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Cross-Grade Comparison of Relationship between Students' Engagement and TIMSS 2011 Science Achievement

Öğrenci Katılımı ve TIMSS 2011 Fen Başarısı Arasındaki İlişkinin Sınıflara Göre Karşılaştırılması

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Abstract

The present study aims to investigate the relationship between students' engagement and achievement, and how this relationship changes across the 4th and 8th grade students in Turkey. TIMSS 2011 data were used for the purpose of the study. 7479 fourth grade elementary and 6928 eighth grade middle school students from Turkey participated in the study. According to the results, the 4th grade students display significantly higher engagement than the 8th graders do. Moreover, both student groups' behavioral engagement has positive effect on science achievement. In terms of emotional engagement trajectories, while the 4th graders' liking science has positive influence on students' science achievement, school belonging has no significant influence. On the other side, the two dimensions of emotional engagement have positive influence on achievement of the 8th graders.

Keywords: student engagement, science achievement, TIMSS 2011.

Öz

Bu çalışma ilkokul 4. Sınıf ve ortaokul 8. Sınıf öğrencilerinin fen bilgisi dersindeki katılım ve başarı ilişkisini ve bu ilişkinin 4. Sınıf ve 8. Sınıfta nasıl farklılık gösterdiğini incelemeyi hedeflemektedir. Bu çalışmanın örneklemini TIMSS 2011 Türkiye verileri oluşturmaktadır. Türkiye'den 7479 4. Sınıf ve 6928 8. Sınıf öğrencileri 2011 yılında TIMSS sınavına katılmıştır. Çalışmanın sonuçlarına göre 4. Sınıf öğrencilerinin 8. Sınıf öğrencilerinden daha yüksek katılım göstermektedir. Ayrıca, her iki grup için davranışsal katılımın başarı üzerinde pozitif etkisi görülmüştür. Duyuşsal katılım açısından incelendiğinde, 4. Sınıflar için feni sevme akademik başarıya pozitif etki ederken, okul bağlılığının anlamlı bir etkisi olmamaktadır. 8. Sınıflarda ise her iki boyutun da pozitif etkisi gözlenmiştir.

Anahtar Sözcükler: Öğrenci katılımı, fen başarısı, TIMSS 2011.

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Introduction

"Trends in International Mathematics and Science Study (TIMSS)" has assessed the 4th and 8th grade students' mathematics and science achievement from an international perspective since 1995. TIMSS sponsored by International Association for the Evaluation of the Education Achievement and has been conducted every four years. Nationally representative samples of 4th and 8th grade students from nearly 60 countries participate in the TIMSS.

TIMSS (2011) was the fifth administration of the study. In 2011, 57 countries at grade 4, and 56 countries at grade 8, including Turkey, participated in the TIMSS. Besides science and mathematics achievements, TIMSS also assesses the knowledge of context for learning related to mathematics and science. Contextual factors are important since they have considerable effects on increasing students' achievement. TIMSS 2011 Contextual Framework encompasses four main areas: National and Community Contexts, School Contexts, Classroom Contexts, Student Characteristics and Attitudes. Although TIMSS presents evidence about students' achievement and achievement-related behaviors in comparison to other countries and educational systems in the world, there is not much research focusing on analyzing TIMSS findings in Turkey (Mullis, et. al, 2009). Hence, the present study aims to analyze TIMSS 2011 findings regarding to Turkish students' science achievement.

