ROLE OF MOTIVATION AND COGNITIVE ENGAGEMENT IN SCIENCE ACHIEVEMENT

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ABSTRACT

ROLE OF MOTIVATION AND COGNITIVE ENGAGEMENT IN SCIENCE ACHIEVEMENT

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The purpose of this study was to investigate the contribution of the motivational beliefs (self-efficacy and task-value) and cognitive engagement to seventh grade students' science achievement. For the specified purpose, cross-sectional correlational research design was used. The data were gathered from the seventh grade students of public middle schools by means of three data collection instruments namely, Background Characteristics Survey (BCS), Motivation and Cognitive Engagement Scale (MCES) and Science Achievement Test for 7th Grade (SAT). The MCES is a self-report instrument including the selected items from the Science Learning Inventory (SLI- Part A) and from Turkish Version of Motivated Strategies for Learning Questionnaire

(MSLQ) in order to measure students' motivational beliefs (self-efficacy and task-value) and the level of their cognitive engagement. A total of 861 seventh grade students (398 girls and 456 boys) participated in the study. Multiple Linear Regression Analysis was used to analyze the data. Results revealed that motivational beliefs (i.e. self-efficacy and task value) positively and significantly contributed to the prediction of students' science achievement and the self-efficacy appeared as the best predictor of the science achievement. Cognitive engagement failed to significantly predict students' science achievement. Finally, bivariate relations among independent variables (self-efficacy, task-value and cognitive engagement) were examined through simple correlation analyses. The result indicated positive and significant correlations among self-efficacy, task-value and cognitive engagement variables.

Keywords: Expectancy-Value Theory, Self-efficacy, Task-Value, Science Achievement

ÖZ

MOTİVASYON VE BİLİŞSEL KATILIMIN FEN BAŞARISINDAKİ ROLÜ

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Yüksek Lisans, İlköğretim Fen ve Matematik Alanları Eğitimi Bölümü

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Mevcut çalışma kesitsel bir araştırma olup öz-yeterlilik ve görev-değer gibi güdüsel inançların ve bilişsel katılımın yedinci sınıf öğrencilerinin fen başarısına olan katkısını incelemeyi amaçlamaktadır. Bu amaç doğrultusunda, devlet okullarında okuyan yedinci sınıf öğrencilerinden üç farklı veri toplama aracı (sırasıyla Kişisel Bilgiler Anketi (BCS), Güdülenme ve Bilişsel Katılım Anketi (MCES), Fen Başarı Testi (SAT)) vasıtasıyla veriler toplanmıştır. MCES anketi, öğrencilerin güdüsel inançlarını (öz-yeterlilik ve görev-değer) ve bilişsel katılım düzeylerini ölçmek amacıyla, Fen Öğrenme Envanteri (SLI-Part A) ve Öğrenmede Güdüsel Stratejiler Anketinin (MSLQ) Türkçe versiyonundan derlenmiş maddelerden oluşmaktadır. Toplam 861 yedinci sınıf öğrencisi (398 kız, 456 erkek) çalışmaya katılmıştır. Katılımcılardan toplanan veriler, çoklu regresyon analizi yöntemi kullanılarak incelenmiştir. Sonuçlar güdüsel inançların (öz-yeterlilik ve görev-değer) pozitif ve anlamlı bir biçimde fen başarısının tahminine katkıda bulunduğunu göstermiştir. Öz-yeterlilik, fen başarısının tahminine en çok katkıda bulunan değişken olmuştur. Ayrıca, analiz sonuçları, bilişsel katılımın, fen başarısının tahminine anlamlı bir katkıda bulunmadığını ortaya koymuştur. Son olarak, öz-yeterlilik, görev-değer ve bilişsel katılım bağımsız değişkenleri arasındaki ikili ilişkiler incelenmiş ve sonuçlar bu değişkenler arasında pozitif ve anlamlı bir ilişki olduğunu göstermiştir.

Anahtar Kelimeler: Beklenti-Değer Kuramı, Öz Yeterlik, Görev-değer, Fen Başarısı

To My Love, Filiz…

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MSLQ	Motivated Strategies for Learning Questionnaire
MCES	Motivation and Cognitive Engagement Scale
SLI	Science Learning Invetory
SAT	Science Achievement Test
CFA	Confirmatory factor analysis
CFI	Comparative fit Index
GFI	Goodness-of-fit index
RMR	Root-mean-square residual
RMSEA	Root-mean-square error of approximation

CHAPTER I

INTRODUCTION

Over about half century, expectancy- value theory has been among the theories gained general acceptance to explain students' achievement related outcomes (Wigfield, 1994). The theory basically claims that individuals' expectations for success and subjective task values are the main arbiters for their subsequent behaviors such as performance, persistence, and task choice (Atkinson, 1957; Eccles, Adler, Futterman, Goff, & Kaczala, 1983; Eccles & Wigfield, 2002; Trautwein, Marsh, Nagengast, Oliver Lüdtke, Nagy & Jonkmann, 2012; Wigfield, 1994; Wigfield & Eccles, 1992; Wigfield, 1994). Accordingly, the theory grounded on these two basic constructs *expectancy for success*, which refers to individuals' beliefs about the extent to which they can exhibit successful performance on certain tasks in a short-term or long- term future, and *subjective task-value*, refers the beliefs about the extent to which individuals perceive a task as important, useful and enjoyable (Eccles & Wingfield, 2002). A great deal of theoretical and experimental studies have put forth that expectation for success and task-value beliefs and their mutual interaction could evidently predict important outcomes including engagement, interest persistence, and academic achievement (Eccles, 1983; Eccles and Wigfield, 2002; Nagengast, Marsh, Scalas, Xu, Hau &

Trautwein, 2011; Trautwein, Marsh, Nagengast, Lüdtke, Nagy & Jonkmann, 2012; Wingfield, 1994). Consequently, the investigation of expectation for success and task-value beliefs is one of essential ways to estimate the major outcomes such as engagement, interest persistence, and academic achievement (Pamuk, 2014; Yerdelen, 2013). Briefly, expectancy-value theory offers strong theoretical constructs for educational studies targeting to clarify students' achievement motivation.

Although Bandura (1997) asserted that expectation for success construct in expectancy-value theory refers only outcome expectations, i.e. previous achievements and is not related with personal or efficacy expectations (self-efficacy), reversely expectancy value theorists claimed that expectation for success construct measures individuals' own expectations and more related with personal or efficacy expectations, not with outcome expectations, therefore, more analogous to Bandura's self-efficacy construct and measured in similar ways (Eccles and Wigfield (2002). Thus, expectation for success construct in expectancy value theory was assessed as Bandura's self-efficacy construct in the present study. Bandura (1997) defined self-efficacy as individuals' confidence in their competence to organize and execute a given course of action to solve a problem or achieve a task. Accordingly, goal setting, activity choice, willingness to expend effort and persistence on a task originates from the individuals' self-efficacy at the

Bandura’s efficacy construct. Likewise, a study conducted by Hoy (2004) revealed that students with high self-efficacy level had tendency to expend more effort, show more persistency when they faced with difficulties and problems and utilized various learning strategies to achieve the given tasks. Parallel to these findings, a great deal of studies showed that students’ self-efficacy is significantly and positively associated with science achievement (Britner2008; Caprara, Fida,Vecchione, Del Bove, Vecchio, Barbaranelli, & Bandura,2008; Hidi, Ainley, Berndorff, & DelFavero, 2006; House, 2008; Lavonen & Laaksonen, 2009; Yoon, 2009). Actually, according to Linnenbrink and Pintrich (2003) self-efficacy takes part in every motivational construct trying to explain the students’ academic achievement. According to Bandura (1977), self-efficacy’s level and strength can be changed by some psychological processes such as performance accomplishments (past achievements), vicarious experience (observing others perform a task), verbal persuasion (social support verbally), and physiological states (Stress, fatigue, mood, tension, emotion, and pain). Therefore, the designs of science education medium have decisive effects on the students’ self-efficacy levels. In other words, appropriate science course mediums can be helpful for the students to improve their self-efficacy level and, in this way, their achievement levels.

The other central construct in the expectancy-value theory is the task-value referring individuals' perceptions of importance, usefulness, interest and cost about an activity (Eccles, et. al., 1983). Eccles and her colleagues (1983) claimed that the four components as attainment value (the importance of the activity for the individual), intrinsic value (the enjoyment that the individuals feel during the activity), utility value (the usefulness of the activity for individuals) and cost (the perceived negative outcomes as a result of the activity) constitute individuals' task-value beliefs.

These components are determinative for the students' effort, persistency and task choices (Wigfield & Eccles, 2000). In other words, students with high task-value for an activity more probably prefer participating in that activity, show more persistence in that activity and expend more effort compared to students with low task-value for the same activity (Cole, Bergin & Whittaker, 2008). Supportively, a great deal of studies in the literature revealed positive association between students' task-value and academic achievement (Eccles & Wigfield, 2002; Pintrich & De Groot, 1990; Pintrich & Schunk, 2002) and specifically, science achievement (Sungur, 2007; Yumusak, Sungur, & Çakıroğlu, 2007).

Briefly, the literature review revealed that the students' motivational beliefs such as self-efficacy and task-value have great influence in their choice of tasks, effort, persistence, use of effective learning strategies, and their actual achievement. The empirical findings were parallel with the theoretical expectations within the framework of the expectancy-value theory. Nevertheless, some researchers argued that the relationship between the motivational beliefs and academic achievement is indecisive and there is a need for more studies about the motivational beliefs enabling useful insight for the educators and education planners to provide a qualified educational medium for the students (Kulwinder Sigh, 2014). The present study has the purpose of making contribution on conceiving the relationship between motivational beliefs and science achievement. In this manner, it can provide some useful insights for educators and curriculum makers. Based on abovementioned literature, the present study proposed positive correlations between motivational beliefs and science achievement.

Another important construct examined in the present study is cognitive engagement which concerns students' willingness to expend effort and long period of time to comprehend a subject deeply or master a difficult skill and the type of processing strategies that they use for learning (Fredericks, Blumenfeld & Paris, 2004; Ravindran, Greene, & Debacker, 2005; Rotgans & Schmidt, 2010). Weinstein and Mayer (1986) claimed that cognitive engagement is an operative gauge of level of learning and academic achievement. A study conducted by Fredericks, Blumenfeld and Paris (2004) reported that the students cognitively engaged tend to utilize various learning strategies. These strategies are essential agents for students' achievement because they enable the students to learn meaningfully (Yumuşak, 2006).

