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Elementary School Students' Attitude toward Science and Related Variables

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Worldwide studies have revealed an important issue in that an increasing percentage of students within the X – Y age group are not interested in science. Many students, especially females, have negative feelings and attitudes toward science, which discourages them from continuing with scientific inquiries. There are limited studies related to the factors predicting school students' attitude toward science; therefore, the purpose of this study is to determine the relationships among the seventh grade elementary students' attitudes toward science, their learning approaches, motivational goals, science achievement and students' nature of science (NOS) views. The questionnaires for this study were administered online to 3,598 seventh grade students in different regions and cities of Turkey. The convenience sampling method was used in this study. The correlation results revealed the positive relationship between attitude toward science and the other variables. Multiple regression analysis indicated that while students' meaningful learning, self-efficacy, and nature of science views have a positive contribution, rote learning contributed negatively to the model. The findings also showed that parents' income and education level had a significant effect on students' attitude toward science.

Keywords: attitude toward science, motivational goal, self-efficacy, nature of science

INTRODUCTION

For several decades school students' attitudes toward science have been discussed within different research contexts. One of the purposes of science education is to develop a positive attitude toward science regardless of individual differences (Arisoy, 2007; Azizoglu & Cetin, 2009). Attitude can be defined as "feelings, beliefs and values held about the enterprise of school science, school science and the impact of the science on society" (Osborne, 2003, p.1050). In his study, Newhouse (1990) defined attitude as positive or negative feelings about a person, an object or an issue. Klopfer (1976) proposed six dimensions regarding 'attitudes toward science' namely; the manifestation of favorable attitudes to science and scientists; acceptance of scientific inquiry as a way of thought; adaptation of scientific attitudes; enjoyment of science learning experiences; development of interest in science and science related activities; and the development of interest in pursuing a career in science.

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Newhouse (1990) emphasizes that attitude is a very important factor in influencing human behavior. Attitude is affected by personal opinion, and these opinions can be formed through personal life experiences and education. Studies concerning the science learning environment show that there is a relationship between this environment and students' attitude toward science (Riah & Fraser, 1997; Aldigre & Fraser, 2000; den Brok, Fisher & Rickards, 2004; Rakıcı, 2004; Puacharearn & Fisher, 2004; Wahyudi & David, 2004; Telli, Çakıroglu & den Brok, 2006). Attitudes toward science involves the students' affective behaviors; for example preference, acceptance, appreciation and commitment.

Oh and Yager (2004) stated that while students' negative attitudes toward science are related to a traditional approach in science instruction, their positive feelings are associated with constructivist science classrooms. The authors also commented that if students are provided with too much scientific information, they will have a more negative attitude. Thus, the authors suggested that the learning environment should be designed in such a way as to allow students to attain scientific knowledge and gain a more positive attitude toward science. Several studies have indicated that the classroom learning environment is a strong factor in determining and predicting students' attitudes toward science (Lawrenz, 1976; Simpson & Oliver, 1990; Riah & Fraser, 1997; Aldolphe, Fraser & Aldridge, 2003). In other words, the classroom environment generally shows a positive correlation with attitude. The current science and technology curriculum and textbooks in use across the world emphasize the importance of nature of science (NOS). The current curriculum in Turkey contains some important features. The scientific method in the current curriculum includes observation, stating hypotheses, collecting data, testing hypotheses, rejecting or accepting hypotheses, and interpreting data. Imagination, creativity, objectivity, inquiry, and being open to new ideas are all important in scientific processes. In science and technology education students should learn the way of attaining knowledge. When students learn new things through discovery, they can reconstruct their knowledge. Also in the curriculum it is emphasized that scientific knowledge is not constant but the information given is the best that is currently known. Moreover, the current curriculum aims to develop awareness about scientific methods in addition to scientific literacy per se. When these features are considered, this science and technology curriculum embraces a "constructivist approach". In the science and technology curriculum most subjects are repeated at all grades at different levels of difficulty from simple to complex. In this way students are encouraged to recall these subjects fairly frequently and thus reinforce their learning.

Individual differences play an important role in student learning (Koran & Koran, 1984). In addition to academic success, individual differences related to other factors such as learning approaches, motivation, cognition, and anxiety have been studied (Debacker & Nelson, 2000; Garcia & Pintrich, 1992; Lin & McKeachie, 1999; Qian, 1995; Koran & Koran, 1984; Zhang, 2000).

The findings of a study by Edmondson (1989) as well as those by Edmondson and Novak (1993) showed the relation between student views about NOS, their definitions of learning, and their approaches to studying and learning science. Learning approaches are categorized into meaningful learning approaches and rote learning approaches (Cavallo, Rozman, & Potter, 2004). Cavallo (1996) explained Ausubel's meaningful learning as "the formulation of relationships between ideas, concepts, and information of science". When the learner integrates a new idea or concept into his or her related concepts, learning will be meaningful. According to this theory, if the learners cannot do this they may resort to rote learning in which the newly acquired knowledge is not associated or linked to the prior relevant knowledge that the learner already possesses. In this case, students do not associate what they have learned with conceptual relationships, but only memorize scientific facts. Novak (1988) suggested that rote learning prevents students' meaningful learning of new scientific ideas and "interferes with their formulation of scientific understanding" (Cavallo et al., 2004, p.289).

Students' acquisition of a meaningful understanding of scientific concepts is one of the goals of science education. When a learner integrates a new idea or concept into his/her existing concepts and structures, learning will be meaningful. During this integration, being aware of prior knowledge and linking this knowledge to the newly presented knowledge by engaging in a learning task constitute the main components of meaningful learning (Ausubel, 1963). The continuous integration of concepts helps the learner form meaningful learning sets. When the learners are unable to integrate new concepts with their prior knowledge, they tend to use rote learning and express their understanding with the definitions of these concepts as isolated facts (Ausubel, 1963; Cavallo, Rozman, Larabee, & Ishikawa, 2001). Researchers have argued that rote learning prevents meaningful learning of new scientific concepts (Cavallo, Rozman, Blickenstaff, & Walker, 2003; Cavallo et al., 2004; Novak, Ring, & Tamir, 1971). Being successful in both rote and meaningful learning depends on the learner's willingness to learn and their tendency to make connections among concepts. In other words, it depends on the learners' motivation to learn. Recent approaches have investigated motivation in relation to goal orientations, interest and emotions, and self-perceptions (Wolfolk, 2004, Murphy & Alexander, 2000). In this study, goal orientations (motivational goals) and self-efficacy as one of the dimensions of self-perceptions were explored to determine student motivation to learn. Motivational goals were derived from Bandura's social cognitive theory in which 'goal' is an important motivational process. Student motivation goals can be affected by peers or academic achievement (Pintrich & Schunk, 2002). Motivation is defined as "an internal state that arouses directs, and maintains behavior" (Wolfolk, 2004, p.350). According to Pintrich (2002) "motivational goals include not just the purposes or reasons for achievement, but reflect a type of standard by which individuals judge their performance and success or failure in reaching that goal" (as cited in Pintrich & Schunk, 2002, p.214). This quotation indicates that there are two dimensions to goal orientation: one related to students' interest in learning something new and the other related to the students' interest in achieving higher course grades (Cavallo et al., 2004). Dweck (1986) categorized these sub-dimensions as learning oriented versus performance oriented. Learning orientation can be exemplified as; learning something new, learning for the sake of learning, or improving oneself (Ames & Archer, 1988). Performance orientation can be exemplified as earning high grades, receiving praise or performing better than the other students (Ames & Archer, 1988). Self-efficacy is defined as "people's judgments of their own capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p.391). Self-efficacy focuses on the particular question of: "Can I do this task in this situation?" (Pintrinch & Schunk, 2002).