One of the TIMSS concerns is about school engagement. Nowadays school engagement is an active research area in education. Fredricks Blumenfeld and Paris (2004) defined engagement as a multidimensional construct that involves three main domains: behavioral engagement, emotional engagement and cognitive engagement. According to the abovementioned researchers' definition, *behavioral engagement* refers to participation in the school activities. It concerns participation in school-related activities like doing the tasks, following the rules. The second dimension of engagement is *emotional engagement.* It refers to positive or negative feelings of students about school, class or teacher. Lastly, *cognitive engagement* can be shortly defined as investment in learning. It focuses on psychological investment in learning which is more than behavioral engagement. The researchers suggest that students' engagement makes significant contributions to other educational outcomes. For instance, school engagement positively relates with psychological development, students' well-being (Fredricks, Blumenfeld, & Paris 2004; Veiga, 2009b), academic performance (e.g. Goodenow, 1993) and negatively with the dropout (e.g. Finn, 1989). The present study aims to investigate the relation between students' engagement and achievement in science based on TIMSS 2011 data. Since there was no evidence about cognitive engagement in TIMSS 2011 data, behavioral and emotional engagement was chosen for the focus of the study. In particular, this study aims (1) to determine whether these three dimensions of school engagement show any difference between the 4th and 8th graders, and (2) to investigate whether the relationship between Students' Behavioral and Emotional Engagement Trajectories and Achievement differ for the 4th and 8th grade students.

Emotional Engagement and Achievement

Emotional engagement refers to the existence of feelings like interest and belonging that facilitate the tasks or the absence of feelings that encourage task-withdrawal (Reeve, 2012). Sense of belonging is one of the important components of emotional engagement. It can be defined as students' perceptions of being accepted, respected and supported by other people at the school like their teachers (Goodenow, 1993). Dewey (1958) draws an analogy between schools and community, and suggests that students have interpersonal needs as community members do. Sense of community has four elements: membership, integration and fulfillment of needs, and a shared emotional connection (McMillan& Chavis, 1986). Community members should experience belonging to the community, feel the importance of the group, and the group pays attention to the person and members' needs. ????? Moreover, a shared emotional connection should exist among community members. if a school can be considered as a community, then it should also be regarded as a place that emphasizes the abovementioned components which refer to feelings like being a part of a group (Osterman, 2000).

Sense of school belonging is actually one of the basic human needs. According to Maslow's hierarchical models of needs, belonging appears in the middle of the pyramid. This implies that after satisfying the physiological and safety needs, people need a membership to the community they live in, in other words, being accepted, respected and supported by other people (Baumeister & Leary, 1995). In this respect, satisfying sense of school belonging has three aspects. Firstly, social context plays an important role to meet the belonging need. Additionally, the needs are domain- and situation-specific, and continuous (Osterman, 2000). Besides, satisfaction of these needs is necessary for effective and healthy functioning of people's performance (Ryan, 1995). When needs are not satisfied, they reduce people's effectiveness. For instance, in educational settings, unsatisfied needs can negatively affect students' motivation, development and performance (Deci & Ryan, 1991).

Liking is another important task-facilitating emotion. If students' feelings about the task are affirmative, then they are likely to have much fun doing it. As mentioned above, existing positive feelings like loving the school, classroom or lessons or absence of negative feelings like anxiety refer to emotional engagement (Reeve, 2012). Actually, people may experience such positive feelings about their interaction with the surrounding environment. The environment that students should interact with may be their teachers and friends at the school (Krapp, Hidi, & Renninger, 1992). Besides, enjoying the subject can encourage them to yield other adaptive educational outcomes. For instance, once students' attention is attracted, and they start to nourish positive feelings about science, then they voluntarily seek additional information, experiences and activities (Jarett, 1999).

To examine the relationship between emotional engagement and academic achievement in terms of Turkish culture; Özdemir *et al.* (2010) investigated the effects of belonging on students' academic achievement. 683 middle school students participated in the study. According to the results, nurturing students' school belonging also helps to improve their achievement. In a recent study, Sarı (2013) investigated the feeling of belonging on 6502 high school students, and suggested that there was a significant difference between low achievers and high achievers in terms of school belonging. To elaborate, students who have less school belonging than those who are low achievers, or vice versa. In terms of students' liking science and achievement relation, Kalendar and Berberoğlu (2009) investigated this relationship in a large scale study, and suggested that students who were more interested in science tended to have higher grades.