The learning strategies can be classified into two groups, namely cognitive and metacognitive strategies (Pintrich, Smith, Garcia & McKeachie, 1993). Rehearsal (memorizing the subject by repeating words by oneself), elaboration (associating new learnings with previous knowledge), and organizational strategies (grouping the subject hierarchically) and critical thinking (transferring previously learned knowledge to new situations) are examples of cognitive strategies (Weinstein & Mayer, 1996). Various studies reported that cognitive strategy use are associated with academic achievement and power of this relation show changes depending on which cognitive strategy is used (Pintrich, Smith, Garcia, and McKeachie 1993; Sedaghat, Abedin, Hejazi, & Hassanabadi, 2011; Yumuşak, 2006). For example, the strategies like elaboration, organization and critical thinking require deep processing of information. Whereas the strategies like rehearsal involve superficial processing of information (Weinstein & Mayer, 1986). Hence, students who use deep processing strategies like elaboration, organization and critical thinking are expected to show better academic performance compared to the students who use superficial or sallow strategies like rehearsal (Pintrich's et al., 1993; Sedaghat et al., 2011). Monitoring (e.g. checking the comprehension level during activity), planning (e.g. skimming the text before reading), and regulating strategies (e.g. rereading the parts of the text which has not been understood) are the instances of metacognitive strategies, which are related with cognitive regulation (Pintrich, 1999), that is, thinking about how to think during the learning or solving a problem (Livingston, 2003; Metcalfe & Shimamura, 1994; Flavell, 1999). Usages of metacognitive strategies are remarkable signs of cognitive engagement, thus, instructors desire their students to perform more metacognitive behaviors (Linnenbrink & Pintrich, 2003). A study conducted by Akyol (2009) revealed positive association between metacognitive strategy usage and science achievement.

As in the present study, several studies assessed the cognitive and metacognitive strategies as the components of the cognitive engagement (Linnenbrink & Pintrich, 2003; Metallidou et al. 2007; Rastegar, Jahromi, Haghighi and Akbari, 2010). For example, Greene, Miller, Crowson, Duke, and Akey (2004) examined cognitive engagement in terms of cognitive and metacognitive strategies and they found that cognitive engagement was a significantly linked to academic performance.

Shortly, related literature has attracted attention to the cognitive engagement as a good indicator of students' learning and achievement. Beside a great deal of other domains, science achievement was also found to be associated with the students' cognitive engagement level. In fact, cognitively engaged students appeared to use various strategies in their learning. Accordingly, based on related literature, the current study proposed that cognitive engagement is positively linked to science achievement.

Furthermore, Garcia and Pintrich (1993) claimed that motivational variables have a linkage with the different students' outcomes like cognitive engagement. In addition, related literature presenting a great deal of studies supporting this positive association available among motivational beliefs (self-efficacy and task-value) and cognitive engagement (cognitive and metacognitive strategy use) (Kahraman & Sungur, 2011; Linnenbrink and Pintrich, 2003; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Schunk 2005; Sungur, 2007; Sungur & Güngören, 2007; Yumusak, Sungur, & Çakıroğlu, 2007). To exemplify, Pintrich and his colleagues' studies results (Pintrich, 1989; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991) put forth that self-efficacy and task-value beliefs had a strong and positive association with the use of cognitive strategies (eg. rehearsal, elaboration, and organizational strategies) and metacognitive strategies (eg. planning, monitoring, and regulating) and higher academic performance.

In sum, the related literature suggested that students' motivational beliefs like self-efficacy and task-value are positively associated with the students' cognitive engagement level (cognitive and metacognitive strategy use). Consequently, the students who have such kind of beliefs more likely exhibit more cognitively engaged behaviors. In other words, they show more persistence, exert more effort and use various cognitive and metacognitive strategies to comprehend related subject contents. In this way, motivational beliefs can contribute on their cognitive engagement, students' learning and academic achievement. Nonetheless, Taş and Çakır (2014) reported that a great deal of studies about motivational beliefs constructs and their relation with the learning strategies has taken in western countries whereas few studies searching these constructs have come from eastern countries for instance the studies of Kahraman & Sungur, 2011; Sungur, 2007. The present study can contribute on the related limited literature in eastern countries by providing insightful findings about motivational beliefs and its association with cognitive engagement. Accordingly, based on the above mentioned literature, the present study aimed to examine this relation between motivational beliefs and cognitive engagement and proposed positive associations between motivational beliefs and cognitive engagement.

1.1. PROBLEMS AND HYPOTHESES

This part of the study includes main problem, related sub-problems, and the hypotheses of the study.

1.1.1 The Main Problems

The three main problems of this study are stated as follows;

1) What is the contribution of motivational beliefs to the prediction of middle school students' achievement in science?

2) What is the contribution of cognitive engagement to the prediction of middle school students' achievement in science?

3) What is the relationship between motivational beliefs and cognitive engagement among middle school students in science course?

1.1.2 Hypotheses

The problems stated above are tested with the following hypotheses that are stated in null form.

The null hypothesis of the main problem 1:

► Ho 1: There is no significant contribution of motivational beliefs (self-efficacy and task value) to the prediction of middle school students' achievement in science.

The null hypothesis of the main problem 2:

► Ho 2: There is no significant contribution of cognitive engagement to the prediction of middle school students' achievement in science.

The null hypothesis of the main problem 3:

- ► Ho 3: There is no relationship between motivational beliefs and cognitive engagement among middle school students in science course.

In the current study, in order to address the main problems, descriptive and inferential statistical procedures were performed by means of two statistical programs which were SPSS 22, and LISREL 8.80. Descriptive statistics and multiple regression analysis were conducted using SPSS 22. Confirmatory factor analysis (CFA) was executed using LISREL 8.80. Lastly, the findings of the study were discussed elaborately.

1.2 SIGNIFICANCY OF THE STUDY

The fact that Turkish students general science achievement scores are below the average of the international exams like TIMMS (Trends in International Mathematics and Science Studies) and PISA (Program of International Students Assessment) (Gök, 2014; Milli Eğitim Bakanlığı [MEB], 2013; Şişman, Acat, Aybay & Karadağ, 2011) can be seen obviously in Ministry of Education reports. Therefore, there is a need of the researches examining the reasons of the current situation of science education in Turkey (MEB, 2013). The present study, which aims to reveal the role of motivational beliefs and cognitive engagement in science achievement, can provide some suggestions to improve the science achievements of the students in the schools and in international exams. Indeed, some researchers argued that the relationship between the motivational beliefs and academic achievement is indecisive and there is a need for more studies about the motivational beliefs enabling useful insight for the educators and curriculum makers to provide a qualified educational medium for the students (Kulwinder Sigh, 2014). In present study, based on expectancy-value theory, the contribution of the motivational beliefs specifically self-efficacy and task-value on science achievement were examined. In this manner, the present study can make some contributions on conceiving the relationships between motivational beliefs and academic achievement, particularly science achievement.

Additionally, according to Wigfield, Tonks and Eccles (2004), individuals' expectancies for success and task value beliefs can be influenced by their culture. The authors further stated that different cultures and countries provide different learning environments influencing the individuals' motivation in various activities leading to cultural differences in their expectancies and values. However, King and McInerney (2014) argued that despite of the role of culture in affecting basic motivational processes, the western theories of achievement have paid little attention to this fact. Congruently, Taş, et al., (2014) reported that a great deal of studies about motivational beliefs and their relation with the learning strategies (i.e. cognitive engagement) was conducted in western countries whereas relatively a few studies examining these constructs were from eastern countries (Kahraman

& Sungur, 2011; Sungur, 2007). For instance, as stated before, Kulwinder Sigh's (2014) study showed that the relationship between the motivational beliefs and academic achievement seemed indecisive in Indian culture. Thus, there is a need for more studies researching motivational beliefs and cognitive engagement in different cultures and countries, especially eastern countries to understand their relation with the academic achievement. Accordingly, although culture is not a variable specifically examined in the currents study, the present study can make contribution to the literature by providing insights about generalizability of the findings across different culture and countries.

Furthermore, based on available literature, cognitive engagement is expected to be a strong predictor of academic performance, that is, the students who have high cognitive engagement are likely to perform well on the tasks (Paris et al., 2001; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Weinstein & Mayer, 1986; Zimmerman & Martinez- Pons, 1986). Therefore, the investigation of the students' cognitive engagement level and its contribution to science achievement can reveal students' current status concerning these variables and their relations with each other leading to some valuable practical suggestions to the teachers and curriculum makers to improve science education in Turkey.

Finally, in the present study, a new instrument was constructed using selected items from the Science Learning Inventory (SLI) (Seyedmonir, 2000) and Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, García, & McKeachie,1993) to measure all aspects of motivational beliefs (self-efficacy and task- value) and cognitive engagement in science comprehensively . Through the combination of these two instruments, it is intended that related constructs are represented by a larger number of items specific to science domain, enhancing the validity and reliability. Indeed, results of the current study showed that the newly constructed instrument provides a valid and reliable measure of students' motivational beliefs and cognitive engagement. Thus, it is suggested that this instrument can be used in the future studies examining student motivation and engagement.

1.3 DEFINITION OF IMPORTANT TERMS

Motivational Belief: As used in this study, motivational belief is defined in terms of self-efficacy and task-value.

Self-efficacy refers to students' confidence in their competence to perform well in science classes.

Task-value refers to students' perceptions concerning importance, usefulness and interestingness of science task and activities.

Cognitive engagement refers to students' willingness to expend effort and long period of time to comprehend a science topic deeply or master a difficult skill and the type of processing strategies that they use for learning (Fredericks, Blumenfeld & Paris, 2004; Ravindran, Greene, & Debacker, 2005; Rotgans & Schmidt, 2010). In this study, cognitive engagement was measured in terms of cognitive and metacognitive strategy use (Linnenbrink & Pintrich, 2003; Metallidou et al. 2007; Rastegar, Jahromi, Haghighi and Akbari, 2010).

Cognitive strategy refers to learning strategies such as rehearsal (memorizing the subject by repeating words by oneself), elaboration (associating new learnings with previous knowledge), and organizational strategies (grouping the subject hierarchically) and critical thinking (transferring previously learned knowledge to new situations) (Weinstein and Mayer, 1996).