In the literature there is an abundance of studies on learning approach, goal orientations, and self-efficacy. Also in some studies, these factors were investigated together to explain the academic achievement of students. The development of epistemological beliefs is also associated with the academic performance of students (Cavallo et al., 2003; Cavallo et al., 2004) and their learning approach (Schommer, 1990; Tsai 1998a, Tsai 1998b). Motivational goal and self-efficacy are also important factors that influence academic achievement (Bandura, 1993; Author et al., 2009). Moreover, there are studies related to the relationship between student efficacy beliefs and goal orientation. The literature reveals contradictory findings about academic efficacy considering it to be positively related to mastery goal orientation (Anderman & Young, 1994; Middleton & Midgley, 1997; Wolters, Yu & Pintrich, 1996); and also that the relationship between academic efficacy and performance goal orientation is unclear (Middleton & Midgley, 1997). The orientation towards the learning goal is the most important motivational factor in predicting student course achievement According to Cavallo et al., (2003) the learning goal is positively related to meaningful learning and tentative view of science. The literature also reveals positive relationships between self-efficacy, meaningful learning, and learning goals (Cavallo et al., 2003; Cavallo et al., 2004). Kizilgunes, Tekkaya and Sungur (2009) investigated the relationship between achievement and epistemological beliefs, achievement motivation, and learning approach. They found that epistemological beliefs directly influence learning approaches and also have an indirect impact on the learning approach and achievement since epistemological beliefs have a direct effect on the achievement motivation. On the other hand, the findings of Schommer (1993) from an investigation into the direct relationship between beliefs about knowledge and the GPAs of high school students revealed that students supporting the idea that scientific knowledge is certain have a lower GPA than those who do not hold this belief. According to Hofer and Pintrich (1997), epistemological beliefs include learners' theories about knowing, the nature of knowledge, and knowledge acquisition (as cited in Kizilgunes et al., 2009). Moreover, Buehl (2003) proposed a model illustrating the association between student beliefs, achievement motivation and learning outcomes. This model hypothesizes that the epistemological beliefs of students have a direct influence on their motivation and the learning strategies they use and indirect effects on their achievement and academic performance. The literature also supports the idea that the more constructivist epistemological beliefs the students possess, the more dynamic the NOS knowledge they support (Tsai, 1998a).

Studies on the achievement, motivational goal, learning approach and self-efficacy

Cavallo et al., (2003) investigated the relationship between the learning approaches of high school students, their motivational goals and achievement in relation to two different science subject matter courses (biology and physics) at a college. The results indicated that the biology students used a rote learning approach more than physics major students. The learning goal proved to be the most important motivational factor in predicting the course achievement of biology students. While the learning goal is positively related to meaningful learning for all students in two different science courses, the performance goal is positively related to rote learning only for the biology students. Furthermore, the findings revealed a negative relationship between rote learning and course achievement for physics non-majors.

In another study, BouJaoude (1992) explored the relationship between high school students' learning approaches, attitudes toward chemistry, and their performance. He determined the differences between the responses of students with different learning approaches using the same instrument. In order to assess the students' approaches to learning BouJaoude administered the Learning Approach Questionnaire (developed by Novak, Kerr, Donn, & Cobern, 1989) to 49 suburban students, registered in two sections of the New York State Regents Chemistry Course which was instructed by the same teacher,. The results indicated that meaningful learners performed better than the rote learners on the misunderstanding test. Furthermore, having developed a coherent understanding, meaningful learners gave more correct answers than the rote learners both on the multiple choice questions and the explanation parts of questions. While meaningful learners were able to link the new information they had learned with their prior knowledge and organized the information in bigger groups, rote learners could not do this furthermore, they stored their information in smaller groups.

In the literature, the findings often reveal that learning orientation is related to a meaningful learning approach, and performance goal orientation is correlated with a rote learning approach. For instance, Kaplan and Midgley (1997) conducted a study with 229 seventh grade students in Southeastern Michigan. The results of that study showed a positive relationship between the performance goal orientation and surface approaches to learning. However, Wolters et al. (1996) found a positive relationship between seventh and eighth graders' performance goal orientations and deeper learning strategies. Kang, Scharmann, Noh and Koh (2005) explored the relationship between motivational variables, cognitive conflict and conceptual change of a total of 159 seventh grade students who were taught . scientific density concepts through computer assisted instruction. The students' learning approach, mastery goal orientation, self-efficacy and other variables were considered to be motivational variables. After the instruction, a conception test was also administered to the students. Interestingly, the regression analysis revealed a non-significant relationship between the conception test scores and motivational variables (meaningful learning approach, mastery goal orientations, and self-efficacy).

Anderman and Young (1994) investigated the motivation and learning strategies of the sixth and seventh grade students. Patterns of adaptive learning scale was administered to 678 students and 24 science teachers. Hierarchical Linear Modelling (HLM) analyses indicated a positive correlation between students' self-efficacy and mastery goal orientations (γ=.19, p<.001). A similar study conducted by Middleton and Midgley (1997) with 703 sixth grade students explored the relationship between students' goal orientations and related variables in the mathematics domain. The findings revealed that while mastery goal orientation was positively related to the academic efficacy (β=.43, p<.001), performance avoid goal orientation was negatively related to academic efficacy (β=-.13, p<.001). In contrast to that study, Skaalvik (1997) found a positive relationship between performance-approach goal orientation, self-efficacy and also academic achievement. Wolters et al. (1996) conducted a correlational study with 434 seventh and eighth grade students. Their findings revealed a positive relationship between the performance goal orientation and the deeper learning strategies of the seventh and eighth graders. Mastery goal orientation was positively related to the students' academic performance and self-efficacy. In contrast to the study conducted by Skaalvik (1997) no correlation was found between performance approach goal orientation and academic achievement.

