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Student and School Level Variables related to Elementary School Students' Attitudes towards Science*

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ABSTRACT

Purpose: In the literature, there are lots of quantitative studies regarding students' attitudes, and results of the studies revealed that students have negative attitudes towards science. Therefore, it is necessary to study the factors that predict the attitudes of the students towards science taking into account the factors at both the school and the student level. The purpose of this study was to investigate what school- and student-level factors are associated with student' attitudes towards science.

Research Methods: The overall design of this study is mainly a cross-sectional survey and correlational. The convenience sampling method was used in this study and 2975 elementary students in different schools and cities of Turkey constituted the sample of this study. The Test of Science Related Attitude, Learning Approach Questionnaire, Achievement Motivation Questionnaire, School Background Questionnaire were used as data collection tools. Hierarchical Linear Modeling (HLM) was selected as a modeling technique for data analyses.

Findings: This study provides a general overview about students' attitudes towards science. The quality of school's educational resources, learning and motivational factors, factors related to student feelings and outside activities, and some student characteristics significantly contributed to the students' attitudes towards science.

Implications for Research and Practice: Enriching science lessons with materials, increasing students' curiosity, making them learn by discovering and making them do experiments have potentials to contribute students' attitudes, and experimental research can be used to explore these effects. In order to examine the reasons why students like science or not in detail, qualitative studies should also be conducted.

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Introduction

According to Petty and Cacioppo (1996), attitude is a tendency of conducting behavior and is not observable. Attitude can be defined as positive or negative feelings about a human, object or subject (as cited in Genc, 2015). Students' attitudes towards science have been studied in different research contexts for years. In the literature there are lots of quantitative studies regarding students' attitudes, and results of the studies revealed that students have negative attitudes towards science. This negative attitude prevents many students from exhibiting positive attitudes towards scientific research and from continuing scientific inquiry (Arisoy, 2007; Azizoglu & Cetin, 2009; Hacieminoglu, 2016). Researchers tried to develop students' attitudes toward science using different teaching methods. One of these studies is conducted by Akamca and Hamurcu (2005). It aimed to investigate the effects of science lessons designed according to multiple intelligence theory on fifth grade students' achievement, permanence of knowledge and attitudes towards science lessons. At the end of the study, conducted through Pre-test – post-test control group quasi-experimental design, It was found that instruction based on multiple intelligences had a significant effect on achievement and permanence but no significant relationship was found between the instruction method and students' attitudes towards science lessons. In another study, (Celik, 2006) examined the effect of web-based science lesson instruction on 9th grade students' problem solving skills and attitudes towards science lesson. In the experimental group, web-based research and discussion environment was created to support the instruction process. Results suggested that web-based instruction did not have a significant effect on students' attitudes towards science lessons.

Sasmaz Oren and Tezcan (2009) conducted a quasi-experimental study to examine the effect of learning cycle approach on 7th grade students' attitudes towards science lessons. In the experimental group lessons were taught through learning cycle method for five weeks. Results suggested that attitudes of students in the experimental group increased significantly compared to the attitudes of students in the control group in which the instruction is done through traditional methods. Similarly, Cibik (2009) aimed to investigate the effect of project-based learning approach on 7th grade students' attitudes towards science lessons. Pre-test – post-test control group quasi-experimental design was used in the study. Project-based learning approach was explained to teachers and students in the experimental group. The implementation process lasted six weeks and every week, students presented their studies. Results suggested that project-based learning approach significantly increased students' attitudes towards science lessons. Koc and Bocek (2012) examined the effect of activities done with simple materials on the 7th grade students' attitudes towards science lessons. Pre-test – post-test control group quasi-experimental design was used in the study. In the experimental group, the force and movement unit was taught through methods such as direct instruction, question-answer and discussion, and along with these methods students conducted experiments with the materials they can find in their immediate environment. At the end of the study it was found that the

experiments done with simple materials had a significant effect on their attitudes towards science lessons.

There are also studies assessing technology integrated classroom on students' attitudes towards science. One of these studies conducted by Gomleksiz and Fidan (2013) aimed to determine the effect of computer-supported mind map (CSMM) technique on 7th grade students' achievement, attitudes towards science and technology lesson and permanence of knowledge. They also aimed to find out views of teachers and students regarding the activities. Results revealed that CSMM technique was more effective in teaching science and technology lesson than the traditional teaching methods. This shows that CSMM technique is more beneficial for improving academic success in teaching of science and technology lesson. As a result of the activities done through CSMM technique students' achievement and attitudes towards science and technology lesson improved more than the students taught through traditional methods. Another study is the one conducted by Sakiz, Ozden, Aksu and Simsek (2014). Researchers aimed to examine the effects of smart board use on the fourth grade student's achievement and attitudes towards science lesson. Pre-test – post-test control group quasi-experimental design was used in the study. The sample group was composed of 78 fourth grade students. Results revealed that smart board use had a positive effect on students' achievement and attitudes towards science lesson.

There are also some similar experimental studies regarding the effects of new teaching strategies (such as, STEM, discovery, out of school learning environment) entering the new science program on students' attitudes towards science. Firstly, Yamak, Bulut and Dundar (2014) aimed to examine the effect of STEM approach on fifth grade students' attitudes towards science lesson and scientific process skills. The sample of the study was composed of 20 elementary school students studying in Ankara. In this study, which was conducted through single group pre-test – post-test design, three different STEM activities were applied. In the implementation process, teacher explained the task and gave materials. Students discussed the process, tested and evaluated their models, and lastly presented them. Results suggested that STEM education positively affected students' attitudes towards science lesson and their scientific process skills. Secondly, one of the studies examining the effects of discovery method was conducted by Unal and Ergin (2006). It aimed to investigate the effect of activities prepared in accordance with the constructivist approaches for the teaching of liquid and gas pressure unit on 7th grade students' achievement and attitudes towards science lesson. Results revealed that activities done through worksheets prepared in line with discovery approach improved students' achievements considerably but it was also found that these activities improved students' attitudes towards science in a low level. Similarly, Kucuk (2014) aimed to determine the effects of simulation method on the 7th grade students' achievement in light unit and their attitudes towards science lesson. Pre-test – post-test control group design was used in the study. In experimental group, lessons were taught through simulation method, and constructivist approach was used in control group. Results showed no significant differences between two groups. Another study on light and sound unit was