Although emotional engagement's connection with other educational variables is suggested by researchers, there is not much research that examines the relationship between achievement and emotional engagement (Fredricks, Blumenfeld, & Paris 2004). Moreover, the case is not different in Turkish educational system; there are very few studies that examine students' emotional engagement (Sarı, 2012). The research results concerning the relationship between emotional engagement and achievement are insufficient and very confusing. Some researchers suggest that students who emotionally engage in the school, classroom or context tend to higher academic achievement (Connell et al., 1994; Goodenow & Grady, 1993; Skinner et al., 1990). On the other hand, some researchers suggest that the relationship between emotional engagement and achievement is not significant for everyone, or every time. For instance, Voelk (1997) found out a positive relation between aforesaid variables for white students, but not for African-American students.

Behavioral Engagement and Achievement

Behavioral engagement refers to participation in the school activities. It concerns students' efforts, persistence, studying, and participating in school-related activities (Finn et al., 1995). Students can be behaviorally engaged in by getting them do the task and follow the rules, or involving them in academic activities (Fredricks, Blumenfeld & Paris, 2004). In contradistinction to other engagement dimensions, teachers can easily understand whether their students are behaviorally engaged or not. Do the students make effort to do the task? Do they persist in the task when they encounter the difficulty? Or do they participate in the academic activities? The answers to these questions refer to students' behavioral engagement (Linnenbrink& Pintrich, 2003).

The relevant literature suggests that students' behavioral engagement is related to their academic achievement. In other words, students who make effort to perform and persist in the academic task tend to show higher performance on their achievement (e.g. Marks, 2000; Fredricks, Blumenfeld & Paris, 2004; Wang& Eccles, 2012). Therefore, a positive relation between behavioral engagement and achievement in science is expected to exist for the purpose of this study.

Students' Engagement Change across Elementary and Middle Schools

Relevant studies suggest that there is a difference between elementary school students and middle school students in terms of achievement-related outcomes (e.g. Eccles & Midgley, 1989). However, there are few studies that examine the grade difference in terms of students' achievement-related outcomes like motivation or school engagement (Anderman & Midgley, 1997). Researchers suggest that early adolescent years are characterized by negative changes in terms of academic performance and other contextual factors. Additionally, the main underlying reason of this change is the students' transition from elementary school to middle school (Eccles& Midgley, 1989; Midgley, Anderman& Hicks, 1995). For instance, Haladyna and Thomas (1979) investigated students' interest in general school and specific domains like science. The researchers suggest that students' interest in science shows a decrease at middle school students compared to elementary students. In another study, Jacobs et al. (2002) examined students' task value beliefs; how students find the subject important, interesting or fun, in a longitudinal study. According to the results, as students get older, their value beliefs decline.

According to previous studies, students show desired behaviors when their socio-emotional needs are met in the school context (Eccles et al., 1993). As mentioned before, there is a significant grade difference between elementary and middle school students' emotional engagement levels; middle school students generally show a lower level of interest, enjoyment and belonging than elementary students do (Haladyna & Thomas, 1979). Therefore, it is expected that in parallel with the decrease in students' emotional engagement, their participation in the academic activities and behavioral engagement also show a tendency to decline. Confirming this suggestion, Wang and Eccles (2012) designed a study to investigate students' engagement - among 7th, 9th, and 11th graders - and the results showed that both emotional and behavioral engagement decline through 7th grades to 11th grades.

In the light of the aforementioned literature, the present study aims to answer following research questions:

(1) Do the 4th and 8th graders' school engagement levels differ from each other?

(2) Does the relationship between Students' Behavioral and Emotional Engagement Trajectories and Achievement differ for the 4th and 8th grade students?

Method

Sample

The sample design for TIMSS is a stratified two-stage cluster sample design. In the first stage, schools were selected according to their sizes. Then they were sorted in consideration of the important demographic variables, and sampled by systematic random sampling approach. In the second sampling stage, the classes were selected from the target students of each participating school (Joncas, 2007). The current study used TIMSS 2011 dataset of Turkey. 7479 fourth grade elementary students from Turkey participated in the study. There were 3627 (48. 5%) girls and 3849 (51. 5%) boys. TIMSS' stratified sample design is expected to be helpful to report participants' demographic information. There are exiguous reading materials, fewer than 100 at most students' homes (86. 1%). Moreover, most of the students have personal rooms (% 47. 7), computer (% 67. 3) and internet access (%45) in their homes.