Recently researchers in Turkey have given importance to these variables in their research for example a study by Hacieminoglu, Yilmaz-Tuzun & Ertepinar (2009).The researchers examined the relationships of 416 seventh grade students in terms of learning approaches, motivational goals, previous science grades, and their science achievement for concepts related to the atomic theory. They also explored the effects of gender and socio-demographic variables on students' learning approaches, motivational goals, and their science achievement for the concepts related to atomic theory. The sample consisted of. The results of the correlation analyses revealed positive relationships between meaningful learning, performance orientation, and self-efficacy. Students' previous science grades was found to be positively correlated with their achievement, meaningful learning, and self-efficacy but negatively correlated with the rote learning and performance orientations. The ANOVA results revealed that the educational level of the parents of the participants had a significant effect on their achievement and meaningful learning, rote learning, and approach performance orientations. In another study, Kizilgunes, Tekkaya & Sungur (2009) developed a model to show the relationship between achievement and epistemological belief, achievement motivation, and the learning approach. A total of 1,041 sixth grade students participated in the study. The results showed that epistemological beliefs directly influenced the learning approach and also influenced the learning approach and achievement indirectly since epistemological beliefs have a direct effect on the motivation for achievement. The findings also revealed that learning goal orientation, and beliefs about the certainty of the knowledge are positively related to learning approaches. Negative association was found among performance goal, self-efficacy, beliefs about the source of knowledge, and learning approach. While certainty beliefs are negatively related to the performance and learning goals, they are positively related to the learning approach. Although the learning goal and meaningful learning are positively related, performance goal and self-efficacy are negatively related to the learning approaches. Furthermore, learning approaches are positively correlated with achievement.

Studies on attitude

For the last thirty years students' attitude towards science has become an increasingly popular subject of research for science educators. Factors such as science achievement, gender difference, student-student and student-teacher interaction and the classroom learning environment all have an effect on the attitude toward science (Ali, Yager, Hacieminoglu & Caliskan, 2013). The results of these studies indicate that there is a relationship between attitude towards science and science achievement (Arisoy, 2007; Freedman 1997). Gender is one of the most significant factors influencing the attitude towards science. Most of the research related to the gender differences in attitude toward science has been conducted with middle and high school students. (Catsambis, 1995, Greenfield, 1996; Jones, Howe, & Rua, 2000; Oakes, 1990; Simpson & Oliver, 1985, 1990)

In the literature there are some contradictory findings related to the difference between genders in the attitude toward science. Some research indicates that middle school male students take a more positive attitude toward science than females (Catsambis, 1995; Jones, Howe, & Rua 2000; Piburn & Baker, 1993; Greenfield, 1996). On the other hand, other studies reported that there is no difference between boys and girls with respect to their attitude toward science (Catsambis, 1995; Dhindsa & Chung, 2003; Miller, Lietz & Kotte, 2002; Smist, Archambault, & Owen, 1994). Hacieminoglu, Yilmaz-Tuzun and Ertepinar (2011) investigated 2,961 sixth, seventh and eighth grade middle school students' attitude toward science and the effect of students' gender, grade level and the educational level of their parents on their attitude toward science. . The results showed that the grade level significantly affected middle school students' attitude towards science regarding the adaptation of scientific attitudes, enjoyment of science lessons, leisure, and career interest in science. Gender and the education level of the students' parents had an influence only on the dimension of the adaptation of scientific attitudes. Catsambis (1995) conducted a study with 24,500 eight grade students to determine the differences between genders in terms of the attitude toward science. The results revealed that male students had more positive attitudes toward science than females, and the latter were less inclined to participate in extracurricular activities. Simpson and Oliver (1985), and Hykle (1993) suggested that males had a more positive attitude toward science than females. Also males chose science as an elective course and they were more motivated to achieve in science than females. On the other hand, Archer and McDonald (1991) indicated that females avoided participating in extra science courses and were less confident regarding their academic skills. Researchers also supported the idea that students' attitude towards science were dependent on the type of science they were interested in; such as physical science or life science. For instance, the findings of another study supports the idea that boys show a more positive attitude toward physical sciences while girls have a more positive attitude toward biological sciences (Schibeci & Riley, 1986; Weinburgh, 1995). In a similar study, by Jones, Howe and Ria (2000) revealed that while boys were interested in learning about planes, cars, light, electricity and new sources of energy, girls were more interested in learning about rainbows, healthy eating and animal communication. Schibeci and Riley (1986) indicated that attitudes influence achievement, rather than achievement influencing attitudes. Students with positive attitudes toward science tend to have higher scores on achievement measures (Weinburgh, 1995). In the literature there are a large number of studies related to the factors predicting students' achievements; such as socio-demographic variables learning approaches, goal orientations, and self-efficacy. Studies revealed an important issue in that an increasing percentage of students are not interested in science. Many students, especially females, have negative feelings and attitudes toward science, which discourages them from continuing with scientific inquiry. Furthermore, there are limited studies related to the factors predicting students' attitude toward science.

The research questions underpinning this study are;

(1) What are the relationships among the seventh grade elementary students' attitudes toward science, learning approaches, motivational goal, science achievement and students' NOS views?

(2) How much variance in seventh grade elementary students' attitude toward science can be explained by learning approaches, motivational goal, science achievement and students' NOS views?

(3) What are the effects of gender and socio-demographic variables on the students' attitude?

METHOD

Sample

The surveys of this study were administered online to 3598 seventh grade students in different regions and cities of Turkey. The convenience sampling method was used in this study and Table 1 shows the distribution of the students according to demographic variables.