conducted by Teker, Kurt and Karamustafaoglu (2017). It aimed to examine the effect of using discovery learning method in light and sound unit on fifth grade students' achievement and attitudes towards science lesson. Pre-test – post-test control group quasi-experimental design was used in the study. Discovery learning approach was used while teaching the experimental group. In control group lessons were taught according to the curriculum and students' book prepared and offered by Ministry of Education. Results suggested that the discovery learning approach had a significant effect on students' achievement and attitudes towards science lesson. Thirdly, one of the studies conducted about science festivals, an out-of-school learning environment, belong to Yildirim and Sensoy (2016). It aimed to investigate the effects of science festivals on 6th grade students' attitudes towards science lesson. Lessons were taught according to the 6th grade science lesson curriculum in both experimental and control groups. However, students in experimental group spent an additional 15-minute of one lesson in every week on the science festival preparations. Some information regarding science festivals, scientific methods, research steps and project diaries were given to the students in experimental group. It was seen from the results that attitudes of the students in the experimental group increased significantly and this increase was preserved for three months after the study. Lastly, Keles and Oner (2016) aimed to examine the effect of elective science applications course on seventh grade students' attitudes towards science lesson. The sample of this quasi-experimental study was composed of 212 seventh grade students studying in Agrı. The implementation process lasted 33 weeks. Activities were done with the students taking this course. Post-test was applied to all the students whether they took this course or not. Results revealed that elective science applications course had a significant effect on 7th grade students' attitudes towards science lesson.

In the literature there are also some descriptive and correlational studies regarding students' attitudes towards science. One of these studies conducted by Bozdogan and Yalcin (2005) aimed to determine 6th, 7th and 8th grade students' attitudes towards physics topics. Descriptive survey model was used in the study. The sample group composed of 337 students (172 male, 165 female). Data were collected through an attitude scale prepared for 6th, 7th and 8th grades separately. It had 33 items in total. Results revealed that while the class level increases students' attitudes towards physics experiments decrease. When the educational opportunities were taken into consideration, attitudes of students studying in second type of schools (better educational opportunities and more teachers) were the highest. After that came the third type of schools (educational opportunities were the best, had the most teachers, were in the city center and were mostly preferred) and first type of schools (limited educational opportunities, less teachers and located in the countryside). Another study examining primary school students' attitudes towards science lesson was conducted by Kozcu-Cakir, Senler and Gocmen-Taskin (2007). It aimed to determine the relationship between primary school students' attitudes towards science lesson and various variables. These variables were as follows: class level, gender, the residential area they live in, educational level of their parents, socio-economic status of their parents, presence of a study room of their own and frequency of using laboratories in science lessons. Descriptive correlational design was used in the study. 440 primary

school students studying in central districts of Mugla participated in this study. Results revealed that there was a significant difference between 6th grade students' and 7th and 8th grade students' attitudes towards science in favor of 6th graders. However no significant difference was found between the attitudes of 7th and 8th graders. It was found that as the class level increased the attitude scores decreased. No significant difference was found between students' attitudes towards science lesson and their gender, residential area they live in, parents' education status and family's socio-economic status. It was also found that having a private room positively affected their attitudes towards science lesson. It can be concluded that because the students having a private room had a more comfortable study environment, they were more successful in their lessons and their attitudes increased accordingly. According to results of the one-way analysis of variance, a significant difference was found between students' science lesson achievement and their attitudes. The students successful in science lessons had more positive attitudes towards science. Moreover, when the laboratory use was examined, a significant difference was found between the groups who use science laboratories sometimes, usually and always and the group using it never. The difference was in favor of the laboratory using group.

The other one is the study of Karacam, Mirza and Elitok (2013) that aimed to compare the 6th grade students' attitudes towards science lesson to their frequency of watching documentaries and their gender. 157 students studying at the sixth grade of an elementary school in Ankara participated in the study. Results revealed that students watching documentaries about science topics more often have more positive attitudes towards science lesson than students watching them rarely.

There are also some recent studies related to students' attitudes towards science and related variables. One of these studies belongs to Kapici and Akcay (2016). The purpose of this study was to investigate middle school students' attitudes towards science. Sample of this study constituted of 2063 fourth to eight grade students from all regions of Turkey. Results revealed that girls have more positive attitudes than boys, and while students' grade level increases, attitudes toward science decrease. The other study conducted by Keles and Aydin (2017) examined elementary school students' attitudes towards science in terms of class level. 649 students (161 fifth grade, 174 sixth grade, 152 seventh grade and 162 eighth grade) participated in the study. Results revealed that students' attitude scores only decrease as they get through from fifth to sixth grade, and that attitude scores stay almost the same for the other class levels.

In educational research data generally have a nested structure. Each student might be nested within some schools or classrooms. Beside this, these schools or classrooms might be nested within any other location such as a district, province, region, or country. If these hierarchical data are analyzed with traditional linear model, some of the basic assumptions especially the independence of observation is violated. The students in the same group (a classroom or a school) are more similar than the students in different groups. All the students of a school or a class are affected by the school or class atmosphere in the same manner. Additionally, the factors that affect the students in the same group (a school or a classroom) have the same effects on only if all the

students are in the same group. For example; the educational resources of school A affect all the students of school A in the same way. On the other hand, they do not have any effects on the students of school B. Therefore, students in different groups can be independent; however the students in the same group like same classroom or same school have the same value on some classroom or school factors. If these hierarchical data are analyzed with the traditional linear model, some of the basic assumptions, especially the independence of the observation, are violated. If the independence of observation assumption is violated, estimating the coefficients can be biased, and the estimates of standard errors can be smaller than they should be. Each group is represented by its own sub-models when the data are analyzed using the hierarchical linear modeling technique (HLM). These sub-models not only show relationships among the variables at the same level, but also reveal the effect of the variables at this level on the other level. For this reason, HLM is a more reliable statistical technique for identifying relationships in studies for hierarchical structural data (Raudenbush & Bryk, 2002). In recent years student, classroom and school level predictors have been investigated using large scale data such as TIMMS and PISA. While some studies in the literature (Huffman, Lawrenz, and Minger, 1997; Le Mare and Sohbat, 2002) support the conclusion that students with female teachers feel more comfortable and safer, Gilmartin, Denson, Li, Bryant and Aschbacher, (2007) found no relation between the number of female teachers in schools and their interest in science courses (as cited in Hacieminoglu, Ertepinar, Yilmaz-Tuzun & Cakir, 2015). Meta-analysis studies of Fuller (1987), Hanushek (1997) and Burtless (1996) revealed that most of the studies they investigated supported the idea that teaching materials, and instructional resources such as school library, availability of science laboratories in science teaching were positively related to students' achievement. Students' attitudes towards science is strongly associated with students' achievement. Therefore, it is necessary to study the factors that predict the attitudes of the students towards science taking into account the factors at both the school and the student level.

The purpose of this study was to investigate what school- and student-level factors are associated with students' attitudes towards science. The specific research questions were:

1. Are there any differences in students' attitudes towards science among schools?

2. Are proportion of female science teachers, ability grouping between science classes, quality of school's physical infrastructure and quality of school's educational resources associated with students' attitudes towards science?