In terms of eight graders, 6928 middle school students from Turkey participated in TIMSS 2011. There were 3514 (50. 7%) boys and 3414 (49. 3%) girls. There are exiguous reading materials, fewer than 100 at most students' homes (83. 7%). Moreover, most of the students have personal rooms (% 53. 1), computers (% 58. 5) and internet access (%45. 4) in their home.

Measures

Behavioral engagement

TIMSS 2011 assess students' behavioral engagement with five items. The questionnaire was a four-point Likert scale ranging from "I agree a lot" to "4 disagree a lot". The items were reversed in order for higher scores to reflect more students' engagement. The reliability coefficient of Cronbach's alpha was .42 for the 4th grades and .66 for the 8th grades. The alpha values are both acceptable since they are higher than .40 (Özdamar, 1997).

Explanatory factor analysis with a Principal Components method was conducted to examine construct validity of behavioral engagement sub-scale. An examination of the Kaiser-Meyer Olkin measure of sampling adequacy suggested that the sample was factorable (KMO value is .61 for 4th grades, and .71 for 8th grades), and the factor loadings were presented in Table 1.

Table 1.
Factor Loadings of Behavioral Engagement

Items	Loadings	
	4th grades	8th grades
I know what my teacher expects me to do	.64	.75
I think of things not related to the lesson	.64	.71
My teacher is easy to understand	.60	.66
I am interested in what my teacher says	.51	.57
My teacher gives me interesting things to do	.42	.45

Emotional engagement

School belonging. It measured students' perceived sense of connectedness to school. In TIMSS 2011 questionnaire, there are 3 items that measure school belonging. It was a four-point Likert scale ranging from "agree a lot" to "disagree a lot". The reliability coefficient of Cronbach's alpha was .66 for the 8th grades, and .52 for the 4th grades.

Explanatory factor analysis with a Principal Components method was conducted to examine construct validity of school belonging sub-scale. An examination of the Kaiser-Meyer Olkin measure of sampling adequacy suggested that the sample was factorable (KMO value is .61 for 4th grades, and .65 for 8th grades), and the factor loadings were presented in Table 2.

Table 2.
Factor Loadings of School Belonging

Items	Loadings	
	4th grade	8th grade
I like being in school	.74	.78
I feel safe when I am at school	.72	.76
I feel like I belong at this school	.69	.74

Like science. Whether students like science or not was measured with 7 items in TIMSS 2011 questionnaire. It was a four-point Likert scale ranging from "agree a lot" to "disagree a lot". The reliability coefficient of Cronbach's alpha was .69 for the 4th grades, and .82 for the 8th grades.

Explanatory factor analysis with a Principal Components method was conducted to examine construct validity of liking science sub-scale. An examination of the Kaiser-Meyer Olkin measure of sampling adequacy suggested that the sample was factorable ((KMO value is .77 for 4th grades, and .75 for 8th grades), and the factor loadings were presented in Table 3.

Table 3.
Factor Loadings of Liking Science

Items	Loadings	
	4th grades	8th grades
I enjoy learning science	.77	.85
I wish I did not have to study science	.72	.79
I read about science in my spare time	.67	.72
Science is boring	.59	.65
I learn many interesting things in science	.58	.63
I like science	.52	.63
It is important to do well in science	.43	.55

Science achievement

There are three science content domains in TIMSS 2011. The questions are about life science, physical science, and earth science. For grade 8, TIMSS measures four domains: biology, chemistry, physics, and earth science. The science achievement scores were transformed into five plausible values based on Item Response Theory in TIMSS data (Foy, Brossman& Galia, 2011). These five plausible values were used to predict science achievement in the current study.