Table 1. Demographic and sociodemographic characteristics of participants

Demographic Characteristics		Number	% Percent
Region	Marmara	558	15.5
	Black Sea	539	14.7
	Central Anatolia	1045	29.0
	Aegean	744	20.6
	Mediterranean	455	12.6
	Eastern Anatolia	115	3.2
	Southeastern Anatolia	28	0.7
	Not recorded	114	3.7
Gender	Female	1760	48.9
	Male	1567	43.6
	Not reported	271	7.6
Income	Low	893	24.8
	Medium	1765	49.1
	High	918	25.5
	Not reported	22	.6
Mother Education Level	Uneducated	84	2.3
	Elementary school	891	24.8
	Secondary school	534	14.8
	High school	1133	31.5
	Undergraduate	735	20.4
	Graduate	198	5.5
	Not reported	23	.6
Father Education Level	Uneducated	21	.6
	Elementary school	387	10.8
	Secondary school	409	11.4
	High school	998	27.7
	Undergraduate	1209	33.6
	Graduate	554	15.4
	Not reported	20	.6

Instruments

The Test of Science Related Attitude (TOSRA) developed by Fraser (1978) was used to measure the students' attitudes toward science. TOSRA consists of 5-point Likert-type (Strongly agree to strongly disagree and these were coded as 5, 4, 3, 2 and 1) 70 items with seven subscales namely; the social implication of science, the normality of scientists, attitudes toward inquiry, adaptation of scientific attitudes, enjoyment of science lessons, leisure interest in science, and career interest in science. From these subscales 40 items and four dimensions (adaptation of scientific attitudes, enjoyment of science lessons, leisure interest in science, and career interest in science) were selected for this study. The reliability of this instrument was reported as .78 by Fraser (1978). TOSRA was translated and adapted into Turkish by Arisoy (2007) using a sample of 8th grade students and for this study the alpha coefficients of these sub-dimensions were found to be .65, .75, .78 and .72 respectively. A sample item for the adaptation of scientific attitudes dimension reads: "I am curious about the world in which we live.", for the enjoyment of science lessons dimension: "I dislike science lessons" for the leisure interest in science: "I would like to belong to a science club" and for the career interest in science: "I would dislike being a scientist after I leave school".

The Learning Approach Questionnaire (LAQ) used in the work of BouJoude (1992), and Cavallo and Schafer (1994) was used in order to assess the students' learning approach. The questionnaire contains 22 items (11 items measuring the rote learning and 11 items measuring meaningful learning) and uses a 4-point Likert scale (Always to Never and these were coded as 4, 3, 2 and 1) . An English version of the questionnaire was originally translated into Turkish by Calıskan (2004) for use with high school students. For this study the Cronbach's alpha reliability of the test was calculated to be .71 for the rote learning scale and .77 for the meaningful learning scale. A sample item for the rote learning dimension reads: "I tend to remember things best if I concentrate on the order in which they are presented by the instructor", and for the meaningful learning dimension it reads: "As I read it I try to relate the new material to what I already know about the topic."

The Achievement Motivation Questionnaire (AMQ) previously applied by Cavallo, Rozman, and Potter (2004) was used to measure the students' motivational goals. The questionnaire contains 14 items and uses a 4-point Likert scale (Strongly agree to strongly disagree and these were coded as 4, 3, 2 and 1). The achievement motivation questionnaire consists of three scales that measure the learning-goal orientation, performance goal orientation, and self-efficacy of the students taking the science course. The English version of the learning approach questionnaire was translated into Turkish by Calıskan (2004) for use with high school students. For this study, the Cronbach's alpha reliability of the test was calculated to be .83 for learning goals scale, .73 for performance goals scale, and .75 for self-efficacy scale. A sample item for the learning-goal orientation dimension reads: "One of my primary goals in this class is to try to improve my knowledge", for the performance goal orientation dimension: "One of my primary goals in this class is to do better than other students" and for the self-efficacy dimension: "I am confident I can do well on the science problems we are given in this class".

The Nature of Science Instrument (NOSI) was developed by Hacieminoglu, Yilmaz-Tuzun and Ertepinar (2012) to assess students' NOS views. The instrument has 13 items and four dimensions; the tentative nature of scientific knowledge (tentative NOS), the distinction between observation and inferences (observation and inferences), the empirical nature of scientific knowledge (empirical NOS), and the role of imagination and creativity in generating scientific knowledge (imagination and creativity). NOSI was constructed in Turkish and the Cronbach's alpha reliability was calculated to be .76. For each dimension, the Cronbach's alpha values were .74, .76, .80, and .63, respectively. All dimensions of this scale were treated as dependent variables of the study. The following examples are presented for the four dimensions;

for the tentative NOS dimension: "Scientific knowledge does not change, because if scientists were not sure about it they would not put that information in the books for students"; for the imagination and creativity dimension: "Scientific knowledge can be influenced by the imagination and creativity of scientists", for observation and inferences dimension: "Scientists are certain about the structure of atoms because they are able to see atoms using microscopes", and for the empirical NOS dimension: "The modern atomic theory that is accepted today might change in the future if scientists find new evidence."

Science Achievement Test (SAT) was developed by the researcher. SAT questions were determined based on the objectives of the course book unit "Structure of the Matter". A table of specification was designed to provide for a better visualization of the unit objectives and test questions. In terms of validity and reliability issues; content validity, construct validity, and the alpha coefficient, one of the internal-consistency methods to measure reliability, were examined. For content validity, two chemistry experts and one science education researcher checked the instrument. For construct validity, a pilot study was carried out with 102 seventh grade students. The final version of SAT contained 15 multiple choice questions with four choices. The Cronbach alpha determining the internal consistency for this instrument was found to be .70.

Data collection and analysis

The data collection was carried out during the 2011-2012 Fall and Spring semester. The researcher used her personal connections and electronic media; such as e-mail to send the survey link to the students. The survey was only completed by the volunteer students. The method of distribution allowed the students to save the survey and continue working on it in their own time. There was no time limitation to finish the survey we would be able to obtain accurate information from each student.

Correlation analysis was used to explore the relationship between the students' attitudes toward science, their learning approaches, science achievement and students' NOS views. The correlation coefficients were computed along these variables.

A standard multiple regression analysis was conducted to evaluate how well the students' attitude toward science can be predicted from the measurement of their learning approaches, motivational goals, science achievement and students' NOS views. Firstly assumptions were checked and found to be tenable for use with this model. The residuals were normally distributed along the predicted dependent variable scores. And the independent variables were seen to show a relationship with dependent variable and the correlation coefficient had to be above .3 (Pallant, 2001). For this study, all the variables and attitudes showed a positive relationship between the students' attitude towards science and the correlation coefficient values were found to be higher than .3 except for the student science achievement ($r= .25$); therefore, the student science achievement variable was removed from the independent variables. Tabachnick and Fidell (1996) suggest that the bivariate correlations among predictors should be less than .7 and in our study the correlation coefficient values between students' science achievement and the predictors (students' learning approaches, motivational goal, and students' NOS view) were no higher than .7. In addition, the tolerance and VIF values for the model were at a respectable level (ranging from .63 to .69) suggesting that there was no multicollinearity problem and therefore, the multiple regression analysis could be carried out, and the interpretation of these results is appropriate.