3. Are students' background characteristics, factors related to students characteristics, factors related to student feelings and outside activities and earning and motivational factors associated with students' attitudes towards science?

Method

Research Design

The overall design of this study is mainly a cross-sectional survey and correlational. Fraenkel and Wallen (2003) stated that the survey type of research is used to describe the characteristics of a population through asking a set of questions. Moreover, correlational type of research is used to determine the relationships among two or more factors without any manipulation.

Research Sample

The convenience sampling method was used in this study and 2975 sixth, seventh and eight grade elementary students in different schools and cities of Turkey constituted the sample of this study. The distribution of the students' demographic characteristics was presented in Table 1.

Table 1

Demographic and Sociodemographic Characteristics of Participants

Demographic Characteristics		Number	% Percent
Region	Marmara	430	14.4
	Black Sea	382	12.9
	Central Anatolia	1004	33.7
	Aegean	633	21.2
	Mediterranean	392	8.5
	Eastern Anatolia	114	3.9
	Southeastern Anatolia	20	0.7
Gender	Female	1531	51.5
	Male	1444	48.5
Income	Low	721	24.2
	Medium	1520	51.1
	High	734	24.7

Research Instruments and Procedures

The Test of Science Related Attitude, Learning Approach Questionnaire, Achievement Motivation Questionnaire, School Background Questionnaire were used as data collection tools for this study. The information about data collection instruments was summarized in Table 2.

Table 2
Information about Data Collection Tools

	The Test of Science Related Attitude	**Learning Approach Questionnaire**	**Achievement Motivation Questionnaire**	**School Background Questionnaire**
Scale type	5-point Likert-type scale	4-point Likert-type scale	4-point Likert-type scale	
Developed by	Fraser (1978)			OECD Publications (2004, p.316)
Translated and adapted into Turkish	Arisoy (2007)	Caliskan, (2004)	Caliskan, (2004)	
Used by	Hacieminoglu (2016)	Bou Joude (1992) Cavallo and Schafer (1994)	Bou Joude (1992) and Cavallo and Schafer (1994)	Hacieminoglu, Ertepinar,Yilmaz-Tüzün & Cakir (2015)
Items	40 items	22 items	14 items	**Information obtained from the principals of each school**
Dimentions and reported cronbach alpha reliability index	Adaptation of scientific attitudes,	Rote learning α .81	Learning goals α .94	**School SES**
	Enjoyment of science lessons,		Performance goals α .82	**Ability grouping between science classrooms,**
	Leisure interest in science,	Meaningful learning α.76	Self-efficacy α .89	**Proportion of female science teachers,**
	Career interest in science			**Quality of school's physical infrastructure,**
	Total Scale α .78 by Fraser (1978)	Cavallo, Rozman and Potter (2004)	Cavallo, Rozman and Potter (2004)	"school buildings and grounds", "heating/cooling and lighting systems, "instructional space (eg., classrooms)" (not at all=1, very little=2, to some extent=3, and a lot=4)
Dimentions and cronbach alpha reliability index	Adaptation of scientific attitudes α .68	Rote learning α .77	Learning goals α .83	
		Meaningful learning α.71		
			Performance goals α .73	**Quality of school's educational resources**
	Enjoyment of science lessons α .83		Self-efficacy α .75	"Instructional materials (eg. textbooks)", "science laboratory equipment and material", "computers for instruction", "library materials", "audio-visual resources" (not at all=1, very little=2, to some extent=3, and a lot=4)
	Leisure interest in science α .84			
	Career interest in science α .80			

Factors

In this study factors considered are labeled as outcome factors, student level factors (Level-1) and school level factors (Level-2), and presented in Table 3.

Outcome Factors

The outcome factors of this study were students' attitudes towards science.

Student Level (Level-1) Factors

Student Level (Level-1) Factors were students' background characteristics, factors related to students characteristics, factors related to student feelings and outside activities, learning and motivational factors.

Students' Background Characteristics

Students' background characteristics were their socio-economic status, parents' education level and parents' occupational status.

Factors related to Student Characteristics

Grade level, Science achievement (science grades) and gender were factors related to student characteristics. Science grades refer to the achievement scores obtained from trial high school exam test, which is a standardized test applied by the Ministry of National Education for all elementary schools.

Factors related to Student Feelings and Outside Activities

The course they like most, whether they read articles or books regarding science, whether they benefit from the internet sites regarding science, whether they watch documentaries and whether they share their ideas about science subject with their families were the factors related to student feelings and outside activities.

Learning and Motivational Factors

Performance goal orientation, learning goal orientation, self-efficacy, rote learning approach and meaningful learning approach were the factors regarding learning and motivation.

School Level (Level-2) Factors

School Level (Level-2) factors were proportion of female science teachers, ability grouping between science classes, quality of school's physical infrastructure and quality of school's educational resources.

Table 3

Outcome, Student and School level Factors

Outcome Factors	***Student Attitude Toward Science***		
Student Level (Level-1) Factors	Students' background characteristics	Socio economic status	INCOMEME INCOMEHI
		Parents' education level	DUMMYCOL DUMMYGRA
		Parents' occupational status	PARENTOC
	Factors related to student characteristics	Grade level	GRADE7 GRADE8
		Science achievement	SCIENGRA
		Gender	GENDER
	Factors related to Student Feelings and Outside Activities	The course they like most	DUMMYLIK
		Whether they read articles or books regarding science	READINGB
		Whether they benefit from internet sites regarding science	INTERNET
		Whether they watch documentaries	DOCUMENT
		Whether they share their ideas about science subjects with their families	SHARINGI
	Learning and Motivational Factors	Performance goal orientation	PERFGOAL
		Learning goal orientation	LEARNGOA
		Self-efficacy	SELFEFFI
		Meaningful learning approach	MEANINGF
		Rote learning approach	ROTELEAR
School Level (Level-2) Factors	Factors related with school characteristics	Proportion of female science teachers	FEMALESC
		Ability grouping between science classes	ABILITYG
		Quality of school's physical infrastructure	PHYSICAL
		Quality of school's educational resources	QUALITYE

Data Analyses

Hierarchical Linear Modeling (HLM) was selected as a modeling technique in order to investigate how the school level factors and student level factors were related to students' attitudes towards science because of the nested structure of the data sets that means students nested within schools. Models were developed by using HLM 6.0 in order to examine the relations between school level and students level factors.

Results

Results of Research Question I (One-Way ANOVA with Random Effects)

With respect to attitudes towards science in order to answer the first research question regarding if there were any differences in students' attitude toward science among schools, one-way ANOVA with random effects model was conducted.