Metacognitive strategy refers to strategies including planning, monitoring and regulating that assist students in the control and regulation of the cognition (Pintrich, Smith, Garcia & McKeachie, 1993).

CHAPTER II

LITERATURE REVIEW

In this chapter, firstly, literature on the motivational beliefs (self-efficacy and task-value) and their relation with achievement was reviewed within expectancy-value theory perspective, Secondly, the literature on cognitive engagement and its relationship with academic achievement was reviewed. During these reviews, the relations between motivational beliefs cognitive engagement and academic achievement were examined in different academic domains. Then, a special focus was given on the relations between motivational beliefs, cognitive engagement and science achievement. Finally, this chapter reviewed the literature on the relationship between motivational beliefs and cognitive engagement.

2.1 Motivational Beliefs from Expectancy-Value Theory Perspective

Expectancy-value theory is a comprehensive model to explain individuals' achievement motivation in many fields such as education, health, communication, and economics etc. (Atkinson, 1957). In the theory, the basic idea is that individuals' expectations and values or beliefs influence their subsequent behaviors, including their performance, persistence, and task choice (Atkinson, 1957; Eccles, Adler, Futterman, Goff, & Kaczala, 1983; Wingfield, 1994;

Wingfield & Eccles, 1992; Wingfield, 1994; Eccles & Wingfield, 2002; Trautwein, Marsh, Nagengast, Oliver Lüdtke, Nagy & Jonkmann, 2012).

The pioneer seminal studies aiming to investigate the application of expectancy-value theory in education were conducted by Eccles and her colleagues (1983). These studies revealed that two main factors, expectancies for success and subjective task values, have central roles in students' achievement related outcomes and choices (Eccles, 1983, 1987; Feather 1988, 1992; Pintrich & Schunk, 1996; Wigfield & Eccles 1992, 2001; Eccles, Wigfield, & Schiefele, 1998). Expectancies for success refer to individuals' beliefs about the extent to which they can exhibit successful performance on certain tasks in a short-term or long- term future, while task-values refer the beliefs about the extent to which individuals perceive a task as important, useful and enjoyable (Eccles & Wingfield, 2002). The findings of both theoretical and experimental studies have revealed that expectancies for success and task-values beliefs and their reciprocal interaction can effectively predict substantial outcomes including engagement, interest persistence, and academic achievement (Eccles, 1983; Wingfield, 1994; Eccles and Wigfield, 2002; Nagengast, Marsh, Scalas, Xu, Hau & Trautwein, 2011; Trautwein, Marsh, Nagengast, Lüdtke, Nagy & Jonkmann, 2012). In other words, the examination of expectancies for success and task-value beliefs is one of essential way to estimate the major outcomes such as engagement, interest persistence, and academic achievement (Yerdelen, 2013; Pamuk, 2014). As a result, expectancy-value theory provides strong theoretical constructs for an educational research, aiming to explain students' achievement motivation. Current expectancy-value theory claimed that Bandura's self- efficacy and expectancy-value theory' expectation for success are analogous each other (Eccles & Wigfield 2002). However, Bandura (1997) divided expectations for successes into two groups as outcome expectation and efficacy expectation and asserted that expectancy-value theories took into consideration just outcome expectations, i.e. previous achievements and did not interest in personal or efficacy expectations. In the same study, Bandura (1997) exemplified that such a belief "more practices provide better performance" was related with outcome expectations, though a belief "Can I do enough practices to perform better?" was related with efficacy expectations. In contrast to Banduras' claims, Eccles et al. (2002) asserts that expectancy-value theories concentrate on the personal or efficacy expectations because the measurement ways of both expectancy beliefs and Bandura's personal efficacy expectations are similar each other and in spite of that theoretically division of these concepts is possible, there is no practical way to distinguish these concepts each other. Thus, self-efficacy beliefs and expectancy beliefs are analogous and the measurements of these concepts are conducted in similar ways (Eccles & Wigfield, 2002).

Self-efficacy is defined as individuals' confidence in their competence to organize and execute a given course of action to solve a problem or achieve a task and not related with the number of the skills individuals have (Bandura, 1997). According to Bandura (1997), goal setting, activity choice, willingness to expend effort and persistence on a task are results of the self-efficacy beliefs individuals have. On the other hand, the students who have lower self-efficacy are apt to refrain from exerting more effort to achieve a task, engaging in a task, showing persistence, setting learning goals and using effective learning strategies (Pintrich & Schunk, 2002; Schunk & Mullen, 2012). Therefore, the self-efficacy level of students is one of the foundational agency influencing the effort they spend on the tasks (Schunk & Ertmer, 2000; Pintrich & Shunk, 2002; Linnenbirnk & Pintrich, 2003; Usher & Pajares, 2008; Walker & Greene, 2009) and the choices related with science activity (Lodewyk & Winne, 2005). Accordingly, different studies manifested that students' self-efficacy is significantly and positively associated with science achievement (Hidi, Ainley, Berndorff, & DelFavero, 2006; Britner2008; Caprara, Fida,Vecchione, Del Bove, Vecchio, Barbaranelli, & Bandura,2008; House, 2008; Lavonen & Laaksonen, 2009; Yoon, 2009). Indeed, Linnenbrink and Pintrich (2003) argued that self-efficacy takes part in every motivational construct trying to explain the students' academic achievement. Additionally, the self-efficacy beliefs that the students have not only affect their motivation level and learning but also their vital decisions and events related with their own lives (Schunk & Pajares, 2009).Thus educators and education policy makers should be aware of this effective factor during education processes and also planning stage.

As another important construct in student motivation according to expectancy-value theory, Eccles et al., 1983 defined the task-value as individuals' perceptions of importance, usefulness, interest and cost about an activity. They argued that the task-value have four components as attainment value, intrinsic value, utility value and cost. Attainment value is related with the importance of the activity for the individual and intrinsic value refers to the enjoyment that the individuals feel during the activity and utility value means the usefulness of the activity for individuals and lastly cost is related with the perceived negative outcomes as a result of the activity. According to Wigfield, et. al., (2000) the individual's value for a particular task is a result of aforementioned components, which are also useful for explaining the effort exerted by an individual on a given task. In other words, students with high task-value for an activity more probably prefer participating in that activity, show more persistence in that activity and expend more effort compared to students with low task-value for the same activity (Cole, Bergin & Whittaker, 2008).

Various studies in the literature revealed positive association between students' task-value and academic achievement (Pintrich & De Groot, 1990; Eccles & Wigfield, 2002; Pintrich & Schunk, 2002; Sungur, 2007; Yumusak, Sungur, & Çakıroğlu, 2007). Nonetheless, when two components of expectancy-value theory were compared with each other, expectancy for success (self-efficacy) appeared as the more important predictor of achievement (Cole, Bergin & Whittaker, 2008). On the other hand, task-value was more related with choice behaviors, persistence and effort (Wigfield & Eccles, 2000). For example, a study with 458 students (243 female, 215 male) was conducted by Zusho, Pintrich, and Coppola (2003) to investigate how students' motivation and use of cognitive and self-regulatory strategies altered over time, and extent to which these motivational and cognitive components predicted students' achievement in chemistry. Students' motivation was assessed in terms of their self-reported self-efficacy, task value, mastery goal orientation, performance goal orientation, interest, and anxiety. Students' course performance was determined according to their grades at the end of the semester. The results revealed that students with adaptive motivational beliefs like self-efficacy and task value tend to get higher scores in chemistry. Among the adaptive motivational beliefs examined in the study, self-efficacy was found to be the best predictor of chemistry achievement.

Briefly, the literature review of motivational beliefs indicated that students' self-efficacy and task-value beliefs have essential roles in the students' choice of tasks, effort, persistence, use of effective learning strategies, and their actual achievement. The empirical findings were parallel with the theoretical expectations within the framework of the expectancy-value theory.

2.2 Students' Achievement in relation to Motivational Beliefs

Eccles and Wigfield (2002) posited direct relations between motivational beliefs like expectancies for success (self-efficacy) and task-value beliefs and achievement related outcomes. When the related literature is examined, there is comprehensive body of knowledge supporting this argument by indicating the relationships between motivational beliefs (self-efficacy and task-value) and the students' academic achievement (Eccles & Wigfield, 2002; Kaur, 2015; Kulwinder, 2014; Pintrich, Marx & Boyle, 1993). Bong (2008) argued that since self-efficacy has effect on students' effort and persistence, it can continuously anticipate academic achievement. In addition, a study conducted by Pajares and Graham (1999) revealed that the unique motivational variable for predicting mathematics achievement was the self-efficacy of average-achieving and gifted middle school students. Moreover, Pintrich and his colleagues (Pintrich, Smith, Garcia & McKeachie, 1993) found that task-value showed positive correlation with performance. Nevertheless, this correlation was not strong as that of the self-efficacy. As seen, the general emphasize along the literature is that the students' motivational beliefs have a very effective role in their academic achievement. However, according to some researchers, the relationship between the motivational beliefs and academic achievement is inconclusive and there is a need for more studies about the motivational beliefs enabling useful insight for the educators and education planners to provide a qualified educational medium for the students (Kulwinder, 2014). The following paragraphs deeply discuss the findings in the relevant literature concerning the relationship between motivational beliefs (self-efficacy and task-value) and academic achievement.

Studying with a sample of 424 Korean middle and high school students, Bong (2001), showed that although high school students' self-concepts and expectancies for success (self-efficacy) could directly predict performance in mathematics, English, computer activities, and sport activities, the middle school students' self-concepts and expectancies for success (self-efficacy) failed to predict their performance in different domains. However, both age groups' task-value beliefs had a more effective role in predicting course plan and enrollment decisions.

In another study, Kulwinder (2014) examined motivational belief (intrinsic goal orientation, extrinsic goal orientation , task value, control of learning beliefs, self-efficacy for learning and performance and test anxiety) in relation to high and low levels of academic achievement among 176 university students from the different majors. The students were divided into the three groups as high achievers, average achievers and low achievers. The findings showed that the high achievers and average achievers differ significantly in their motivational beliefs namely task-value and control on learning beliefs. However, the students of high achievers and low achievers do not differ significant between them on motivational beliefs, namely intrinsic goal orientation, extrinsic goal orientation , task value, control of learning beliefs, self-efficacy for learning and performance and test anxiety. Moreover, the students of average achiever and low achiever groups do not have significant difference on task value pattern of motivational belief. The researcher concluded that the high achievers have more positive task-value beliefs and, thus, such motivational beliefs should be taken in consideration during teaching and learning process for academic excellence.

