know, Value and Do As a Citizen?* In Science Technology Society, 1985 Yearbook of the National Science Teachers Association, Washington, DC.

Byrne, M. S. & Johnstone, A. H. (1987). Critical thinking and science education. *Studies in Higher Education*, 25(8), 325.

Chuang, H. F & Cheng, Y. J. (2002). The relationships between attitudes toward science and related variables of junior high school students. *Chinese Journal of Science Education,* 10,(1), 1-20.

Çepni, S., Ayvacı, Ş. H. & Bacanak, A. (2004). *Fen Eğitimine Yeni Bir Bakış Fen- Teknoloji- Toplum.* Trabzon: Topkar Matbacılık.

Çilenti, K. (1985). *Fen Eğitimi Teknolojisi.* Ankara: Kadıoğlu Matbaası.

Çokadar H. & Külçe C. (2008). Pupils' attitudes towards science: A case of Turkey. *Word Applied Sciences Journal***,** 3(1), 102-109.

Demirbaş, M. & Yağbasan, R. (2004). Fen bilgisi öğretiminde, duyuşsal özelliklerin değerlendirilmesinin işlevi ve öğretim süreci içinde öğretmen uygulamalarının analizi üzerine bir araştırma. *Gazi Üniversitesi Kırşehir Eğitim Fakültesi Dergisi*, 5(2), 177-193.

Demirbaş, M. & Yağbasan, R. (2005). İlköğretim öğrencilerinin fen bilgisi dersindeki bilimsel tutumlarının belirlenmesi ve geliştirilmesine Yönelik öneriler. *XIV. Ulusal Eğitim Bilimleri Kongresi,* Pamukkale Üniversitesi Eğitim Fakültesi (28–30 Eylül 2005), Denizli.

Demirbaş, M. & Yağbasan, R. (2006). Fen bilgisi öğretiminde bilimsel tutumların işlevsel önemi ve bilimsel tutum ölçeğinin Türkçe'ye uyarlanma çalışması. *Uludağ Üniversitesi Eğitim Fakültesi,* XIX(2), 271-299.

Demirbaş, M. & Yağbasan, R. (2008). İlköğretim 6. sınıf öğrencilerinin bilimsel tutumlarının geliştirilmesinde sosyal öğrenme teorisi etkinliklerinin kullanılması. *Fırat Üniversitesi Sosyal Bilimler Dergisi,* 18(1), 105-120.

Demirbaş, M. & Yağbasan, R. (2011). 2005 Fen ve teknoloji öğretim programının, ilköğretim öğrencilerindeki bilimsel tutumların gelişimine etkisi. *International Online Journal of Educational Sciences,* 3(1), 321-342.

Duran, M. (2008). *Fen Öğretiminde Bilimsel Süreç Becerilerine Dayalı Öğrenme Yaklaşımının Öğrencilerin Fene Yönelik Tutumlarına Etkisi.* Yayımlanmamış Yüksek Lisans Tezi, Muğla Üniversitesi, Fen Bilimleri Enstitüsü, Muğla.

Erten, S., Kiray, S.A., & Sen-Gumus, B. (2013). Influence of scientific stories on students ideas about science and scientists. *International Journal of Education in Mathematics, Science and Technology, 1(2), 122-137.*

Gürkan, T. & Gökçe, E. (2000). İlköğretim öğrencilerinin fen bilgisi dersine yönelik tutumları. *IV. Fen Bilimleri Eğitimi Kongresi.* Hacettepe Üniversitesi, Ankara.

Hamurcu, H. (2002). Fen bilgisi öğretiminde etkili tutumlar. *Eğitim Araştırmaları Dergisi*, 8, 144-152.

Karasar, N. (2007). Bilimsel Araştırma Yöntemi. Ankara: Nobel Yayıncılık.

Kavak, K. G. (2008). *Öğrencilerin Bilime ve Bilim İnsanına Yönelik Tutumlarını ve İmajlarını Etkileyen Faktörler.* Yayımlanmamış Yüksek Lisans Tezi, Selçuk Üniversitesi, Eğitim Bilimleri Enstitüsü, Konya.