For i= 1, …, nj students in school j, and j = 1, …, 23 schools, equations at two levels are:

Level 1 (Students level) Model:

$Y_{ij} = \beta_{0j} + r_{ij}$

Level 2 (School level) Model:

$\beta_{0j} = \gamma_{00} + u_{0j}$

where

Y_{ij} = the endogenous factor, attitude toward science for i^{th} students in j^{th} school

β_{0j} = the intercept (the mean attitude toward science for the j^{th} school)

r_{ij} = the student level error

γ_{00} = the grand mean

u_{0j} = the random effect associated with unit j (school)

The final estimation of fixed effects obtained from analysis of variance model of attitudes toward science is represented in the Table 4.

Table 4

Final Estimation of Fixed Effects for One-Way ANOVA with Random Effects for Attitudes towards Science

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	**p-value**
Average school mean, γ_{00}	3.546715	0.028411	124.836	0.000

The analysis of variance indicates that average school mean of attitudes towards science, the grand-mean of attitudes towards science (γ_{00}), was statistically different from zero. That means there were significant differences among schools.

The grand-mean of attitudes towards science was 3.546 with a standard error of 0.028, indicating a 95% confidence interval of:

Confidence Interval = 3.546 ± 1.96 (0.028) = (3.491, 3.600)

Table 5

Final Estimation of Variance Components for One-Way ANOVA with Random Effects for Attitudes towards Science

Random Effect	*Variance Component*	*df*	*Chi-square*	**p-value**
School mean, u_{0j}	0.01327	22	89.69055	0.000
Level-1 Effect, r_{ij}	0.47801			

The final estimation of variance components obtained from the one-way ANOVA with random effects model is represented in Table 5.

The findings also indicated significant (p< .005) variation does exist among schools in their attitudes towards science (χ^2 = 89.69055, df = 22). The result also revealed that school level factors might account for the differences in the students' attitudes toward science.

At the student level Var(r_{ij}) = σ^2 = 0. 47801. At the school level, τ_{00} is the variance of the true school means, β_{0j}, around the grand-mean, γ_{00}. Var(u_{0j})= τ_{00} = 0.01327.

The intraclass correlation (ICC), which represents proportion of variance in Y (attitude toward science) among schools, is

ICC = τ_{00} / (τ_{00} + σ^2) = 0.01327/ (0.01327+ 0. 47801) = 0.027

indicating that about 2.7% of the variance in attitudes toward science is among schools.

HLM also provides an estimate of the reliability of the sample mean in any school. The reliability is an estimate of the true school mean and is affected by the sample size within each school. The overall estimate of reliability is the average of the school reliabilities. ρ = .715 indicating that the sample means tend to be a reliable indicator of true school means. The equation for determining reliability of the mean attitudes towards science within each school is:

ρ = τ_{00} / [τ_{00} + (σ^2 / nj)]. Therefore, the reliability of the sample mean varies from school to school because the sample size, nj, varies.

In the following models, additional level 1 (student level) factors will be tried to reduce the variation within schools (σ2) and additional level 2 (school level) factors will be tried to explain between school differences (τ00).

Results of Research Question II (Means as Outcomes Model)

In order to answer the second research question regarding which of the school level factors are associated with students' attitudes toward science, means-as-outcome model was applied.

Equations at two levels are:

Level 1 (Students level) Model:

$Y_{ij} = \beta_{0j} + r_{ij}$

Level 2 (School level) Model:

$\beta_{0j} = \gamma_{00} + \gamma_{01}$ (QUALITYE) + γ_{02} (FEMALESC) + γ_{03} (ABILITYG) + γ_{04} (PHYSICAL) + u_{0j}

for j = 1, 2, …, n schools

where

β_{0j} = the school mean on students' attitudes toward science

γ_{00} = the intercept (the grand mean for students' attitude toward science, that is the average of the school means on students' attitude toward science scores across the population of schools)

γ_{01} = the differentiating effect of quality of school's educational resources on the school mean on students' attitude toward science.

γ_{02} = the differentiating effect of proportion of female science teachers on the school mean on students' attitude toward science.

γ_{03} = the differentiating effect of ability grouping between science classes on the school mean on students' attitude toward science.

γ_{04} = the differentiating effect of quality of school's physical infrastructure on the school mean on students' attitude toward science.

τ_{00} = the conditional variance or school level variance in β_{0j} after controlling for these school level factors.

u_{0j} = the residual

The model was first run with all four factors, but *Proportion of female science teachers, Ability grouping between science classes, Quality of school's physical infrastructure* were not significant and were removed from the final analysis. The final estimation of fixed effects obtained from means as outcomes model of students' attitude toward science is represented in Table 6.

The results revealed significant and positive relationship between quality of school's educational resources and students' attitudes toward science (γ_{01}= 0.003, se=0.001).

Table 6

Final Estimation of Fixed Effects for Means as Outcomes Model for Attitudes toward Science

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	**p-value**
Model for School Means[1]				
Intercepts, γ_{00}	3.546	0.025	137.868	0.000
QUALITYE, γ_{01}	0.003	0.001	2.125	0.045

[1] The student level factors were Grand Mean Centered before analysis.

The final estimation of variance components obtained from means as outcomes model is represented in Table 7. The degrees of freedom for this model (Means as Outcomes Model) is based on the number of schools with sufficient data, and the number of school level factors included in the model.

Degrees of Freedom = J – Q – 1, where

J = the number of schools with sufficient data

Q = number of school level factors included in the model

Thus, all schools were used in this analysis and degrees of freedom for this model is:

df = J – Q – 1 = 23 – 1 – 1 = 21

Table 7

Final Estimation of Variance Components for Means as Outcomes Model for Attitudes toward Science

Random Effect	*Variance Component*	*df*	*Chi-square* χ^2	**p-value**
School mean, u_{0j}	0.01005	21	68.16538	0.000
Level-1 Effect, r_{ij}	0.47819			

The residual variance between schools (τ_{00} = 0.01005) is substantially smaller than the original variance (τ_{00} = 0.01327) resulting from the analysis of variance model. This reduction is due to the inclusion of school level factors.

Proportion of variance explained at

$$\text{level 1} = \frac{\tau_{00}(\text{ANOVA}) - \tau_{00}(\text{Means as Outcomes})}{\tau_{00}(\text{ANOVA})}$$

Proportion of variance explained at level 1= $\frac{0.01327 - 0.01005}{0.01327} = 0.242$

This result indicated that 24.2% of the true between school variance in students' attitude toward science was accounted for *Quality of school's educational resources.*

Finally, in order to examine whether the school attitude toward science means vary significantly when quality of school's educational resources is controlled chi-square statistics was conducted. Chi-square statistic χ^2 was found as 68.1653 (df=21, p= .00). This finding indicated that this school level factor namely quality of school's educational resources did not account for all the variation in the intercepts. However, even after controlling for quality of school's educational resources, schools still varied significantly in their average attitude toward science views.