An analysis of variance (ANOVA) was conducted to explore the effects of gender and the socio-demographic variables (income, and the educational level of the parents, the latter being categorized into graduate, undergraduate and other) on students' attitude toward science.

RESULTS

Correlational analysis

Cohen (1988) suggests the following correlation values to determine the strength of the relationship; r=.10 to .29, small; r=.30 to .49, medium; r=.50 to 1.0, high. The Pearson correlation results showed that the students' attitude toward science had a strong positive correlation with performance goal orientation (r=.58), learning goal orientation (r=.59), self-efficacy (r=.60), meaningful learning (r=.58), and rote learning (r=.42). However, there was a medium level of correlation between the students' attitude toward science and science achievement (r= .25) and students' NOS views (r= .32). The students' NOS views were significantly positive in terms of their correlation with performance goal orientation (r=.25), learning goal orientation (r=.28), self-efficacy (r=.28), meaningful learning (r=.08), rote learning (r=.04), and science achievement (r=.16); however, the strength of the relationship was found to be weak. The results also indicated that both types of learning approaches (meaningful learning and rote learning) had a strong positive correlation with performance goal orientation (r=.54, r=.57), learning goal orientation (r=.56, r=.56), and self-efficacy (r=.54, r=.54). In terms of the students' science achievement this variable was positively correlated with learning goal orientation (r=.24), meaningful learning (r=.21), and self-efficacy (r=.26). On the other hand students' science achievement was negatively correlated with performance goal orientation (r=-.26), and rote learning (r=-.25). The results of the correlation analysis are shown in Table 2.

Table 2. Intercorrelations among attitudes towards science, learning approaches, science achievement and students' nature of science views

	Achiv	PO	LO	SE	ML	RL	NOS	Atti
Achiv	___							
PO	-.206*	___						
LO	.344*	.918*	___					
SE	.268*	.916*	.936*	___				
ML	.314*	.545*	.568*	.549*	___			
RL	-.251*	.547*	.566*	.545*	.900*	___		
NOS	.168*	.250*	.287*	.289*	.083*	.040*	___	
Atti	.395*	.582*	.597*	.609*	.583*	.421*	.326*	___

**Correlation is significant at the 0.01 level (2-tailed)*

** Science Achievement Test Scores, (Achiv), Learning Approaches (RL: Rote Learning, ML: Meaningful Learning), Motivational Goals (LO: Learning Orientation, PO: Performance Goal Orientation, SE: Self-efficacy), Nature of Science views (NOS), Students Attitude Toward Science (Atti).*

Multiple regression analysis

The results of the multiple regression analysis indicated that meaningful learning, students' self-efficacy, students' NOS views and rote learning significantly contributed to the students' attitude toward science, (Adjusted R^2 =.515, F (4, 3593) = 955.267, p=.000 p< .000). This finding indicated that approximately 51.5 percent of variance of the attitude scores can be accounted for by the linear combination of meaningful learning, students' self-efficacy, students' NOS view and rote learning. The model explains 51.5% of the variance in the attitude toward science, which is moderately high for educational studies. Both R^2 and adjusted R^2 are 51.5.The equal R^2 and adjusted R^2 values offer evidence for cross-validation. Furthermore, this model with three predictors reaches statistical significance. The combined variables of meaningful learning, self-efficacy and students' NOS views explains the significant portion of the variance in the students' attitude toward science.

The multiple regression equation can be expressed as:

$Y_{atti.} = 1.142 + .427X_{ML} + .462\,X_{SE} + .365\,X_{NOS} - .114\,X_{RL}$

$Y_{atti.} = .338X_{ML} + .411\,X_{SE} + .124\,X_{NOS} - .090\,X_{RL}$

The significance values of 0.000 for meaningful learning, self-efficacy, and students' NOS views show that these variables are included in the model because of their significance. While meaningful learning and self-efficacy made the largest unique contribution to the model (β= .338, β= .411), rote learning made the smallest unique negative contribution to the model (β= -.090). Students' NOS views had also significant contribution to the students' attitude toward science (β= .124). The results of the multiple regression analysis are given in Table 3.

Table 3. Multiple regression results

	β Weight	Adjusted R^2	F	p
Attitude toward science				
Meaningful learning	.338	0.515	955.267	0.000
Self Efficacy	.411			
Nature of Science	.124			
Rote Learning	-.090			

Analysis of variance results

The ANOVA results (Table 4) revealed that gender had a significant effect on the students' attitude toward science. $F(1, 3569) = 63{,}63$, $p = .00$, in favor of boys (M = 3.04, SD = 0.43; M = 2.94, SD = 0.95).

Table 3. One-way ANOVA results for effect of gender and socio-demographic variables on students' attitude

	df	F	p
Attitude			
Gender	1	63.63	.000*
Income	2	4.09	.017*
Mother Education Level	3	3.59	.013*
Father Education Level	3	4.58	.003*

In terms of the Sociodemographic Variables (SDV), family income and the educational level of the students' parents had a significant effect on the students' attitude towards science, $F(2, 3573) = 4.09$, $p = .017$; $F(3, 3571) = 3.59$, $p = .013$; $F(3, 3574) = 4.58$, $p = .003$, respectively. Family income was a categorical variable consisting of low income family, medium income family, and high income family. Pairwise comparisons using the Bonferroni test indicated that the mean scores of the students from a low income family (M = 2.60, SD =1.06) were significantly different from those students from a medium income family (M = 2.93, SD = .89), p =.007 and from a high income family (M = 2.93 SD = .89), p =.020

The educational level of the students' mothers and fathers was categorized into four levels; primary or less, secondary and tertiary , undergraduate, graduate. In terms of the effect of the mother's education on the students' attitude towards science, students with mothers having primary education or less (M = 2.61 SD = 1.32), had significantly lower scores in terms of their attitude toward science than the students whose mothers had received secondary and tertiary education (M = 2.95 SD =.82), those with undergraduate degrees (M = 3.00 SD = .82). Similarly, students whose fathers had primary education or less (M = 2.38 SD = 1.54), had significantly lower scores in terms of the attitude toward science than students whose mothers had received secondary and tertiary education (M = 2.81 SD =1.05), undergraduate (M = 3.01 SD = .74)and graduate degrees (M = 2.92 SD = .95).