Metallidou and Vlachou (2007) examined motivational beliefs, cognitive engagement and achievement in language and mathematics in elementary school. The data were gathered from 263 Greek primary school students of fifth and sixth grade classes. The study also examined age and gender differences. As measurement instrument, the researchers used a 7-point Likert scale of Motivated Strategies for Learning Questionnaire (Pintrich & De Groot, 1990) which comprised of five factors: (a) Self-efficacy, (b) Intrinsic Value, (c) Test Anxiety,

(d) Cognitive Strategy Use, and (e) Self-regulation Strategies. In addition, students' academic achievement in Greek language and mathematics was evaluated with a 1- to 20- point comparative scale in relation to the rest of the class. The findings of the study drew attention to the key motivational role of self-efficacy in academic achievement and also it was found most significant predictor for students' achievement and cognitive strategy use.

Pintrich and De Groot (1990) performed a correlational study to examine the relationships between motivation, self-regulated learning, and classroom academic performance for 173 seventh graders in eight science and seven English classes. The researchers administered a self-report instrument to the students to assess their self-efficacy, intrinsic value, test anxiety, self-regulation, and use of learning strategies. In order to measure the performance, the authors evaluated work on the classroom assignments. The findings suggested that both self-efficacy, found as one of the best predictors of performance, and intrinsic value have positive relations with cognitive engagement and performance.

Thus, aforementioned studies revealed positive correlations between students' motivational beliefs and their academic achievement in different domains. The studies conducted specifically in science domain also revealed similar results. For example, in a study conducted in Turkey, Özkan (2003) studied with a sample of

980 tenth grade students, to examine the roles of students’ motivational beliefs (self-efficacy, intrinsic value and test anxiety) and learning styles on their biology achievement. As measuring instruments, the researcher used Turkish version of the Motivated Strategies for Learning Questionnaire, Learning Style Inventory, and Biology Achievement Test. The findings showed that self-efficacy and intrinsic value have low positive correlation with students’ biology achievement.

In a recent study, Yerdelen (2013) conducted a national cross-sectional study in Turkey with the 8198 seven grade students and 372 science teachers to examine the interrelations among 7th grade students’ science achievement, self-regulation in science class (i.e., self-efficacy, metacognitive self-regulation, mastery approach goals, mastery avoidance goals, performance approach goals, and performance avoidance goals), perceptions of classroom learning environment, and science teachers’ beliefs and occupational wellbeing. The findings showed that at the students’ self-efficacy beliefs in learning science and science teachers’ self-efficacy for student engagement were best predictors of Science Achievement.

Similarly, Areepattamannil, Freeman, and Klinger (2011) examined the predictive effects of students’ motivation for learning science and motivational beliefs, and science instructional practices on science achievement. The researchers worked with a sample composed of 13,985 Canadian students at the age of 15 who participated to the PISA- 2006. They evaluated students' motivation for learning science and motivational beliefs in terms of delectation of science, general affinity in science, instrumental motivation for learning science and future-focused motivation for learn science; and self-efficacy and self-concept in science. They evaluated the instructional practices by mean of science teaching including a center on specific applications, utilizing student inquiries, involving active participation activities, and interactive science teaching. They utilized students' demographics as control variables. The findings indicated that motivational beliefs and enjoying science had positive and significant effect on the science achievement. Additionally, self-efficacy was one of the variables having a quite strongly positive relation with the science achievement compared to other predictors. Based on the findings, the researchers argued that students who feel more confidence in performing science related tasks and have more positive perception for their ability to learn science are more likely to show higher science achievement.

Abovementioned findings are as expected considering the fact that students who have high self-efficacy generally show more resistance and spend more effort on the tasks when they confront with the difficulties (Pintrich & Schunk, 2002; Schunk and Zimmerman, 2006; Schunk & Mullen, 2012). Parajes (2002) also pointed self-efficacy as the key motivational belief to provoke motivation and engagement. However, the study conducted by Pintrich and his colleagues (Pintrich, Smith, Garcia & McKeachie, 1993) showed that both task-value and self-efficacy have positive correlation with the performance, nonetheless, the self-efficacy beliefs have stronger relations with the performance than task-value beliefs have. As stated in many empirical and theoretical studies, motivational beliefs like self-efficacy and task-value are influential for the subsequent behaviors and achievement task choices. Therefore, it is not possible to underestimate their roles in the academic achievement, especially science achievement (Areepattamannil, Freeman, and Klinger, 2011). Accordimgly, current study aims to examine to contribution of students motivational beliefs to their science achievement. Based on the available literature, it is expected that positive correlations exist between motivational beliefs and science achievement.

2.3 Cognitive Engagement

Cognitive engagement refers students' willingness to expend too much effort and long period of time to exactly comprehend a subject or master a difficult skill and the type of processing strategies that they use for learning (Fredericks, Blumenfeld & Paris, 2004; Ravindran, Greene, & Debacker, 2005; Rotgans & Schmidt, 2010). Cognitive engagement is an effective gauge of level of learning and academic achievement (Pintrich & Schrauben, 1992; Weinstein & Mayer, 1986). In other words, students' learning and achievement level have a strong a relation with their cognitive engagement. Successful students generally are more cognitively engaged with the task relative to less successful students. In addition, Fredericks et al. (2004) reported that the students cognitively engaged tend to utilize various learning strategies. These strategies are essential agents for students' achievement because they help the students learn fruitfully subjects that they study (Yumuşak, 2006).

Pintrich, Smith, Garcia and McKeachie (1993) classified learning strategies into two main categories namely, cognitive and metacognitive strategies. Weinstein and Mayer (1996) defined cognitive strategies as rehearsal (memorizing the subject by repeating words by oneself), elaboration (associating new learnings with previous knowledge), and organizational strategies (grouping the subject hierarchically) and critical thinking (transferring previously learned knowledge to new situations). Different studies revealed that cognitive strategy use are associated with academic achievement and power of this relation show changes depending on which cognitive strategy is used (Sedaghat, Abedin, Hejazi, and Hassanabadi, 2011; Yumuşak, 2006; Pintrich, Smith, Garcia, and McKeachie 1993). For example, cognitive strategies such as elaboration, organization, and critical thinking allow deeper processing of information while strategies like rehearsal as a cognitive strategy is associated with superficial processing of information (Weinstein & Mayer, 1986). Thus, students who use deep processing strategies like elaboration, organization and critical thinking are expected to show better academic performance compared to the students who use superficial or sallow strategies like rehearsal (Pintrich's et al., 1993; Sedaghat et al., 2011). However, Dowson and McInery (1998) reported that different strategies may be effective in different subject areas because usefulness of each strategy can change depending on the requirements and features of subject domain.

Metacognitive strategies concern cognitive regulation (Pintrich, 1999). In other words, these strategies involve thinking about how to think during learning or solving a problem (Metcalfe & Shimamura, 1994; Flavell, 1999; Livingston, 2003). Moreover, metacognitive strategies like monitoring, planning, and regulating strategies, enable the students to utilize their cognitive strategies more efficiently and have indirect effects on information processing and understanding (Linnenbrink & Pintrich, 2003). To exemplify, skimming the text before reading (planning), checking the comprehension level during the reading by asking question by oneself (monitoring), rereading the parts of the text which has not been understood (regulation) are instances of metacognitive strategies (Pintrich, 1999). Consequently, instructors desire their students to get more metacognitive and exhibit more metacognitive behaviors which are significant signs of cognitive engagement (Linnenbrink & Pintrich, 2003).

In some studies, cognitive engagement was assessed as cognitive and metacognitive strategies that the students utilize (Linnenbrink & Pintrich, 2003; Metallidou et al. 2007; Rastegar, Jahromi, Haghighi and Akbari, 2010). For example, Greene, Miller, Crowson, Duke, & Akey (2004) found that cognitive engagement, comprising of cognitive and metacognitive strategies, is a powerful factor which directly result in better performance. Therefore, students' cognitive engagement levels have an essential role in their academic achievement. Moreover, different empirical and theoretical studies produced findings manifesting the significant relation between cognitive engagement and the academic achievement (Butler & Winne, 1995; Pintrich, 2000; Zimmerman, 2000; Muis and Franco, 2009; Rotgans & Schmidt, 2010; Rastegar, Jahromi, Haghighi and Akbari 2010).

2.4 Students'Achivement in Relation to Cognitive Engagement

In the literature, it is commonly found that cognitive engagement and the academic achievement have a positive strong relation with each other (Ames and Archer, 1988; Pintrich & Schrauben, 1992; Weinstein & Mayer, 1986; Reschly, Huebner, Appleton, & Antaramian, 2008; Appleton, Christenson, Kim, & Reschly, 2006). That is to say, high cognitive engagement is associated with high academic achievement and better learning (Pintrich & Schrauben, 1992; Weinstein & Mayer, 1986). As stated before, cognitive engagement assessed in different studies as cognitive and metacognitive strategy usage of the students (Metallidou et al. 2007; Rastegar, et al., 2010). In other words, the metacognitive and cognitive strategies used during the learning refer to cognitive engagement. Moreover, cognitively engaged students generally prefer using various learning strategies (Fredericks et al., 2004). This situation can indicate how cognitive engagement and use of learning strategies like cognitive and metacognitive have strong associations with each other. The usage of various cognitive and metacognitive learning strategies (cognitive engagement) facilitates the students to learn the subjects meaningfully (Yumuşak, 2006). As a result, cognitive engagement can make positive contributions on the students' academic achievement. Pintrich, Smith, Garcia, and McKeachie's (1993) study also provided a support for the positive association expected between cognitive engagement (various cognitive and metacognitive usages) and academic achievement.

Parallel to the study conducted by Pintrich's et al., (1993), Sedaghat, Abedin, Hejazi, and Hassanabadi (2011) examined the relations among perceived ability, perceived instrumentality, achievement goals, cognitive engagement, and academic achievement. A sample composed of 1371 (708 males and 663 females) high school students participated in the study. Approaches to Learning (ATL) scale (Miller, DeBacker, & Green, 1999) was used for measuring student's perceived ability and achievement goals by means of learning, performance-approach, performance-avoidance, and future goals/perceived instrumentality. Cognitive scale of the MSLQ (Pintrich et al., 1993) was utilized for assessing students' cognitive engagement (shallow and deep cognitive learning strategies). The findings of the study revealed that the perceived ability and deep strategy use predicted achievement significantly and positively. On the contrary, shallow strategy use and performance goal predicted achievement significantly and negatively. The results remarked that cognitive strategy usage (a direct sign of cognitive engagement) and perceived ability and performance goals could show the level of academic achievement as predictors of academic achievement.