Results of Research Question III (Random Coefficient Model)

In order to answer the fifth research question regarding which of the student level factors help to explain the difference in understanding the students' attitude toward science Random Coefficient Model was conducted.

The equations to answer this question are:

Level 1(Students level):

$Y_{ij} = \beta_{0j} + \beta_{1j}$(GRADE7) + β_{2j}(GRADE8) + β_{3j}(SCIENGRA) + β_{4j}(GENDER) + β_{5j} (INCOMEME) + β_{6j}(INCOMEHI) + β_{7j}(DUMMYCOL) + β_{8j}(DUMMYGRA) + β_{9j} (PARENTOC) + β_{10j}(DUMMYLIK) + β_{11j}(READINGB) + β_{12j}(INTERNET) + β_{13j}(DOCUMENT) + β_{14j}(SHARINGI) + β_{15j}(PERFGOAL) + β_{16j}(LEARNGOA) + β_{17j}(SELFEFFI) + β_{18j}(MEANINGF) + β_{19j}(ROTELEAR) + r_{ij}

Level 2(School level):

$\beta_{0j} = \gamma_{00} + u_{0j}$

$\beta qj = \gamma_{q0} + u_{qj,}$

where

Y_{ij} = Attitude toward Science of student *i* in class *j*

β_{0j} = the school mean on attitude toward science

β_{1j} = the differentiating effect of 7th grade level in school j

β_{2j} = the differentiating effect of 8th grade level in school j

β_{3j} = the differentiating effect of science achievement in school j

β_{4j} = the differentiating effect of gender in school j

β_{5j} = the differentiating effect of medium level income in school j

β_{6j} = the differentiating effect of high-level income in school j

β_{7j} = the differentiating effect of college education level as a highest educational level of parents in school j

β_{8j} = the differentiating effect of graduate education level as a highest educational level of parents in school j

β_{9j} = the differentiating effect of highest parental occupational status in school j

β_{10j} = the differentiating effect of the course student like most in school j

β_{11j} = the differentiating effect of if students read articles or books regarding science in school j

β_{12j} = the differentiating effect of if students benefit from internet sites regarding science in school j

β_{13j} = the differentiating effect of if students watch documentary film in school j

β_{14j} = the differentiating effect of if students share their ideas about science subjects with their families in school j

β_{15j} = the differentiating effect of students' performance goal orientation in school j

β_{16j} = the differentiating effect of students' learning goal orientation in school j

β_{17j} = the differentiating effect of students' self-efficacy in school j

β_{18j} = the differentiating effect of students' meaningful learning approach in school j

β_{19j} = the differentiating effect of students' rote learning approach in school j

βqj = the coefficient for factor *q* for class j after accounting for other factors

γ_{00} = the average of school mean on attitude toward science across the population of schools

γ_{q0} = the average *q* factor- attitude toward science slope across those schools

u_{0j} = the unique increment to the intercept associated with school *j*

u_{qj} = the unique increment to the slope associated with school *j*

The final random coefficient model included the factors significantly related to attitudes toward science, and the factors both significantly related to attitudes toward science and randomly varying. The final estimation of fixed effects obtained from random coefficient model of is displayed in the Table 8.

Table 8

Final Estimation of Fixed Effects for Random Coefficient Model for Attitude toward Science

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	**p-value**
Overall mean attitude toward science[1], γ_{00}	3.213	0.038	83.380	0.000
GRADE7, γ_{10}	-0.045	0.021	-2.096	0.036
GRADE8, γ_{20}	-0.132	0.047	-2.814	0.005
SCIENGRA, γ_{30}	0.020	0.009	2.044	0.041
READINGB, γ_{40}	0.219	0.025	8.764	0.000
INTERNET, γ_{50}	0.126	0.023	5.392	0.000
SHARINGI, γ_{60}	0.166	0.024	6.903	0.000
SELFEFFI, γ_{60}	0.166	0.020	7.946	0.000
MEANINGF, γ_{60}	0.437	0.022	19.035	0.000
ROTELEAR, γ_{60}	-0.310	0.021	-14.557	0.000

[1] The student level factors were Group Mean Centered before analysis.

The Grade-Attitudes toward science *slope* coefficients indicates that students from different grades had significantly different attitudes toward science. Students from seventh grades (γ_{10}= -0.045, se= .021) and eighth grades (γ_{20}= -0.132, se=.047) performed significantly lower than the students from sixth grades on students' attitudes toward science.

The Science grade- attitudes toward science slope coefficients (γ_{30}= .020, se= .009) indicates that students' science achievement is significantly and positively related to students' attitudes toward science. Students having higher achievement had better attitudes toward science than the other students.

The reading books - attitudes toward science slope coefficients (γ_{40}= .219, se= .025) indicates that the more the students read articles or books regarding science, the better attitude toward science the students had.

The Internet- attitudes toward science slope coefficients (γ_{50}= .126, se= .023) indicates that whether they benefited from internet sites regarding science is significantly and positively related to students' attitudes toward science.

The Students' sharing their ideas - attitudes toward science slope coefficients (γ_{80}= .166, se= .024) indicates that students' sharing their ideas about science subject with

their families was significantly and positively related to students' attitudes toward science.

The Self efficacy- attitudes toward science slope coefficients (γ_{90}= .166, se= .020) indicates that students' self-efficacy was significantly and positively related to students' attitudes toward science. Students having high self-efficacy had better attitudes toward science.

While the rote learning approach - attitudes toward science slope coefficients (γ_{90}= -.310, se= .021) indicates that students' rote learning approach was significantly and negatively related to students' attitudes toward science, the meaningful learning approach - attitudes toward science slope coefficients (γ_{80}= .437, se= .022) indicates that students' meaningful learning approach was significantly and positively related to students' attitudes toward science, Students having rote learning approach had lower attitudes toward science. Students having meaningful learning approach had higher attitudes toward science.

The final estimation of variance components obtained from random coefficient model is displayed in Table 9.

Table 9

Final Estimation of Variance Components for Random Coefficient Model for Attitudes toward Science

Random Effect	*Variance Component*	*df*	*Chi-square* χ^2	**p-value**
School mean, u_{0j}	0.10861	22	125.38959	0.000
Level-1 Effect, r_{ij}	0.54394			

Variance among the school means τ_{00}= 0.108 with a chi-square statistic of 125.389 is found to be statistically significant (p=.000).