DISCUSSION AND CONCLUSION

The correlation analysis revealed that the students' attitude toward science showed a positive correlation with the performance goal orientation, learning goal orientation, self-efficacy, meaningful learning, and rote learning, science achievement and students' NOS views. All these relationships are above the medium level with some having an even higher level. Moreover, our study revealed that while the students' achievement is negatively related to a rote learning approach, and performance goal orientation, it is positively related to learning goal orientation, self-efficacy and meaningful learning. In the literature the idea promoted in the literature that attitudes influence achievement, rather than achievement influencing attitudes was supported; therefore, students with positive attitudes towards science tend to have higher scores on the achievement measures (Weinburgh, 1995). This result showed that students having a more positive attitude towards science preferred to undertake meaningful learning rather than rote learning, resulting in the achievement of higher scores. Students having higher achievement scores are aware of their ability to better learn new scientific topics and this awareness increases their self-efficacy. While some of our findings in this study are supported by other studies in the literature, there are others that are in contrast. For example, to our study, Cavallo et al., (2004) found that there was a positive correlation between students' meaningful learning, self-efficacies, and their achievement. In addition, achieving high grades motivated the performance oriented students to work harder on their courses but they had lower achievement levels in the courses. This finding is consistent with those of Cavallo, et al. (2003) and Hacieminoglu et al. (2009) who found that rote learning and performance orientation negatively affected the course achievement. These correlational analyses suggest that in order to obtain a high achievement from science courses students need to undertake meaningful learning rather than rote learning. Furthermore, parallel to the students' rise in achievement their self-efficacy will also increase. Hacieminoglu et al. (2009) explored the positive relationships between meaningful learning, performance orientation, and self-efficacy. Students' previous science grades were found to be positively correlated with achievement, meaningful learning, and self-efficacy and negatively correlated with rote learning and performance orientations.

The findings in the studies in the literature support the negative correlation between self-efficacy, rote learning and approach performance orientation, and the positive correlation between rote learning and performance orientation. Rote learning and studying for higher grades do not support the science learning process in the long term due to the memorization of concepts (BouJaoude, 1992; Cavallo et al., 2003; Cavallo et al., 2004; Hacieminoglu et al., 2009; Novak, Ring & Tamir, 1971). Interestingly, our study revealed a positive and high relationship between the both types of learning approaches (meaningful and rote) and motivational goals (performance goal orientation, learning goal orientation and self-efficacy). These results might be related to the high school entrance examination in Turkey where higher scores in the national exam that the students take at the end of the each grade level of elementary school qualifies them to enroll in one of the prestigious high schools. Therefore, students who engage in meaningful learning students may also be concerned about getting high grades. In other words, these students might possess both learning goal orientation and performance goal orientation. Meaningful learners trying to get high marks in order to gain entry to a good high school may use rote learning from time to time. For that reason both meaningful learners and rote learners have a higher self-efficacy. In our study the students' self-efficacy is positively related to both learning goal orientation and performance goal orientation while in the literature academic efficacy is positively related to mastery of goal orientation (Anderman & Young, 1994; Middleton & Midgley, 1997; Wolters, Yu & Pintrich, 1996); however, the relationship between academic efficacy and performance goal orientation is still unclear (Middleton & Midgley, 1997).

Multiple regression analysis revealed that the students' meaningful learning, self-efficacy and NOS views positively contributed to their science achievement. However, rote learning negatively contributed to the model. Student self-efficacy was positively related to all the NOS views. Students having higher levels of self-efficacy reported a more complete understanding of NOS views. Kizilgunes et al. (2009) revealed similar and supportive relationships regarding the results obtained from this study. Attaining meaningful learning may increase self-efficacy towards learning science with a more complete understanding of NOS leading to a more positive attitude toward science. Neither rote learning nor studying for higher grades is helpful in retaining the positive attitudes toward science in the long term.

In our study in terms of gender difference the ANOVA results revealed that the male students' attitude toward science was higher than the female students. Our findings are similar to those obtained in the studies by Catsambis (1995), Jones, Howe, and Rua (2000), Piburn and Baker (1993) and Greenfield (1996). On the other hand, our findings contradict the findings of Dhindsa and Chung (2003), Miller, Lietz and Kotte (2002), and Smist, Archambault and Owen (1994) since these studies suggested that there was no difference between boys and girls with respect to their attitude toward science. Another factor influencing the students' attitude toward science was their parents' income. The ANOVA results showed that, the level of income had influence on the students' attitude towards science. Students from families with a high income had higher attitude scores than those from medium income families. This could be that students from high income families are presented with many opportunities for improving their attitude towards science; such as visiting museums, undertaking scientific activities, having access to different books and materials in a comfortable home environment. Interestingly, students from families with low income had higher attitude scores than those from medium income families. This result might be related to the extracurricular activities since free courses are provided by the school for the students from low income families to encourage the students to acquire a more positive attitude toward science.

In terms of the effect of the education level of the students' parents, our findings did not support the idea that when the education level of fathers increased, the students' attitude toward science became more positive. In fact, the results revealed that the students, whose mothers only had received primary education or less had significantly lower scores in their attitude toward science than other students. There were no significant difference in the attitude scores of students whose mothers had received secondary and tertiary education, undergraduate and graduate level of education. Regardless of the levels of the parents' education the action of fathers and mothers to encourage and motivate their children to enter higher education has a positive impact on their attitude to science. In Turkey there are facilities both inside and outside school such as communities and science clubs which offer students different experiences which can influence their attitude towards science.

This study provides an overview of students' attitude towards science and the predictive variables related to their attitude. Our findings indicate that generally the students had not respectable level of positive attitude toward science. The teachers' different application of science and technology curriculum and varying classroom environment might lead to negative feelings about science. The study of Author et al. (2013) supported the idea that traditional teaching and over dependence on textbooks could be responsible for the increasing negative student attitudes about science. Teachers should be aware of students' individual differences to improve students' attitude toward science. The school counseling service should offer guidance to the parents of the children about the ways in which they can encourage their children to develop a more positive attitude to science. Furthermore, the different variables influencing the students' attitude should be taken into consideration in a wider perspective.

REFERENCES

Aldoplhe, F. S. G., Fraser, B. J., & Aldigre, J. M. (2003). *A cross national study of learning environment and attitudes amoung junior secondary science students in Australia and Indonesia.* Paper presented at the Third International Science, Mathematics and Technology Education Conference, East London, South Africa.

Aldridge, J. M., & Fraser, B. J. (2000). A cross-cultural study of classroom learning environments in Australia and Taiwan. *Learning Environments Research, 3,* 101–134.

Ali, M. M., Yager, R. E., Hacieminoglu, E., & Caliskan, İ. (2013). Changes in student attitudes regarding science when taught by teachers without experiences with a model professional development program. *School Science and Mathematics, 113*(3), 109-119.

Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Student's learning strategies and motivation processes. *Journal of Educational Psychology, 80*, 260-270.

Anderman, E. R., & Young A. J. (1994). Motivation and strategy use in science: Individual differences and classroom effects. *Journal of Research in Science Teaching, 31*, 811-831.

Archer, J., & McDonald, M. (1991). Gender roles and school subjects in adolescent girls. *Educational Research, 33,* 55-64.

Arısoy, N. (2007). Examining 8th grade students' perception of learning environment of science classrooms inrelation to motivational beliefs and attitudes. Unpublished Theses in Middle East Technical University, Ankara, Turkey.

Ausubel, D.P. (1963). *The psychology of meaningful verbal learning.* New York: Grune & Stratton.

Azizoğlu, N., & Çetin, G. (2009). The effect of learning style on middle schools students' motivation and attitudes towards science, and the relationships among these variables. *Kastamonu Education Journal, 17*(1), 171-182.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28,* 117-148.

BouJaoude, S. B. (1992). The relationship between high school students' learning strategies and the change in their misunderstandings during a high school chemistry course. *Journal of Research in Science Teaching, 29*(7), 687-699.

Buehl, M. M. (2003). *At the crossroads: Exploring the intersection of epistemological beliefs, motivation, and culture.* Paper presented at the Annual Meeting of the American Educational Research Association, April, Chicago, IL.

Caliskan, İ. S. (2004). *The effect of inquiry-based chemistry course on students' understanding of atom concept, learning approaches, motivation, self-efficacy, and epistemological beliefs.* Unpuplished master thesis, The Middle East Technical University, Ankara.

Catsambis, S. (1995). Gender, race, ethnicity, and science education in the middle grades. *Journal of Research in Science Teaching*, 32(3), 243-257.

Cavallo, A. M. L., & Schafer, L. E. (1994). Relationships between student's meaningful learning orientation and their understanding of genetic topics. *Journal of Research in Science Teaching, 31*(4), 393-418.

Cavallo, A. M. L. (1996).Meaningful learning reasoning ability and student's understanding and problem of genetics topics. *Journal of Research in Science Teaching*, *38*, 625-656.

Cavallo, A. M. L., Rozman, M., Larabee, T., Ishikawa, C. (2001). *Shifts in male and female students' learning, motivation, beliefs, and scientific understanding in inquiry-based college physics course.* Paper presented at the annual conference of the National Association for Research in Science Teaching, St. Louis, MO.

Cavallo, A. M. L., Rozman, M., Blickenstaff, J., & Walker , N. (2003). Learning, reasoning, motivation, and epistemological beliefs. *Journal of College Science Teaching, 33,* 18-23.

Cavallo, A. M. L., Rozman, M., & Potter, W. H. (2004). Gender differences in learning constructs, shifts in learning constructs, and their relationship to course achievement in a structured inquiry, yearlong collage physic course for life science majors. *School Science and Mathematics, 104*(6), 288-301.

Cohen, J. W. (1988). *Statistical power analysis for the behavioral sciences (2nd edition)*. Hilsdale, NJ: Lawrence Erlbaum Associates.

DeBacker, T. K., & Nelson, R. M. (2000). Motivation to learn science: Differences related to gender, class type, and ability level. *Journal of Educational Research, 93*(4), 245-254.

den Brok, P., Fisher, D., & Rickards, T. (2004). *Predicting Australian Students' Perceptions Of Their Teacher Interpersonal Behavior.* Paper presented at the annual meeting of the American Educational Research Association, San Diego.

Dhindsa, H. S. & Chung, G. (2003). Attitudes and achievement of Bruneian science students. *Internalational Journal of Science Education, 25*, 907-922.

Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist, 41,* 1040-1048.

Edmondson, K.M. (1989). *The influence of students' conceptions of scientific knowledge and their orientations to learning on their choices of learning strategy in a college introductory level biology course*. Unpublished doctoral dissertation, Cornell University, Ithaca, NY.

Edmondson, K.M., & Novak, D.N. (1993). The interplay of scientific epistemological views, learning strategies, and attitudes of college students. *Journal of Research in Science Teaching*, *30*, 547-559.

Fraser, J. B. (1978). Development of a test of science-related attitudes, *Science Education, 62*(4), 509-515.

Freedman, M. P. (1997). Relationship among laboratory instruction, attitude toward science, and achievement in science knowledge. *Journal of Research in Science Teaching*, 34, 343-357.

Garcia, T., & Pintrich, P. R. (1992). *Critical thinking and its relationship to motivation, learning strategies, and classroom experiences.* Paper presented at the annual meeting of the American Psychological Association, Washington, DC.

Greenfield, T. A. (1996). Gender, etnicity, science achievement and attitudes. *Journal of Research in Science Teaching, 33,* 901-933.

Hacieminoglu, E., Yilmaz-Tuzun, O., & Ertepinar, H. (2009). Investigating elementary students' learning approach, motivational goals and achievement in science. *Hacettepe University Journal of Education, 37*, 72-83.

Hacieminoglu, E., Yilmaz-Tuzun, O., & Ertepinar, H. (2011). Middle school students' attitude toward science in constructivist curriculum environment. *International Journal on New Trends in Education and Their Implications, 2*(3), 1-6*.*

Hacieminoglu, E., Yilmaz-Tuzun, O. & Ertepinar, E. (2012). Development and validation of nature of science instrument for elementary students. *Education 3-13: International Journal of Primary, Elementary and Early Years Education,* (online published). doi:10.1080/03004279.2012.671840.

Hykle, J. A. (1993, April). *Template for gender-equitable science program.* Paper presented at the annual meeting of the National Association for Research in Science Teaching. Atlanta, GA.

Jones, G.M., Howe, A., & Rua, M. J. (2000). Gender differences in students' experiences, interests and attitude toward science and scientists. *Science Education, 84,* 180-192.

Kahle, J.B.; & Damnjanovic, A. (1997). How research help address gender equity. Research Matters- to the Science Teacher, 9703, 1-3. Available on line at http://www.narst.org/publications/research/gender2.cfm.

Kang, S., Scharmann, L. C., Noh, T., & Koh, H. (2005). The influence of students' cognitive and motivational variables in respect of cognitive conflict and conceptual change. *International Journal of Science Education, 27,* 1037–1058.

Kaplan, A., & Midgley, C. (1997). The effect of achievement goals: Does level of perceived academic competence make a difference? *Contemporary Educational Psychology, 22,* 415-435.

Kizilgunes, B., Tekkaya, C., & Sungur, S. (2009). Modeling the relations among students' epistemological beliefs, motivation, learning approach, and achievement. *The Journal of Educational Research, 102*(4), 243-255.