In another study, Dowson, et al., (1998) explored how motivational (academic and social goals) and cognitive (cognitive and metacognitive strategies) variables shape middle school students' performance in mathematics and English. The participants of the study were 602 Australian middle school students (328 females and 274 males). The results of the study showed that students' mathematics achievements were significantly associated with monitoring, regulating and cognitive strategy use and nevertheless, English achievement had a significant relation with students' monitoring and regulating strategy use. The researcher concluded that mathematics and English achievement might be interrelated with cognitive and metacognitive strategies use. They also emphasized that different subject areas required usage of diverse strategies because usefulness of each strategy could show changes according to features of the related subject area which students studied on.

Miller, Greene, Montalvo, Ravindran, and Nichols (1996) managed a two-stage exploratory study with 297 high school math students to examine motivation, perceived ability, and engagement (self-regulatory activities, use of deep or shallow strategies, effort and persistence) and academic achievement. The researchers explored the degree to which scores of self-reports of motivation, perceived ability, and engagement (self-regulatory activities, use of deep or shallow strategies, effort and persistence) predicted the academic achievement. The results of the study's first stage indicated that cognitive engagement variables (effort, persistence, and self-regulation) and the achievement have positive correlation and cognitive engagement variables explained 24% of the variance in achievement. Nevertheless, the results of the study' second phase showed incongruities with previous findings despite of replicating and extending them. The later findings revealed that the persistence and perceived ability could significantly predict the academic achievement and explain 28% of the variance in achievement.

Pintrich and De Groot (1990) studied with 173 seventh grade students (100 girls and 73 boys) with a mean age of 12.6 years from science and English classrooms in USA to probe motivational (intrinsic value, self-efficacy and test anxiety) and self-regulated learning (cognitive strategy use including rehearsal, elaboration and organizational strategies and self-regulation including metacognitive and effort management strategies) components of classroom academic performance. The researchers used MSLQ to measure motivational and self-regulated learning components, and they evaluated the academic performance in term of classroom tasks and assignments. The findings displayed that cognitive engagement was positively associated with each three variables of self-efficacy and intrinsic value and performance.

Overall, aforementioned studies suggested a positive correlation between cognitive engagement and achievement in different academic domains. The studies conducted specifically in the science domain also produced similar results. For example, Akyol (2009) conducted a study comprising 1517 seventh grade students to investigate the differences in the level of students' cognitive and metacognitive strategy use and the contribution of cognitive and metacognitive strategy use (rehearsal, elaboration, organization, critical thinking, and metacognitive self-regulation) to the students' science achievement. In addition, the relations between students' background characteristics (gender, prior knowledge, socioeconomic status) and the variables including students' cognitive and metacognitive strategy use and science achievement were examined. The results indicated that students' science achievements were significantly predicted by the students' use of elaboration and metacognitive self-regulation strategies. Moreover, the variables of prior knowledge, mother's educational level, father's educational level, number of reading materials at home, frequency of buying a daily newspaper, presence of a separate study room, presence of a computer with internet connection at home had a relation with cognitive and metacognitive strategy use and science achievement.

Kaya and Kablan (2013) managed a national study comprising of 574 fourth grade primary school students to explore the relations between students' strategy use and science achievement. The researcher utilized a self-report scale to evaluate students' cognitive- metacognitive strategies use (rehearsal, elaboration, organization, critical thinking, and metacognitive self-regulation) and resource management (managing time and study environment, effort regulation, peer learning, and help seeking). To evaluate the science achievement, they used the modified questionnaire from The Trends in Mathematics and Science Study (TIMSS) 2007. The results showed that combination of effort regulation, metacognitive self-regulation and critical thinking accounted for 13% of variance in the science scores.

In sum, related literature has remarked cognitive engagement as a good indicator of students' learning and achievement. As in many other domains, science achievement was also found to be associated with the students' cognitive engagement level. Indeed, cognitively engaged students appeared to use various strategies in their learning. Thus, in the current study, it is expected that cognitive engagement is positively linked to science achievement.

2.5 Relationships between Motivational Beliefs and Cognitive Engagement

Different studies revealed that motivational beliefs (self-efficacy and task value) and cognitive engagement (cognitive and metacognitive strategies use) are associated with each other (Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Linnenbrink and Pintrich, 2003; Schunk 2005; Sungur, 2007; Sungur & Güngören, 2007; Yumusak, Sungur, & Çakıroğlu, 2007; Kahraman & Sungur, 2011). For instance, Pintrich and his colleagues' studies results (Pintrich, 1989; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991) revealed that self-efficacy and task-value beliefs had a strong and positive association with the use of cognitive strategies (eg. rehearsal, elaboration, and organizational strategies) and metacognitive strategies (eg. planning, monitoring, and regulating) and higher academic performance. Similarly, Yumusak, Sungur and Cakiroglu (2007) conducted a study with 519 tenth grade students to examine the contribution of motivational beliefs, cognitive and metacognitive strategy use to high school students' achievement in biology. MSLQ (Pintrich et al., 1991) and biology achievement test were used to gather the data from the participants. The findings of the study revealed that motivational beliefs accounted for 10% of variance in biology achievement. In addition to that, motivational beliefs like intrinsic goal orientation, task value and self-efficacy were positively linked to cognitive and metacognitive strategy use (cognitive engagement). A separate study, comprising of 391 high school students, was conducted by Sungur (2007) to explore the relationships between motivational beliefs and metacognitive strategy use. The result of the study indicated that task value beliefs, self-efficacy, and control of learning beliefs have significant and positive relationships with metacognitive strategy use.

In another study, Kahraman and Sungur studied with 115 seventh grade students to examine students' use of metacognitive strategies such as such as planning, monitoring, and evaluating. The result of the study indicated that self-efficacy was a significant and positive predictor of students' metacognitive strategies. Moreover, according to Linnenbrink and Pintrich (2003) the use of deeper processing strategies was activated by the students' self-efficacy beliefs and high self-efficacy provide the students to expend more effort to comprehend a problem and to consider it deeply. Consequently, it was stated that self-efficacy beliefs and cognitive engagement have positive interrelation each other. Furthermore, the study by Schunk (2005) indicated that high self-efficacy facilitated the students to dynamically use cognitive and metacognitive strategies, in this way, students showed more academic performance. Briefly, as stated by Linnenbrink and Pintrich (2003), self-efficacy beliefs have direct relation with behavioral, motivational and cognitive engagement of the students on academic tasks. This means that students with high self-efficacious have tendency to exert great effort to deal with problems and to achieve a task and they also use effective learning strategies like cognitive and metacognitive strategies and show intrinsic interest in academic tasks.

Moreover, Sungur and Güngören (2007) argued that the level of the students' intrinsic interest in academic task and perception of usefulness and importance of the academic tasks are signals of their cognitive engagement level and academic achievement. In other words, if a student has high level of intrinsic interest in academic task and perception of usefulness and importance of academic tasks, students will be more likely to show more cognitive engagement and attain better academic achievement. Since intrinsic interest in academic task and perception of usefulness and importance of academic tasks are component of the task-value, it can be expressed that the students' task-value beliefs are positively associated with their cognitive engagement level (cognitive and metacognitive strategy use) (Pintrich & De Groot, 1990; Sungur, 2007; Yumusak, Sungur, & Çakıroğlu, 2007). In another study, similar results reported by Pintrich and Schrauben (1992).

They stated that although value beliefs like importance and utility might not directly influence the learning or achievement, they had function providing rise in the cognitive engagement and use of diverse cognitive and metacognitive strategies. Based on the findings of related literature, it can be expressed that cognitive engagement and task-value beliefs have a positive association with each other. In other words, the students who have high task-value beliefs on an academic task most probably show more cognitive engagement on this task. Even that these beliefs directly affect the academic achievement as stated by Pintrich and Schrauben (1992), they still have an important role in increasing students' cognitive engagement (cognitive and metacognitive strategy use). In this way, task-value beliefs can make contribution on the students' academic achievement, specifically science achievement.

To sum up, students' motivational beliefs like self-efficacy and task-value are positively associated with the students' cognitive engagement level (cognitive and metacognitive strategy use). This means that the students who have such kind of beliefs more likely exhibit more cognitively engaged behaviors. Accordingly, they show more persistence, exert more effort and use various cognitive and metacognitive strategies to comprehend related subject contents. This situation can contribute on students' learning and academic achievement. Accordingly, in the present study, positive associations were predicted between motivational beliefs and cognitive engagement.

2.6 Summary of the Findings

Aforementioned literature revealed that students' motivational beliefs (i.e. self-efficacy and task value) and cognitive engagement are positively linked to their achievement. In addition, positive associations were found between motivational beliefs and cognitive engagement.

CHAPTER III

METHOD

This part presents the research method under the seven subtitles which are design of the study, population and sampling, instruments, data collection, data analysis, limitations and assumptions, threats to internal validity and ethical issues.

3.1 Design of the Study

The investigation of how the seventh grade elementary students' motivational beliefs and cognitive engagement contribute to the prediction of their science achievement and how the seventh grade elementary students' motivational beliefs have a relation with their cognitive engagement level are the main purposes of this study. To examine these relationships, a correlational study based on the data from self-reports instrument was realized.

3.2 Population and Sampling

The target population of the study is all seventh grade public elementary school students in Ankara. Since it is not easy to reach to this target population, it is appropriate to identify an accessible population. The accessible population is all seventh grade public elementary school students in Etimesgut District. The result of the current study was generalized to this population.

Cluster random sampling and convenience sampling methods were utilized to reach the sample of the present study. During the sampling process, firstly Etimesgut district was selected by convenience sampling method, considering transportation, money, and administrative restrictions. Then, five different elementary schools were randomly selected as clusters from this district. The total number of the elementary public schools in Etimesgut District is 42 according to Etimesgut Education Directorate. Numbers were randomly assigned to each school and table of random numbers was utilized to determine the participant elementary public schools. Following this procedure, 5 elementary public schools were selected accessing 12 % of the schools in the target district. The table 3.1 displays the schools and the number of the students in each school participating in the study.