The variances in the Analysis of Variances Model and Random Coefficient Model will be compared to calculate the variance explained at the student level. It can be compared by creating an index of the proportion of reduction in variance at the student level by comparing the σ^2 estimates from these two models.

Proportion of variance explained at

$$\text{level 1} = \frac{\sigma^2(\text{ANOVA}) - \sigma^2(\text{Random Coefficient})}{\sigma^2(\text{ANOVA})}$$

$$\text{Proportion of variance explained at level 1} = \frac{0.47801 - 0.29587}{0.47801} = 0.3810$$

By including these student level factors (seventh grade level, eight grade level, science achievement, whether they read articles or books regarding science, whether they watch documentaries, whether they benefit from internet sites regarding science, whether they share their ideas about science subject with their families, students' self-efficacy, students' meaningful learning and rote learning approach) as predictors of students' attitudes toward science within school variance was reduced by 38.1%. Therefore, these factors account for about 38% of the student level variance in attitudes toward science.

Discussion, Conclusion and Recommendation

This study provides a general overview about students' attitudes toward science and the predictive variables related to their attitude. Results of the One-Way ANOVA with random effects in HLM analysis revealed that there are significant differences in students' attitudes toward science among schools. These differences among schools in terms of students' attitudes could be resulted from many factors such as schools, classrooms, teachers, and students. In the present study factors regarding schools and students were examined and results were discussed. George (2000) found that 7th grade students in suburban schools had more positive attitudes toward science than students in metropolitan and rural schools. Also, Bozdogan and Yalcin (2005) indicated that attitudes of students studying in second type of schools (better educational opportunities, more teachers) were the highest. After that came the third type of schools (educational opportunities were the best, had the most teachers, were in the city center and were mostly preferred) and first type of schools (limited educational opportunities, less teachers and located in the countryside).

When the results of the study regarding school level variable were examined, it was found that while proportion of female science teachers, ability grouping between science classes, and quality of school's physical infrastructure were not significantly contributed to the model, the quality of school's educational resources significantly contributed to the students' attitudes toward science. In this study, instructional materials (eg. textbooks), science laboratory equipment and materials, computers for instruction, library materials, and audio-visual resources were regarded as quality of school's educational resources. Results revealed that the more educational resources the schools had, the more positive attitudes students developed towards science. When the students' attitudes were evaluated in terms of socio-economic status and parents' educational level it was found that parents' socio-economic status and their educational level did not significantly contribute to students' attitudes towards science. The results of the present study supported that independent from parents' socio-economic status and their educational level, the more quality of school's educational resources was, the more positive attitudes students developed towards science. Although the parents' socio-economic status is not so good, if the schools

improve their instructional materials (eg. textbooks), science laboratory equipment and materials, computers for instruction, library materials, and audio-visual resources, that is to say, if they create a rich and active learning environment, students could develop positive attitudes towards science. Hacieminoglu(2016) and Perera, Bomhoff and Lee (2014) supported the idea that, even if the students have a low socio-economic level, they can be encouraged by their parents to perform well if their families see the value of science and display a positive attitude toward science. Kozcu-Cakir, Şenler and Gocmen-Taskin (2007), Sinan, Sardag, Salifoglu, Cakir and Karabacak (2012), Sulun, Ekiz and Sulun (2009) stated that while students' attitudes towards science is positively related to frequency of having science lessons in the laboratory.

When the results of the study were examined in terms of students' characteristics variables, it was found that while gender do not significantly contribute to the model, grade level and science achievement significantly contribute to students' attitudes toward science. Results reflected that gender had no significant contribution to the model, namely there was no significant difference between boys and girls in their attitudes towards science. Our findings are similar to those of Dhindsa and Chung (2003), Kaya and Boyuk (2011), Kozcu Cakir, et al. (2007), Miller, Lietz and Kotte (2002), Sinan, et al. (2012) and Smist, Archambault and Owen (1994). On the other hand, our findings contradict the findings of Catsambis (1995), Hacieminoglu (2016), Jones, Howe, and Rua (2000), Piburn and Baker (1993) and Greenfield (1996) since these studies revealed that, male students' attitudes toward science was higher than that of the female students. Also, Gurkan and Gokce (2000) found that female students' attitudes towards science lesson were higher than male students. On the other hand, while there is a positive correlation between students' attitudes towards science and their science achievement, their attitudes are negatively correlated with their grade level. Namely, as the students' science achievement increases, their attitudes increase too. The findings of the present study are similar to those obtained by Hacieminoglu, (2016), Beaton, Mullis, Martin, Gonzalez, Kelly & Smith (1996); Kozcu Cakir et al. (2007); Sulun, Ekiz and Sulun (2009); Weinburgh, (1995). Similarly, Gurkan and Gokce (2000) found that students who were successful in science lessons had a positive attitude towards science. With respect to the grade level; as the students' class level increases, their attitudes towards science decreases. This could be resulted from the exams which students take to attend a prestigious high school. Students prefer to memorize the information while studying these multiple-choice exams and this might affect their attitudes towards science negatively. Related supporting literature, (Bozdogan and Yalcin, 2005; George, 2000; Kapici and Akcay , 2016; Kozcu Cakir, et al., 2007; Sinan, et al., 2012) often reveals that the attitude scores of students are higher in primary school, and that as the students get older their attitudes decrease relatively. On the other hand, in the study of Keles and Aydin (2017) results revealed that students' attitude scores only decrease as they get through from fifth to sixth grade, and that attitude scores stay almost the same for the other class levels. Also, Kaya and Boyuk (2011) stated that students' attitude scores towards science lesson differ in favor of 8th graders and that no difference is found for the other class levels.

Regarding to the factors related to student feelings and outside activities following variables contributed positively to students' attitudes towards science; whether they read articles or books regarding science, whether they benefited from the internet sites regarding science, whether they shared their ideas about science subject with their families. Similarly, Christidou (2011) suggested that web sites and TV programs about science had an effect on students' attitudes and interests towards science. Researcher stated that identifying the negative elements of books, magazines and TV programs about science by examining their contents positively affected students' attitudes towards science lesson (as cited in; Karacam, Mirza and Elitok, 2013). Also, Long and Steinke (1996) stated that TV programs about science affected students' attitudes towards science lesson (as cited in; Karacam, Mirza and Elitok, 2013). George and Kaplan (1998) examined the effect of parent and teacher variables on students' attitudes towards science. Results revealed that parents directly or indirectly affected their children's attitudes towards science. Researchers stated that parents directly affect their children's attitudes by talking to them about their lessons and they indirectly affect the attitudes by encouraging them to join activities or going museums and libraries (as cited in; Karacam, Mirza and Elitok, 2013). On the other hand, in this study watching documentaries had no significant contribution to the students' attitudes toward science. Karacam, Mirza and Elitok (2013) supported that students watching documentaries about science topics more often have more positive attitudes towards science lesson than students watching them rarely.