Klopfer, L. E. (1976). Astructure for the affective domain in the relation to science education. *Science Education, 60*, 299-312.

Koran, M. L., & Koran, J. J. (1984). Aptitude- treatment interaction research in science education. *Journal of Research in Science Teaching 21*(8), 793-808.

Lawrenz, F. P. (1976). Student perception of the classroom learning environment in biology, chemistry and physics courses. *Journal of Research in Science Teaching, 13,* 351– 353.

Lin, Y. G., & McKeachie, W. J. (1999). *College student intrinsic and/or extrinsic motivation and learning.* (ERIC Document Reproduction Service No. ED435954).

Middleton, M., & Midgley, C. (1997). Avoiding the demonstration of lack of ability: An underexplored aspect of goal orientation. *Journal Educational Psychology*, *89*, 70-718.

Miller, L., Lietz, P., & Kotte, D. (2002). On decreasing gender differences and attitudinal changes. Factors influencing Australian and English pupils' choice of a career in science. *Psyhology, Evolution, and Gender, 4,* 69- 92.

Murphy, P. K., & Alexander, P. (2000). A motivated exploration of motivation terminology. *Contemporary Educational Psychology, 25,* 3-53.

Newhouse, N. (1990). Implication of attitudes and behavior research for environmental conservation. *The Journal of Environmental Education, 22(1),* 26-32.

Novak, J. D., Ring, D. G., & Tamir, P. (1971). Interpretations of research findings in terms of Ausubel's theory and implications for science Education. *Science Education, 55*(4), 483-526.

Novak, J. (1988). Learning science and the science of learning. *Studies in science education, 15,* 77-101.

Novak, J., Kerr, P., Donn, S., & Cobern, W. (1989).*Epistemological issues in science education.* Symposium presented at the Annual Conferance of the National Association for Research in Science Teaching, San Francisco, CA.

Oakes, J. (1990). Opportunities, achievement and choice: Woman and minority students in science and mathematics. *Review of Research in Education, 16,* 153-222.

Oh. P. S., & Yager, R. E. (2004). Development of Constructivist Science Classrooms and Changes in Student Attitudes toward Science Learning. *Science Education International, 15*(2), 105-113.

Osborne, J. (2003). Attitudes towards science: a review of the literature and its implications, *International Journal of Science Education*, 25(9), 1049-1079.

Pallant, J. (2001). *The SPSS survival manual: A step-by-step guide to data analysis using SPSS for Windows.* St Leonards, NSW: Allen & Unwin

Piburn, M. D., & Baker, D.R. (1993). If I were the teacher…qualitative study of attitude toward science. *Science Education 77,* 393-406.

Pintrinch, P., & Schunk, D. (2002). *Motivation in education.* Merrill Prentice Hall.

Puacharearn, P. & Fisher, D. (2004). *The effectiveness of cooperative learning integrated with constructivist teaching on improving learning environments in Thai secondary schoolscience classrooms.* Curtin University of Technology, Australia.

Qian, G. (1995). *The role of epistemological beliefs and motivational goals in ethnically diverse high school students' learning from science text.* Paper presented at the annual meeting of the national reading conference, New Orleans, LA.

Rakıcı, N. (2004). *Eight grade students' perceptions of their science learning environment and teachers' interpersonal behavior.* Unpublished thesis submitted to the graduate school of Natural and Applied Sciences of the Middle East Technical University.

Riah, H. & Fraser, B. J. (1997). *Chemistry learning environment in Brunei Darusssalam's secondary schools.* In D.L. Fisher & T. Rickards (Eds.), Science, Mathematics and Technology Education and National Development: Proceedings of the Vietnam conference (pp. 108-120). Hanoi; Vietnam.

Schibeci, R. A., & Riley, J. P. (1986). Influence of students' background and perceptions on science attitudes and achievement*. Journal of Research in Science Teaching, 23(3),* 177-187.

Schommer, M. (1990). Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology, 82,* 498-504.

Schommer, M. (1993). Epistemological development and academic performance among secondary students. *Journal of Educational Psychology, 85,* 406-411.

Simpson, R. D., & Oliver, J. S. (1985). Attitude toward science and achievement motivation profiles of male and female science students in grades 6 through 10. *Science Education, 69(4),* 511-526.

Simpson, R. D., & Oliver J. S. (1990). A summary of major influences on attitude and achievemevt in science among adolescent students. *Science Education, 74,* 1-18.

Skaalvik, E. M. (1997). Self-enhancing and self-defeating ego orientation: Relations with task and avoidance orientation, achievement, selfperceptions, and anxiety. *Journal of Educational Psychology, 89*, 71–81.

Smist, J. M., Archambault, F. X., & Owens, S. V. (1994). *Gender difference in attitude toward science.* Paper presented at the annual meeting of the American Educational Research Association (New Orleans, LA, USA).

Sternberg, R. J. (1997). *Thinking styles.* New York: Cambridge University Press.

Tabachnick, B. G. & Field, L. S. (1996). *Using multivariate statistics* (3rd Ed.). New York: Harpercollins College Publishers.

Telli, S. Cakiroglu, J., & den Brok, P. (2006). *Turkish secondary education students' perceptions of their classroom learning environment and their attitude towards Biology.* In D. L. Fisher & M. S. Khine(Eds.), Contemporary approaches to research on learning environments: world views (pp.517-542).

Tsai, C. C. (1998a). An analysis of Taiwanese eighth graders' science achievement, scientific epistemological beliefs and cognitive structure outcomes after learning basic atomic theory. *International Journal of Science Education, 20,* 413–425.

Tsai, C. C. (1998b). An analysis of scientific epistemological beliefs and learning orientations of Taiwanese eighth graders. *Science Education, 82,* 473–489.

Wahyudi, W. & David F. T. (2004). The status of science classroom learning environments in Indonesian lower secondary schools. *Learning Environment Research, 7,* 43-63.

Weinburgh, M. (1995). Gender differences in student attitudes toward science: a meta-analysis 18. of the literature from 1970 to 1991, *Journal of Research in Science Teaching*, 32, 387-398.

Wolfolk, A. (2004). *Educational Psychology.* Boston, MA, Allyn & Bacon.

Wolters, C. A., Yu, S. L., & Pintrich, P. R. (1996). The relation between goal orientation and students' motivational beliefs and self-regulated learning. *Learning and Individual Differences, 8,* 211-238.

Zhang, L. (2000). University students' learning approaches in three cultures: An investigation of Biggs's 3P model. *The Journal of Psychology, 134*(1), 37-55.