Table 3.1 The Schools and their Corresponding Students Numbers

The schools involved in the study	Number of students	Percentage of students (%)
School 1	506	58.77
School 2	114	13.24
School 3	87	10.10
School 4	31	3.60
School 5	123	14.29
Total	861	100.00

Accordingly, the participants of this study were 861 seventh grade students from five elementary public schools in Etimesgut District. Of 861 students, 398 (46.2 %) were girls and 456 (53.0 %) were boys. Their mean age was 13.09 (*SD*= .55). Their mean last semester science grade was 3.83 (*SD*= 1.06). About 72 % of the participants come from the families with 2 or 3 children. About 70% of participants' mothers are unemployed. However, about 90% of participants' fathers are employed. Nearly 58% of the participants' mothers' education level is middle school or lower. About 60% of the participants' fathers are from high school or higher, nearly 40 % of the participants have books between 26 and 100 in their homes. Few students (7%) have lower than ten books in their homes. 12% of them has more than 200 books in their homes. 64% of the participants' families sometimes buy newspapers. Nevertheless, 23 % of the participants' families never buy newspapers. Most participants have a study room (84%), a computer (83%) and internet connection (%73) in their homes. Detailed background information was presented in table 3.2.

Table 3.2 Background Characteristics of Students

	Frequency(f)	Percent (%)
GENDER		
Girl	398	46.2
Boy	456	53.0
AGE		
14	111	12.9
13	728	84.6
12	2	0.2
Other	2	0.9

Table 3.2 Background Characteristics of Students (continued)

NUMBER OF SIBLING		
0	84	9.8
1	363	44.2
2	257	29.8
3	90	10.5
4	45	5.2
5 or more	11	1.3
LAST TERM SCIENCE GRADE		
1	21	2.7
2	71	8.2
3	212	24.6
4	259	30.1
5	277	32.2
MOTHER'S EDUCATIONAL LEVEL		
Illiterate	19	2.2
Primary school	250	29.0
Secondary school	217	25.2
High school	243	28.2
University	88	10.2
MSc	19	2.2
PhD	0	0
FATHERS' EDUCATIONAL LEVEL		
Illiterate	5	0.6
Primary school	127	14.8
Secondary school	191	22.2
High school	287	33.3
University	182	21.1
MSc	33	3.8
PhD	4	0.5
MOTHERS' EMPLOYMENT STATUS		
Employed	225	26.1
Unemployed	598	69.5
No Regular Job	13	1.5
Retired	13	1.5
FATHERS' EMPLOYMENT STATUS		
Employed	773	89.8
Unemployed	15	1.7
No Regular Job	16	1.9
Retired	36	4.2

Table 3.2 Background Characteristics of Students (continued)

NUMBER OF READING MATERIALS AT HOME		
0-10 books	62	7.2
11-25 books	216	25.1
26-100 books	314	36.5
101-200 books	154	17.9
More than 200 books	100	11.6
PRESENCE OF A SEPARATE STUDY ROOM		
Have a separate study room	719	83.5
Do not have a separate study room	125	14.5
FREQUENCY OF BUYING A DAILY NEWSPAPER		
Never	191	22.2
Sometimes	551	64.0
Always	95	11.0
PRESENCE OF A COMPUTER		
Have a computer	720	83.6
Do not have a computer	118	13.7
PRESENCE OF AN INTERNET CONNECTION		
Have an internet connection	623	72.4
Do not have internet connection	221	25.7

3.3 Instruments

Three data collection instruments were used in the study. The first instrument is Background Characteristics Survey, and second instrument is Motivation and Cognitive Engagement Scale (MCES), a questionnaire comprising the combination of selected items from the Science Learning Inventory (SLI- Part A) and from Motivated Strategies for Learning Questionnaire (MSLQ) in order to measure the motivational beliefs (self-efficacy and task-value) and the level of the cognitive engagement of the students, and the last instrument is Science

Achievement Test for 7th Grade (SAT). The name of the instruments and the variables assessed were summarized in Table 3.3

Table 3.3 Data Collection Instruments and Variables

Instruments	**Variables**
Background Characteristics Survey	Gender Age Number of Sibling Last Term Science Grade Mother's Educational Level Father's Educational Level Mother's Employment Status Father's Employment Status Number of Reading Materials at Home Presence of a Separate Study Room Frequency of Buying a Daily Newspaper Computer Internet Connection
Motivation and Cognitive Engagement Scale (MCES)	Cognitive strategies Metacognitive strategies Self-efficacy Task value
SAT (Yerdelen, 2013)	Science achievement

3.3.1. Background Characteristics Survey

This instrument has 13 items searching the background characteristics of the participants in terms of gender, age, previous semester science grade, number of siblings, parents' educational level and their employment status, number of reading materials at home, frequency of buying a daily newspaper, presence of a separate study room, a computer and an internet connection (see Appendix-A).

3.3.2. Motivation and Cognitive Engagement Scale (MCES)

Motivation and Cognitive Engagement Scale was used to assess students' motivational beliefs and cognitive engagement in science. The scale was constructed using the items from The Motivated Strategies for Learning Questionnaire (Pintrich, Garcia & McKeachie, 1991) and Science Learning Inventory (Seyedmonir, 2000). Detailed information about each of the instrument and the procedure followed during the scale construction were explained in the following sub-sections.

3.3.2. 1. The Motivated Strategies for Learning Questionnaire (MSLQ)

The Motivated Strategies for Learning Questionnaire (MSLQ) was developed by Pintrinch, et al., (1991). This is a self-report instrument including 81-items on a Likert scale ranging from 1 (not at all true of me) to 7 (very true of me). Two main parts, namely Motivation Section and Learning Strategies Section, constitute the instrument. The Motivation Section is composed of 31 items evaluating distinctive dimensions of students' motivation. The motivational dimensions evaluated in this section are intrinsic goal orientation (4 items), extrinsic goal orientation (4 items), task value (6 items), control of learning beliefs (4 items), self -efficacy for learning and performance (8 items), and test anxiety (5 items). The Learning Strategies Section includes 50 items evaluating students' cognitive and metacognitive strategy usages in nine dimensions: rehearsal (4 items), elaboration (6 items), organization (4 items), critical thinking (5 items), metacognitive self-regulation (12 items), time and study environment (8 items), and effort regulation (4 items), peer learning (3 items) and help seeking (4 items).

Studying with 380 college students coming from the different majors Pintrich and McKeachie (1993) conducted a study to validate the MSLQ. In the validation study, Cronbach alpha coefficients of the sub-scales in the motivation section ranged from .62 to .93. The reliability coefficients of the sub-scales in the learning strategies section ranged from .52 to .80. Confirmatory factor analyses revealed that the motivation section with 6 factors (χ^2/df = 3.49, GFI = .77, AGFI = .73, RMR = .07) and the learning strategies section with 9 factors (χ^2/df = 2.26, GFI = .78, AGFI = .75 RMR = .08) had a reasonable model fit. The authors suggested that MSLQ sub-scales are modular, and researchers can use any sub-scale depending on their research purpose.

Sungur (2004) translated and adapted the MSLQ into Turkish. During its validation for Turkish sample, the author worked with a total of 488 high school students. For the Turkish version of the MSLQ, reliability coefficients of the subscales in the motivation section ranged from .54 to .89 while that of the learning strategies section ranged from .57 to .81. Providing similar fit indices with the original version of the MSLQ, CFA results suggested that Turkish version of the MSLQ also had a reasonable model fit for the motivation section (χ^2/df = 5.3, GFI = .77, RMR = .11) and the learning strategies section (χ^2/df = 4.5, GFI = .71, RMR = .08). In the current study, items from task value, self -efficacy for learning and performance, and rehearsal sub-scales were used while constructing the Motivation and Cognitive Engagement Scale.

3.3.2.2 Science Learning Inventory (SLI)

Science Learning Inventory (SLI) is a self-report instrument on a five-point scale developed by Seyedmonir (2000). This questionnaire is composed of two main parts as SLI-A part (conceptual ecology and cognitive engagement) and SLI-B part (science epistemology). SLI-A part comprise 48 items in the three sub-scales, namely; Existing Conceptions (11 items), Motivation (21 items), and Cognitive Engagement and Processes (16 items). SLI-B part includes 48 items in the subtitles of Scientific World View (21 items), and Scientific Inquiry (27 items). In the present study items selected from Motivation and Cognitive Engagement and

Processes sub-scales in SLI-A were used while constructing the Motivation and Cognitive Engagement Scale (MCES).

During the validation study of the SLI-A, Seyedmonir used principle component factor analysis to build the seven factor structure and examined the factor loading of the items using orthogonal varimax rotation. The convergent and divergent validity of the SLI-A scale was ensured checking the correlation of the scale with already existing scales. Also the stability of the scale was provided by checking the correlation scores of four-week-test-retest application.

3.3.2.3 Construction of Motivation and Cognitive Engagement Scale

The MCES was constructed to measure students' motivational beliefs and cognitive engagement in three dimensions, namely self-efficacy, task value, and cognitive engagement. Accordingly, during the construction of the MCES, items targeting students' self-efficacy, task value and cognitive engagement were selected from the MSLQ and SLI-A. More specifically, in order to assess students' self-efficacy in science, 8 items were selected from the self-efficacy for learning and performance sub-scale of the MSLQ and 5 items were selected from the motivation sub-scale of the SLI-A. In order to assess students' task value beliefs in science 6 items from the task value subscale of the MSLQ and 7 items from the motivation sub-scale of the SLI-A were selected. In addition, in order to assess the students' cognitive engagement, 15 items were selected from cognitive engagement and processes sub-scale of SLI-A and one item was selected from metacognitive self-regulation sub-scale of the MSLQ.

Table 3.4 presents the proposed dimensions of the MCES, corresponding items, and source of the items before the pilot study.