Learning and motivational factors were investigated in this study. They were performance and learning goal orientation, self-efficacy, meaningful learning approach and rote learning approach. From these variables while self-efficacy and meaningful learning approach contributed positively, rote learning approach contributed negatively to the students' attitudes towards science. Performance and learning goal orientation had no significant contribution to the model as supported by Hacieminoglu (2016). Similarly, Christidou (2011), George (2000) and Sinan, et al. (2012) also found that there was a positive correlation between students' attitudes towards science lesson and their self-efficacy perceptions. Students who believed in their abilities to perform well in science were more likely to have higher attitudes towards science than students who were less efficacious.

Recommendation

Since hierarchical data were used in relational screening model to get more reliable results, techniques which do not violate independence of observation hypothesis such as HLM must be used. As is seen in this study, different features related to different schools, classes and teachers could affect attitudes towards science differently. In this study, students' attitudes towards science differed among schools. When the school variable was examined, it was found that quality of school's educational resources significantly predicted students' attitudes towards science. Thus, improving instructional materials, science laboratory equipment and materials, computers for instruction, library materials, and audio-visual resources in all schools will have a

potential to contribute students' attitudes towards science. So, although families' socio-economic status is below average, students' attitudes towards science will be positively affected since the school will provide the materials that their families could not. Moreover, another finding supporting this one was that the following variables contributed positively to students' attitudes towards science; whether they read articles or books regarding science, whether they benefit from the internet sites regarding science, whether they share their ideas about science subject with their families. If the quality of school's resources are improved students can read articles and books regarding science and can do research by taking advantage of the internet sites regarding science in school's computer laboratory. Teachers should assign projects that lead students to do research regarding science topics. Teachers should raise the awareness of families about what they can do with their children, and with the help of parent-teacher association students' attitudes towards science should be improved. Teachers should increase self-confidence of students by valuing the projects and research done by them. They have to make students feel successful in the classroom environment and thus, by improving their students' self-efficacy, they can help their students have positive attitudes towards science. As the students' class level increases, their attitudes towards science decreases. This could be resulted from the exams which students take to attend a prestigious high school. Students prefer to memorize the information while studying these multiple-choice exams and this affects their attitudes towards science negatively. Therefore, teachers should arrange teaching learning environments in order to provide meaningful learning experiences, and they should prefer assessment and evaluation methods based on performance evaluation rather than multiple-choice exams. If teachers ask questions requiring memorization, students prefer to learn by memorizing. Therefore, teachers should ask questions to make students think about how to use knowledge both in the exams and in the teaching-learning process. So, students prefer meaningful learning to memorizing. There are many quantitative studies examining students' attitudes towards science. Enriching science lesson with materials, increasing students' curiosity, making them learn by discovering and making them do experimental observations affect their attitudes positively. In order to examine the reasons why students like science or not in detail, qualitative studies should also be conducted.

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Özet

Problem Durumu: Literatürde, öğrencilerin tutumları konusunda çok sayıda nicel çalışmalar vardır ve çalışmaların sonuçları, öğrencilerin önemli ve artan oranda fen bilimleri ile ilgilenmediğini ve fen bilimlerine yönelik negatif tutuma sahip olduğunu ortaya koymuştur. Pek çok öğrencinin, bilimsel araştırmaya devam etmelerini engelleyen, fen bilime karşı olumsuz duygu ve tutumları vardır. Eğitim ile ilgili araştırma verilerinde genellikle iç içe gruplanmış bir yapı vardır. Her öğrenci bazı okullarda veya sınıflarda gruplanmış olabilir. Bunun yanı sıra, bu okullar ya da sınıflar, il, bölge ya da ülke gibi başka herhangi bir lokasyonda gruplanmış olabilir. Bu hiyerarşik (aşamalı) veriler geleneksel doğrusal modelle analiz edilirse, özellikle gözlemin bağımsızlığı gibi temel varsayımların bir kısmı ihlal edilir. Veri aşamalı doğrusal modelleme yöntemi (HLM) kullanılarak analiz edildiğinde her grup kendi alt modelleri ile temsil edilmektedir. Bu alt modeller aynı seviyedeki değişkenler arasındaki ilişkilerle beraber, bu seviyedeki değişkenlerin diğer seviyedekilere olan etkisini de ortaya koymaktadır. Bu nedenle HLM, araştırmacılar için hiyerarşik yapıya sahip verilerdeki ilişkileri tanımlamak için daha güvenilir bir istatistiksel tekniktir. Öğrencilerin hem okul hem de öğrenci düzeyindeki özelliklerini göz önünde bulundurarak fen bilimine yönelik tutumlarını yordayan faktörler ile ilgili sınırlı sayıda çalışmalar bulunmaktadır.

Araştırmanın Amacı: Bu çalışmanın amacı öğrencilerin fen bilimlerine yönelik tutumlarını yordayan okul ve öğrenci düzeyindeki faktörleri belirlemektir.

Araştırmanın Yöntemi: Bu çalışmanın deseni temel olarak kesitsel ve korelasyonel bir araştırmadır. Bu çalışmada uygun örnekleme yöntemi kullanılmış ve bu çalışmanın

örneklemini Türkiye'nin farklı okul ve şehirlerindeki 2975 ilköğretim öğrencisi oluşturmuştur. Veri toplama araçları olarak fen bilimleri ile ilgili tutum ölçeği, öğrenme yaklaşımı ölçeği, başarı motivasyon ölçeği, ve okul özellikleri anketi kullanılmıştır. Veri analizinde aşamalı doğrusal modelleme(HLM) kullanılmıştır.