Analyses

TIMSS data are available all individuals interested in the data collected and analyzed as part of TIMSS 2011 (http://TIMSSandpirls.bc.edu/TIMSS2011/international-database.html). Since the present study does not aim to make comparisons between other countries, the data from Turkey was considered to be relevant for the purpose of the study. For this elimination, and to make the necessary analyses, the International Database (IDB) Analyzer ver. 3.1 was used. The International Association for the Evaluation of Educational Achievement (IEA) developed the IDB to analyze IEA surveys like TIMSS 2011. All procedures offered within the analysis module of the IDB Analyzer considered sampling weights (IDB Analyzer, 2013). After importing in the data SPSS 18, the preliminary data analyses were conducted to examine potential outliers and missing values. SPSS 18 was also used to compare the 4th grade and the 8th grade students' engagement with Multivariate Analysis of Variance.

Results

Descriptive Statistics

Descriptive statistics were used to investigate the students' profiles about achievement and engagement in science. Table 4 presents means and standard deviations for dependent variables for each grade. There were no variables with 3% or more missing values. Therefore, no missing data analyses were used.

Table 4.
Descriptive Statistics for Grade with Respect to Engagement

	4th grade		8th grade	
	M	*SD*	*M*	*SD*
School Belonging	3.75	.45	3.47	.63
Like	3.69	.42	3. 29	.63
Behavioral Engagement	3.48	.49	3.19	.62

Max.:4 Min.: 1

Science Achievement for the 4th and 8th grades

Fifty two countries participated in TIMSS 2011 assessment for the fourth grade. The top score that students can reach at the TIMSS Science scale was 1000; however, their academic performance ranged between 300 and 700. The mean score of achievement was 500, with 100 standard deviations. Turkey's average of science achievement score for the 4th grades was 463. Moreover, 3.3% of the fourth grade Turkish students' science achievement was too low for estimation.

Forty five countries participated in TIMSS 2011 assessment for the eighth grades. As was for the fourth grades, the mean score of achievement was 500 with 100 standard deviations. Turkey's average of science achievement scores for 8th grades was 483. Besides, 3.5% of 8th grade's science achievement was too low for estimation.

Inferential Statistics

For the first research question

1. Do the 4th and 8th graders show differences in terms of school engagement?

A Multivariate Analysis of Variance (MANOVA) was conducted to investigate grade differences in students' engagement. Dependent variables were school belonging, efficacy and behavioral engagement. Results revealed a significant difference between the fourth and eighth graders on the collective dependent variables (Wilks' Lambda= .853, F (1, 13393) =1911, 16, p= .000). As shown in Table 5, the pairwise comparisons using a Bonferroni adjusted alpha level of .01 showed a statistically significant mean difference between the 4th and 8th graders with respect to belonging ($\eta 2$ = .062), liking science ($\eta 2$ = .125) and behavioral engagement ($\eta 2$ = .066).

Table 5.
MANOVA Pairwise Comparisons

	F	P value	Eta Squared
Belonging	884,046	.00*	.062
Like	1911,164	00*	.125
Behavioral Engagement	939,250	00*	.066

* The mean difference is significant at the .01 level (.05 /3)

For the second research question

2. Do the relationship between Students' Behavioral and Emotional Engagement Trajectories and Achievement differ for the 4th and 8th grade students?

In order to investigate elementary and middle school students' achievement in science in relation to emotional and behavioral engagement, two multiple, linear regression analyses were conducted separately for the 4th and 8th graders. Prior to the analyses, multicollinearity, outliers, normality, linearity, homoscedasticity, and independence of residuals assumptions were checked. To examine multicollinearity, correlations between all of the three independent variables were checked by Pearson product-moment correlations. According to Tabachnick and Fidell (1996), problems occur at higher correlations (.90 and higher). Since, none of the correlations were .90 or higher, no problem was detected.