Kılıç, B. (2011). *İlköğretim Sekizinci Sınıf Öğrencilerinin Bilimsel Yaratıcılık ve Bilimsel Tutum Düzeylerinin Belirlenmesi.* Yayımlanmamış Yüksek Lisans Tezi, Eskişehir Osmangazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Eskişehir.

Kıray, S.A. (2010). *İlköğretim ikinci kademede uygulanan fen ve matematik entegrasyonunun etkililiği.* Yayımlanmamış Doktora Tezi. Ankara: Hacettepe Üniversitesi, Sosyal Bilimler Enstitüsü.

Lederman, N.G., Lederman, J.S., & Antink, A. (2013). Nature of science and scientific inquiry as contexts for the learning of science and achievement of scientific literacy. *International Journal of Education in Mathematics, Science and Technology, 1(3), 138-147.*

MEB, (2006). *İlköğretim Fen ve Teknoloji Dersi Öğretim Programı*, Milli Eğitim Bakanlığı Yayınları, Ankara.

Mıhladız, G. & Duran, M. (2010). İlköğretim Öğrencilerinin Bilime Yönelik Tutumlarının Demografik Değişkenler Açısından İncelenmesi, *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi*, 10(20).

Pearson, E. M. (1993). *Effects of Teachers' Instructional Method of the Nature of Scientific Knowledge and Scientific Attitudes on Students' Understanding of the Nature of Scientific Knowledge and Scientific Attitudes*. Yayımlanmamış Doktora Tezi, University Of Massachusetts Lowell, Massachusetts.

Şişman, M., Acat, B., Aypay, A. & Karadağ, E. (2011). *Uluslararası Fen ve Matematik Öğrenci Başarısı Sınavı* (Trends in International Mathematics and Science Study/TIMSS) Türkiye Ulusal Raporu. MEB, Ankara.

Turgut, F. (1997). *Eğitimde ölçme ve değerlendirme metotları.* Ankara: Gül Yayınevi.

Turhan, F., Aydoğdu, M., Şensoy, Ö. & Yıldırım, H. İ. (2008). İlköğretim 8. sınıf öğrencilerinin bilişsel gelişim düzeyleri, fen bilgisi başarıları, fen bilgisine karşı tutumları ve cinsiyet değişkenleri arasındaki ilişkinin incelenmesi. *Kastamonu Eğitim Dergisi,* 16(2), 439-450.

Türkmen, L. (2006). *Bilimsel Bilginin Özellikleri ve Fen–Teknoloji Okuryazarlığı.* Fen ve Teknoloji Öğretimi (Bahar, M. Ed.), Ankara: Pegem Akademi Yayıncılık.

Uzun, S. (2011). *İlköğretim 5. Sınıf Öğrencilerinin Bilimsel Bilgiye Yönelik Görüşlerinin ve Fen Bilimine Yönelik Tutumlarının İncelenmesi.* Yayımlanmamış Yüksek Lisans Tezi, Rize Üniversitesi, Sosyal Bilimler Enstitüsü, Rize.

Ünal G. Ç. & Ergin, Ö. (2008). İlköğretim öğrencilerinin bilimsel bilgiye yönelik görüşlerini belirleme ölçeği, *İlköğretim Online Dergisi*, 7(3), 706-716.

Ülgen, G. (1997). *Eğitim Psikolojisi, Kavramlar, İlkeler, Yöntemler, Kuramlar ve Uygulamalar.* Ankara: Kurtiş Matbaası.

Yenice, N. & Saydam, G. (2010). 8th grade students' science attitudes and views about nature of scientific knowledge. *Journal of Qafqaz University*, 29(1): 89- 97.

Yenice, N. & Ozden, B. (2013). Analysis of scientific epistemological beliefs of eighth graders. *International Journal of Education in Mathematics, Science and Technology, 1(2), 107-115.*