Araştırmanın Bulguları: Bu çalışma, öğrencilerin fen bilimlerine yönelik tutumları ve ilgili yordayıcı değişkenler hakkında genel bir bakış sunmaktadır. Aşamalı doğrusal modelleme sonuçları farklı okullardaki öğrencilerin fen bilimlerine yönelik tutumları anlamlı düzeyde farklılıklar gösterdiğini ortaya koymuştur. Öğrencilerin tutumları bakımından okullar arasında olan bu farkın okulla ilgili faktörler, sınıfla ilgili faktörler, öğretmenle ilgili faktörler, öğrencilerle ilgili faktörler gibi bir çok yordayıcısı olabilir. Bu çalışmada okul ve öğrenci düzeyindeki faktörler incelenmiş ve sonuçlar tartışılmaya çalışılmıştır. Çalışmanın sonuçları okul özellikleri ile ilgili değişkenler açısından incelendiğinde kadın fen öğretmenlerinin oranı, fen sınıfları arasında beceri gruplaması, okulun fiziki altyapısının kalitesinin modele anlamlı bir katkısı olmamakla birlikte, okulun eğitim kaynaklarının kalitesi, öğrencilerin fen bilimine yönelik tutumlarına anlamlı bir katkıda bulunmuştur.Bu çalışmada okuldaki eğitim kaynaklarının kalitesi olarak, öğretim materyalleri, fen laboratuar ekipmanı ve materyalleri, eğitim amaçlı bilgisayarlar, kütüphane materyalleri, görsel-işitsel kaynaklar ele alınmıştır. Çalışmanın sonuçları okulların eğitsel kaynakları ne kadar yeterli ise, öğrencilerin fen bilimine yönelik tutumlarının o kadar olumlu olduğunu göstermektedir.Öğrencilerin tutumları ailelerin sosyoekonomik durumu ve eğitim düzeyi, açısından değerlendirildiğinde ailelerin sosyoekonomik durumu ve ailelerin eğitim düzeyi, öğrencilerin fen bilimime yönelik tutumlarına anlamlı ölçüde katkıda bulunmamıştır. Çalışmanın sonuçları öğrenci özellikleri ile ilgili değişkenler bakımından incelendiğinde ise cinsiyetin modele anlamlı bir katkısının olmadığı, sınıf düzeyi ve fen başarısının ise öğrencilerin fen bilimlerine yönelik tutumlarına anlamlı düzeyde katkı sağladığı belirlenmiştir. Fen başarısı öğrencilerin fen bilimlerine yönelik tutumlarına pozitif düzeyde anlamlı katkı sağlarken, sınıf düzeyi değişkeni öğrencilerin fen bilimlerine yönelik tutumlarına negatif duzeyde anlamlı katkı sağlamıştır. Yani öğrenci başarısı arttıkça öğrenciler fen bilimlerine yönelik daha olumlu tutum sergilerken, sınıf düzeyi arttıkça öğrenciler fen bilimlerine yönelik negatif tutum göstermektedirler. Bunun yanısıra öğrenci duyguları ve okul dışı faaliyetlerle ilgili faktörler göz önünde bulundurulduğunda öğrencilerin fen bilimleri ile ilgili makaleler veya kitaplar okuyup okumadıkları, fen bilimleri ile ilgili internet sitelerinden yararlanıp yararlanmadıkları, fen bilimleri ile ilgili fikirlerini aileleri ile paylaşıp paylaşmadıkları.gibi değişkenler öğrencilerin fen bilimlerine karşı tutumlarına olumlu katkılar sağlanmıştır. Öğrencilerin öğrenme ve motivasyonla ilgili özellikleri incelendiğinde bu değişkenlerden, öz-yeterlik ve anlamlı öğrenme yaklaşımı öğrencilerin fen bilimlerine karşı tutumlarına olumlu düzeyde katkı sağlarken, ezbere öğrenme yaklaşımı ise öğrencilerin fen bilimlerine karşı tutumlarını negatif düzeyde yordamıştır.

Sonuç ve Öneriler

İlişkisel çalışmalarda daha güvenilir sonuçlar elde etmek için hiyerarşik yapıda veriler kullanıldığında HLM gibi gözlemlerin bağımsızlığı varsayımını ihlal etmeyen

teknikler kullanılmalıdır. Bu çalışmadada görüldüğü gibi farklı okullar sınıflar ve öğretmenler ile ilgili farklı özellikler öğrencilerin fen bilimlerine yönelik tutumunu farklı şekillerde etkileyebilir. Bu çalışmada öğrencilerin fen bilimlerine yönelik tutumları okullar arasında farklılık göstermektedir. Okul ve öğrenci özellikleri ile ilgili değişkenler öğrencilerin fen bilimlerine yönelik tutumlarını farklı düzeylerde yordadığı sonucuna ulaşılmıştır. Bu çalışmanın sonuçları göstermektedirki, öğrencilerin ailelerinin sosyoekonomik düzeyi ve eğitim düzeyinden bağımsız olarak okulların eğitim kaynaklarının kalitesi ne kadar gelişmiş olursa öğrenciler fen bilimlerine yönelik o kadar olumlu tutum geliştirmektedirler. Ailenin sosyoekonomik durumu çok iyi olmasa bile okullar öğretim materyalleri (ör. Ders kitapları), fen laboratuar ekipmanı ve materyalleri, eğitim amaçlı bilgisayarlar, kütüphane materyalleri, görsel-işitsel kaynaklarını arttırırlarsa ve geliştirirlerse, yani zengin ve aktif bir öğrenme ortamı oluştururlarsa öğrenciler fen bilimlerine yönelik olumlu tutum geliştirebilirler. Öğretmenler öğrencileri bilgisayar labaratuvarlarında fen bilimleri ile ilgili internet sitelerinden yararlanarak araştırmalarını yapabilmeleri konusunda cesaretlendirmeliler ve onlara araştırma yapmaya yönlendirecek projeler vermelidirler. Öğretmenler öğrencilerin kendilerinin yaptıkları araştırmalara ve projelere değer vererek onların özgüvenlerini arttırmalılar. Öğrencilerin sınıf seviyesi yükseldikçe fen e yönelik olumsuz tutuma sahip olmaktadırlar. Öğrenciler çoktan seçmeli soru tipinde olan liselere giris sınavlarına çalışırken bilgileri ezberleme yolunu tercih etmektedirler, bu da fen e yönelik tutumu olumsuz bir şekilde etkilemektedir. Fen Bilimleri programımız araştırma sorgulama temelli öğretimi temel almaktadır. Bu nedenle öğretmenlerimiz öğrenciyi anlamlı öğrenmeye sevk eden, ezbere öğrenme den uzaklaştıracak şekilde öğretim tasarlamaya özen göstermeli, ve çoktan seçmeli sınavlardan ziyade performans değerlendirmeyi temel alan ölçme değerlendirme yöntemlerini tercih etmelidirler. Öğretmen hem sınavlarda hemde öğretim sürecindeki sorularında bilgiyi bilmek yerine bilgiyi nasıl kullanacağını bileceği mantıksal düşünme yeteneğini geliştirecek şekilde sorular sormalıki hem öğrenci anlamlı öğrenmeyi tercih etsin, hemde ezberleyerek öğrenmekten uzaklaşsın. Öğrencilerin fen bilimlerine yönelik tutumlarını inceleyen çok sayıda nicel araştırma mevcuttur, öğrencilerin feni sevmelerinin veya sevmemelerinin nedenlerini daha detaylı inceleyebilmek için bu konuda nitel araştırmalar da yapılmalıdır.