Table 3.4 The items used in MCES and their dimension and their source

Dimension		Item	instrument
	q2	I believe I will receive an excellent grade in this class.	MSLQ
	q4	I'm certain I can understand the most difficult material presented in the readings for this course.	MSLQ
	q6	I'm confident I can understand the basic concepts taught in this course.	MSLQ
Self-Efficacy	q8	I'm confident I can understand the most complex material presented by the instructor in this course.	MSLQ
	q11	Despite trying hard, one will never understand some science concepts	SLI-A
	q12	I'm confident I can do an excellent job on the assignments and tests in this course.	MSLQ
	q15	I expect to do well in this class.	MSLQ
	q18	Different theories about things makes learning science difficult or confusing	SLI-A

Table 3.4 The items used in MCES and their dimension and their source (Continued.)

	q19	When learning a new scientific concept, I sometimes wonder if I can get through its complexity and finally “understand” what it says	SLI-A
Self-Efficacy	q21	I believe my high-school science background is sufficient to help me succeed in college science courses	SLI-A
	q23	It is hard for me to sort out conflicting information and facts	SLI-A
	q24	I'm certain I can master the skills being taught in this class.	MSLQ
	q26	Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.	MSLQ
	q1	I think I will be able to use what I learn in this course in other courses.	MSLQ
	q3	I find science to be closely related to everyday life situations or experiences.	SLI-A
	q5	It is important for me to learn the course material in this class.	MSLQ
Task-Value	q7	Understanding the concepts in science is more important to me than the grade I get	SLI-A
	q9	Learning science, in general, is boring to me	SLI-A
	q10	I am very interested in the content area of this course.	MSLQ
	q13	I don’t expect myself using much of the concepts covered in science classes other than recalling them for exams	SLI-A

Table 3.4 The items used in MCES and their dimension and their source (Continued.)

	q14	I like reading scientific magazines or books	SLI-A
	q16	I find most of the materials in science courses not relevant to my personal life	SLI-A
Task-Value	q17	I think the course material in this class is useful for me to learn.	MSLQ
	q20	I like the subject matter of this course.	MSLQ
	q22	Understanding the subject matter of this course is very important to me.	MSLQ
	q25	I do / would enjoy working on science projects, activities, or exercises.	SLI-A
	q1	When I read a science textbook, I mostly pay attention to the factual information	SLI-A
	q2	I use analogies and examples to help me learn and/or explain new materials or experiences	SLI-A
Cognitive Engagement	q3	If I am learning a new concept, I relate it to something that I have already learned or know about.	SLI-A
	q4	In science classes I go along with the information presented in the class even if I don't agree	SLI-A
	q5	I have passed a science course by primarily memorizing its factual content	SLI-A
	q6	When I read an interesting idea or topic, I usually think of asking questions and possible answers to those questions	SLI-A

Table 3.4 The items used in MCES and their dimension and their source (Continued.)

	q7	If I don't agree with a scientific concept presented in class, I often speak up or ask questions in class	SLI-A
	q8	When I am reading a textbook or listening to a lecture, I pause regularly to check my comprehension of the material	SLI-A
	q9	When studying a chapter in my science textbooks, I often create diagrams, charts, and concept maps to help me organize the information	SLI-A
	q10	When I get my science tests back, I go over my mistakes to figure out why	SLI-A
Cognitive Engagement	q11	I tend to memorize concepts for most of my science tests	SLI-A
	q12	I ask myself questions to make sure I understand the material I have been studying in this class.	MSLQ
	q13	In my science classes, I only study things that I know will be on a test or assignment	SLI-A
	q14	When I read a science textbook, I think about the applications of the concept being discussed	SLI-A
	q15	I usually end up cramming for my science tests a day or two before the exam	SLI-A
	q16	When I study scientific theories or concepts, I try to integrate them by identifying some of their commonalties and/or differences	SLI-A

In a more detailed manner, the procedure used to construct the MCES was as follows: The MSLQ items used in the MCES were already adapted into Turkish by Sungur (2004). In the present study, the selected Motivation and Cognitive Engagement and Processes sub-scales items in SLI-A were translated and adapted into Turkish by the researcher. The translated version of the items (see Appendix-C) was examined by two instructors from faculty of education for content validity. The instructors also examined the items for clarity, comprehensiveness, and sentence structure. Additionally, an expert in an Academic Writing Center in a large university checked for the grammar structure of the translation. Moreover, in order to determine whether the items were clear and understandable for the seventh grade students, the translated items were administered to three seventh grade students and their opinions regarding the clarity of the items were gathered. Based on the feedbacks from the experts and the students, minor revisions were made in a few items and items were prepared on a 4-point scale. After making necessary revisions, the MCES with 42 items from the MSLQ and SLI-A was pilot tested. Of 42 items, 13 belong to self-efficacy sub-scale, 13 belong to task value sub-scale, and 16 belong to cognitive engagement subscale.

A pilot study was carried out with 251 seventh grade students to evaluate the psychometric properties of the MCES. Result revealed that the MCES sub-scales had sufficiently high internal consistencies as indicated by Cronbach's alpha values of .86 for self-efficacy, .86 for task-value, and .81 for cognitive engagement. In order to validate the 3-factor structure of the MCES, a Confirmatory Factor Analysis (CFA) was executed by using LISREL 8.80. While executing CFA, Robust Maximum Likelihood Estimation method was utilized against the violation of the multivariate normality which is an essential assumption of CFA (Kline, 2011). Data appeared not to ensure the multivariate normality assumption since multivariate skewness (386.25) and kurtosis (1886.03) values, provided by LISREL 8.80, were not in the acceptable level.

According to CFA results, although the goodness of fit indices (GFI) were not within acceptable limits, remaining indices supported the three factor structure of the MCES and model fit was good (χ^2/df = 1.55, CFI=.97, GFI = .79, NFI=.93, RMR = .05, SRMR=.06, RMSEA=.05). Table 3.4 presents lambda ksi estimates for each item in MCES after the pilot study.

Table 3.5 Lambda ksi Estimates for The Motivation and Cognitive Engagement Scale (MCES) in the Pilot Study

Self –Efficacy Sub-scales		**Task Value Sub-scales**		**Cognitive Engagement Sub-scales**	
Questions	LX Estimate	Questions	LX Estimate	Questions	LX Estimate
q2	.70	q1	.55	q1	.57
q4	.60	q3	.49	q2	.69
q6	.64	q5	.75	q3	.65
q8	.61	q7	.42	q4	.25
q11	.31	q9	.48	q5	.01
q12	.65	q10	.58	q6	.67

Table 3.5 Lambda ksi Estimates for The Motivation and Cognitive Engagement Scale (MCES) in the Pilot Study (Continued.)

q15	.71	q13	.29	q7	.57
q18	.22	q14	.68	q8	.58
q19	.20	q16	.19	q9	.41
q21	.58	q17	.68	q10	.61
q23	.28	q20	.69	q11	.19
q24	.67	q22	.70	q12	.66
q26	.65	q25	.60	q13	.13
				q14	.61
				q15	- .01
				q16	.56

However, in order to improve the reliability and validity of the instrument, some revisions were made based on the results of the pilot study and feedbacks from the participants during the administration of the instrument. For example, during the administration of the instrument, it was realized that one of the items of the self-efficacy sub-scale “When learning a new scientific concept, I sometimes wonder if I can get through its complexity and finally understand what it says” was difficult for students to understand. Also, reliability analysis of the self-efficacy sub-scale showed that deletion of this item led to a sharp increase in the reliability value. Considering this finding and the fact that there was another item with a similar meaning in the MCES (see q.8 in Table 3.4), this item (see q.19 in the Table 3.4) was decided to be removed from the instrument.

Another item deleted according to the analysis of the pilot study’s data was “I usually end up cramming for my science tests a day or two before the exam”.

Elimination of the item created the highest reliability increase in cognitive engagement part of the instrument according to internal consistency analysis. So the item was removed from the scales (see q.15 in the Table 3.4). Nevertheless, considering the validity issue, four new items from the MSLQ were added to the instrument to better represent the cognitive engagement as a construct.

Since the item (see q.16 in Table 3.4) "I find most of the materials in science courses not relevant to my personal life" in task-value sub-scale did not contribute well to the total reliability of this sub-scale, this item was decided to be rearranged positively. Because, some research suggest that elementary school students experience difficulty in understanding negative statements, and they may not reflect their actual opinions when they face with such negatively worded items (Benson & Hocevar, 1985; Marsh, 1984).

Another revision was made on the item "No matter how hard I try, there are some science concepts that I will never understand" in self-efficacy sub-scale (see q.11 in Table 3.4). For the purpose of improvement in the validity, the expression "I will never understand" was decided to be emphasized by writing it in bold in order to attract the attention of the participants to the expression.

Finally, in the item "the fact that there are different theories to describe the same phenomenon makes learning science difficult or confusing for me" was rearranged in the way that "the fact that there are different theories *(e.g. atom theories)* to describe the same phenomenon makes learning science difficult or confusing for me" to make the meaning of the item more clear considering feedback from the participants in the pilot study. In this way, the validity of the self-efficacy sub-scale was tried to be improved (see q.18 in Table 3.4).

After these modifications, the revised instrument consisted of 44 items. Among these items, 12 belong to self-efficacy sub-scale, 13 belong to task value sub-scale, and 19 belong to cognitive engagement subscale. Table 3.6 shows the proposed dimensions of the MCES, corresponding items, and the name of the instruments where items were selected and the item status after the revision of the MCES.

Table 3.6 The items used in MCES and their dimensions and their sources, and the items status after the revision.

Dimension	Item		Instrument	Item Status
	q2	I believe I will receive an excellent grade in this class.	MSLQ	Retained
Self-Efficacy	q4	I'm certain I can understand the most difficult material presented in the readings for this course.	MSLQ	Retained

Table 3.6 The items used in MCES and their dimensions and their sources, and the items status after the revision (continued).

	q6	I'm confident I can understand the basic concepts taught in this course.	MSLQ	Retained
	q8	I'm confident I can understand the most complex material presented by the instructor in this course.	MSLQ	Retained
	q11	Despite trying hard, one will never understand some science concepts	SLI-A	Retained After Revision
	q12	I'm confident I can do an excellent job on the assignments and tests in this course.	MSLQ	Retained
	q15	I expect to do well in this class.	MSLQ	Retained
Self-Efficacy	q18	Different theories about things makes learning science difficult or confusing	SLI-A	Retained After Revision
	q19	When learning a new scientific concept, I sometimes wonder if I can get through its complexity and finally “understand” what it says	SLI-A	Deleted
	q21	I believe my high-school science background is sufficient to help me succeed in college science courses	SLI-A	Retained

Table 3.6 The items used in MCES and their dimensions and their sources, and the items status after the revision (continued).