The Relationship between Engagement and Achievement in Science for the 4th Grade Students

The multiple linear regression analysis was conducted to examine how well the 4th grade elementary students behavioral and emotional engagement were (liking science, and school belonging), and to predict their science achievement. Results showed that the linear combination of predictor variables significantly accounted for 16% of variance in science achievement. More specifically, it was found that behavioral engagement and liking science each made a statistically significant contribution to the prediction of students' science achievement ($p < 0.05$), while school belonging failed to achieve significance ($p > 0.05$). The size and direction indicated that students who like science activities and behaviorally engaged in science lessons tend to be more successful in science than others. Of these two significant predictors, however, behavioral engagement appears to be more important in explaining science achievement as indicated by the largest correlation for behavioral engagement (β=.30). Beta coefficients, beta standard errors and zero order correlation coefficients are presented in Table 6.

Table 6.
Contribution of the 4th Grade Elementary Students' Engagement to Science Achievement

	β	β Standard Error	Zero-order correlation
Belonging	-.01	.02	.13
Like	.16*	.02	.28
Behavioral Engagement	.30*	.02	.38

* The correlation is significant at the .05 level.

The Relationship between Engagement and Achievement in Science for the 8th Grade Students

The multiple linear regression analysis was conducted to examine how well the 8th grade middle school students behavioral and emotional engagement were (liking science, and school belonging), and to predict their science achievement. Results showed that the linear combination of predictor variables significantly accounted for 8% of variance in science achievement. More specifically, it was found that both behavioral and emotional engagement trajectories each made a statistically significant positive contribution to the prediction of students' science achievement ($p < 0.05$). The school belonging has a significant positive relation with both of the other independent variables; behavioral engagement (r=.27), liking science (r=.22) and the dependent variable, science achievement (r=.03) at the bivariate level. However, in the multiple regression analysis, the relation between school belonging and science achievement is negative. This may be a result of a suppressor phenomenon. Therefore, the negative sign of belonging, in here, does not mean that while school belonging increases, science achievement should decrease, but that the suppressor variable (belonging) has a low correlation with the science achievement, and a high correlation with the other independent variables (Pandey & Elliot, 2010). Of these three significant predictors, however, behavioral engagement appears to be more important in explaining science achievement as indicated by the largest correlation for the behavioral engagement (β=.20). Beta coefficients, beta standard errors and zero order correlation coefficients are presented in Table 7.

Table 7.
Contribution of the 8th Grade Middle School Students' Engagement to Science Achievement

	B	β standard error	Zero-order correlation
Belonging	-.05*	.02	.03
Like	.09*	.02	.21
Behavioral Engagement	.20*	.03	.25

* The correlation is significant at the .05 level.

Discussion

Using the data from TIMSS 2011, the present study aims to investigate Turkish elementary and middle school students' achievement and school engagement in science. Students' science achievement was predicted by taking into account the presence of five plausible values. Because of absence of evidence about cognitive engagement, the current study focuses on two dimensions of engagement: emotional and behavioral engagement. School belonging and liking science was handled as emotional engagement trajectories, students' effort, persistence, and attention in the class were regarded as behavioral engagement. In this context, the present study aims (1) to determine whether these three dimensions of school engagement (school belonging, liking science and behavioral engagement) show difference among the 4th and 8th graders, and (2) to investigate whether the relationship between Students' Behavioral and Emotional Engagement and Achievement differ for the 4th and 8th grade students.

The current study's first purpose is to find out about the grade differences in Turkish students' emotional and behavioral engagement. The results indicated that the 4th grade elementary students show higher engagement than the 8th grade middle school students do in terms of both emotional engagement and behavioral engagement. In other words, the 4th grade students feel like much more belonging to the school, show more interest in science and are more willing to participate in the class than the 8th grade students do. Actually, these findings were not surprising and were parallel with previous results. For instance, in a similar study, Wang and Eccles (2011) investigated whether school engagement display developmental differences from the 7th through the 11th grades. They handled school participation as behavioral engagement, sense of school belonging as emotional engagement, and strategy usage as cognitive engagement. The findings show that three dimensions of school engagement decrease from the 7th grades through the 11th grades. Relevant literature also suggests that after students' transition from elementary school to middle school, their contextual factors are prone to decline (Eccles& Midgley, 1989; Midgley, Anderman& Hicks, 1995).

The second aim of the present study was to investigate the relationship between students' behavioral and emotional engagement trajectories and achievement of the 4th and the 8th grade student. The results suggest that behavioral engagement is the most effective variable to explain science achievement in the present study for both the 4th and 8th grades. Parallel with this finding, previous studies also suggest that students who participate the class, make efforts to complete the task, and persist in the academic activities tend to show higher performance in academic tasks (e.g. Marks, 2000; Fredricks, Blumenfeld & Paris, 2004; Wang& Eccles, 2012). To sum up, this finding confirmed the basic consideration about engagement and achievement. To clarify, those students who regularly attend classes, pay attention to the academic tasks, in other words who are more behaviorally engaged in lesson tends to show better academic performance (Finn, 1989).

Liking science and school belonging were handled as two trajectories of emotional engagement in the present study. Regarding to the liking science, the results suggest that liking science is positively related to science achievement for both the 4th and 8th grades. In line with related literature, the current study indicates that students, who tend to have higher levels of positive feelings about science subjects, tend to have higher achievement in science than others do. For instance, in a study, Hidi *et al.* (2006) investigated the relation between students' liking and their performance in science-related writing, and suggested positive correlation between the variables. In a similar study, Areepattamannil, Freeman and Klinger (2011) examined effects of enjoyment of science on students' science achievement. 13.985 15-year-old students participated in the study. The researchers suggest that students' emotions about science have considerable effects on their science achievement. In a recent study, Villavicencio and Bernardo (2013) explore the effect of enjoyment on students' achievement on 1.345 students, and confirmed the previous results, its positive contribution to achievement. Last but not least, Schiefele, Krapp and Winteler (1992) investigated the relation between interest and achievement by a meta-analysis. The studies that were included in the meta-analysis measured interest mostly by asking whether participants like science or not. . According to the findings, all the research reported positive significant relations between interest and achievement. Besides, the researchers calculated a mean correlation of r= .30.

The other trajectory of emotional engagement investigated in this study was school belonging. The results suggest that school belonging has no significant contribution on the 4th grade students' science achievement. On the other hand, the positive relation is suggested between school belonging and science achievement for the 8th grades. It was surprising since the positive contribution to both of the emotional engagement trajectories was expected for both grades; although the previous findings about the relation between school belonging and achievement were quite mixed up. While some researchers suggest positive relation (e.g. Goodenow & Grady, 1993; Skinner et al., 1990), other do not (e.g. Wang & Eccles, 2012). The reason of the nonsignificant relation for achievement and school belonging can be attributed to grade differences. To explain, studies about elementary students' emotional engagement can differ from other age groups' work (Jimmerson, et. all, 2003). Despite this fact, according to the authors' knowledge there is not much research about the abovementioned relation especially in elementary level. Actually, in our country, there is not enough study about students' emotional engagement (Sarı, 2012). Therefore, further studies can investigate students' emotional engagement for different grades in a more detailed manner.

The other interesting point for the results were that emotional and behavioral engagement accounted for 16% of the variance in the fourth grade students' science achievement, whereas it was 8% of variance in the eighth grade students' science achievement. Although the relationship for the 8th grades was statistically significant, it may be not practically significant due to its' low R^2 value. In other words, the strength of engagement and achievement relation in science is not the same for elementary and middle school students. Supporting these findings, relevant literature suggests that students' achievement-related behaviors like interest, attitude or motivation, can change from the 4th through the 8th grades. Moreover, this change is generally on the decline (e.g Cleary& Chen, 2009; Fredericks & Eccles, 2002). Hence, there can be other contextual factors that help understand and explain the 8th grade students' achievement in science.

There are some limitations in this study. Firstly, one of the major limitations is that it was impossible for the researcher to include cognitive engagement in the model since this study involves a secondary analysis of data already collected. Secondly, the present study investigates the achievement and engagement relationship in the science domain. These relationships can differ in other domains, and how they differ is not answered in the present study. Besides, it is a cross sectional study and does not claim to reveal the cause-and-effect relations.

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