Self-Efficacy	q23	It is hard for me to sort out conflicting information and facts	SLI-A	Retained
	q24	I'm certain I can master the skills being taught in this class.	MSLQ	Retained
	q26	Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.	MSLQ	Retained
Task-Value	q1	I think I will be able to use what I learn in this course in other courses.	MSLQ	Retained
	q3	I find science to be closely related to everyday life situations or experiences.	SLI-A	Retained
	q5	It is important for me to learn the course material in this class.	MSLQ	Retained
	q7	Understanding the concepts in science is more important to me than the grade I get	SLI-A	Retained
	q9	Learning science, in general, is boring to me	SLI-A	Retained
	q10	I am very interested in the content area of this course.	MSLQ	Retained

Table 3.6 The items used in MCES and their dimensions and their sources, and the items status after the revision (continued).

	q13	I don't expect myself using much of the concepts covered in science classes other than recalling them for exams	SLI-A	Retained
	q14	I like reading scientific magazines or books	SLI-A	Retained
	q16	I find most of the materials in science courses not relevant to my personal life	SLI-A	Retained After Revision
Task-Value	q17	I think the course material in this class is useful for me to learn.	MSLQ	Retained
	q20	I like the subject matter of this course.	MSLQ	Retained
	q22	Understanding the subject matter of this course is very important to me.	MSLQ	Retained
	q25	I do / would enjoy working on science projects, activities, or exercises.	SLI-A	Retained
	q1	When I read a science textbook, I mostly pay attention to the factual information	SLI-A	Retained
Cognitive Engagement	q2	I use analogies and examples to help me learn and/or explain new materials or experiences	SLI-A	Retained

Table 3.6 The items used in MCES and their dimensions and their sources, and the items status after the revision (continued).

	q3	If I am learning a new concept, I relate it to something that I have already learned or know about.	SLI-A	Retained
	q4	In science classes I go along with the information presented in the class even if I don't agree	SLI-A	Retained
	q5	I have passed a science course by primarily memorizing its factual content	SLI-A	Retained
Cognitive Engagement	q6	When I read an interesting idea or topic, I usually think of asking questions and possible answers to those questions	SLI-A	Retained
	q7	If I don't agree with a scientific concept presented in class, I often speak up or ask questions in class	SLI-A	Retained
	q8	When I am reading a textbook or listening to a lecture, I pause regularly to check my comprehension of the material	SLI-A	Retained
	q9	When studying a chapter in my science textbooks, I often create diagrams, charts, and concept maps to help me organize the information	SLI-A	Retained

Table 3.6 The items used in MCES and their dimensions and their sources, and the items status after the revision (continued).

	q10	When I get my science tests back, I go over my mistakes to figure out why	SLI-A	Retained
	q11	I tend to memorize concepts for most of my science tests	SLI-A	Retained
	q12	I ask myself questions to make sure I understand the material I have been studying in this class.	MSLQ	Retained
	q13	In my science classes, I only study things that I know will be on a test or assignment	SLI-A	Retained
Cognitive Engagement	q14	When I read a science textbook, I think about the applications of the concept being discussed	SI-A	Retained
	q15	I usually end up cramming for my science tests a day or two before the exam	SLI-A	Deleted
	q15	I make lists of important terms for this course and memorize the lists	MSLQ	Added
	q16	When I study scientific theories or concepts, I try to integrate them by identifying some of their commonalties and/or differences	SLI-A	Retained

Table 3.6 The items used in MCES and their dimensions and their sources, and the items status after the revision (continued).

	q17	When studying for this class, I read my class notes and the course readings over and over again.	MSLQ	Added
Cognitive Engagement	q18	I memorize key words to remind me of important concepts in this class.	MSLQ	Added
	q19	When I study for this class, I practice saying the material to myself over and over.	MSLQ	Added

In the main study, the revised instrument (see Appendix-B) was used. The revised instrument comprised 44 items clustering under a 3-factor model with a reasonably good fit (χ^2/df = 2.95, CFI=.97, GFI = .85, NFI=.93, RMR = .05, SRMR=.06, RMSEA=.05). Moreover, in main study sub-scale reliabilities ranged from .64 to .84 (Self-efficacy Cronbach's alpha = .64, Task-value Cronbach's alpha=.73 and Cognitive Engagement Cronbach's alpha=.84). Lambda ksi estimates presented in Table 3.7 shows that items had sufficiently high factor loadings for the motivational beliefs and cognitive engagement.

Table 3.7 Lambda ksi Estimates for The Motivation and Cognitive Engagement Scale (MCES) in the Main Study

Self –Efficacy Sub-scales		Task Value Sub-scales		Cognitive Engagement Sub-scales	
Questions	LX Estimate	Questions	LX Estimate	Questions	LX Estimate
q2	.55	q1	.49	q1	.58
q4	.54	q3	.55	q2	.67
q6	.63	q5	.64	q3	.58
q8	.55	q7	.35	q4	.23
q11	.30	q9	.39	q5	.12
q12	.62	q10	.59	q6	.61
q15	.72	q13	.28	q7	.53
q18	.30	q14	.56	q8	.51
q20	.63	q16	.60	q9	.34
q22	.31	q17	.71	q10	.60
q23	.68	q19	.63	q11	.22
q25	.70	q21	.70	q12	.61
		q24	.60	q13	.08
				q14	.59
				q15	.36
				q16	.60
				q17	.46
				q18	.42
				q19	.54

3.3.3 The Science Achievement Test (SAT)

The science Achievement Test for 7th Grade (SAT-7th Grade) aims to evaluate seventh grade elementary students' science accomplishment (Yerdelen, 2013) (See Appendix-D). This test comprises 14 multiple-choice questions about the subject matters, Body Systems (BS), Force and Motion (FM), and Electricity (EC), of the first semester seventh grade elementary science and technology curriculum, implemented countrywide in Turkey. The multiple–choice questions in the SAT were selected from the pool of the questions used in the previous years' Level

Determination Exams (Seviye Belirleme Sınavı; SBS) for the seventh grade students. In the SAT, seven questions were related to the Body Systems unit, four questions were related to the Force and Motion unit and four questions were related to the Electricity unit. Number of items for each unit was determined considering the time allotted for each unit during instruction. The items were at knowledge level (q.9 and q.11), comprehension level (q.1, q.4, q.5, q.6, q.7, q.8, q.10, q.12, q.13 and q.14) and application level (q.2 and q.3) in the Bloom's taxonomy. The reliability coefficient was found to be .78 applying Kuder Richardson-20 formula (Yerdelen, 2013). In the current study, Kuder Richardson-20 reliability was found to be .81, indicating a sufficiently high reliability.

3.4. Data Collection

The first step in the current study involved the determination of the research problem. After this stage, related literature was reviewed based on the variables in the research questions, which are self-efficacy, task-value, cognitive engagement and science achievement. These variables specifically were investigated in the Educational Resources Information Center (ERIC), the Ebscohost, Science Direct and International Dissertations Abstracts databases, YÖK, TUBITAK-ULAKBIM, library of METU and Internet (e.g., Google Scholar) in order to attain the result of the former studies having similar field of investigation. Afterward, the Motivation and Cognitive Engagement Scale (MCES) was developed by selecting, translating and adapting the related items from the MSLQ and SLI-A. During this stage, two instructors from faculty of education and METU Academic Writing Center and two science teachers and also three seventh grade students reviewed the instrument and gave feedbacks about how the instrument can be improved for validity. Based on the feedbacks, necessary revisions were made. After selection of the participant public elementary schools, permission was taken from the Research Center for Applied Ethics and the Ministry of Education to conduct the pilot and the main study in the 2014-2015 academic years (see Appendix-E). The pilot study of the MCES was realized with participation of the 251 seventh grade public elementary school students in Etimesgut District in Ankara. Confirmatory factor analysis was performed to analyze suggested factor structures and internal consistencies of the sub-scales. According to the result of the analysis, final revisions on the instrument were made. Then, the main study was conducted with 861 seventh grade students in the 2014-2015 spring semesters in Etimesgut districts of Ankara. Of out 42 elementary public schools in Etimesgut District, 5 schools took part in the study.

The data collection was fulfilled by the researcher with the support of teachers. Firstly, purpose of the study was explained briefly to administers, teachers and students. Then, the researcher assured that there were no physical or psychological harms of the study to the participants and the data attained from the participants would be kept in confidence and the result of the study would not affect their grades. In addition, the researcher informed the students about that there were no obligations to participate in the study and they could withdraw whenever they feel discomfort. The instructions of the instrument were announced to the participants and it was emphasized that there was no right or wrong answer in the MCES. The participants were asked for completing the instrument without leaving empty items and answering items sincerely. Administration of the instrument took about a lesson hour.

3.5 Data Analysis

In the current study, descriptive and inferential statistical analyses were performed by means of two statistical programs which were SPSS 22, and LISREL 8.80. Descriptive statistics and multiple regression analysis were conducted using SPSS 22. Confirmatory factor analysis (CFA) was executed using LISREL 8.80.

3.6 Descriptive Statistics

Descriptive statistics depicts participants' profiles concerning variables of the study in terms of mean and standard deviation.

3.7 Inferential Statistics

In the current study, the prediction of students science achievement by their motivational beliefs and cognitive engagement was examined utilizing Multiple Linear Regression Analysis, " a family of techniques that can be used to explore the relationship between one continuous dependent variable and a number of independent variables or predictors" (Pallant, 2001, p.134).

3.7.1. Assumptions of the Study

The subsequent part displays the assumption which the researcher made during the study process;

- The administration of the instruments was conducted under standard conditions.
- The responses of the participants to the items in the instruments were sincere.
- There was no interaction among the students through the administration process of the study.
- The sample represents the main characteristics of the target population well.

3.8 Threats to Internal Validity of the Study

The possible internal validity threats in correlational study include subject characteristics, mortality, location, instrumentation (instrument decay, data collector characteristics, data collector bias), and testing (Fraenkel, Wallen, &

Hyun, 2012). The subsequent paragraphs discuss which of the listed internal validity threats may be present in the current study.

The subject characteristics as a potential threat to internal validity was tried to be ruled out restricting the study to only 7th grade students. However, subject characteristics such as gender and socio-economic status can still pose a threat to the internal validity. Concerning mortality as a potential threat, it was not considered as a threat for this study because the current study was a cross sectional study administering all the collection instruments at one point in time. In addition, as another potential threat to internal validity, location was ignored, because the data were collected under similar conditions in all participant schools. Additionally, in the present study, instrument decay as part of instrumentation threat was not considered as a threat to internal validity because, as it was mentioned before, all self-report instruments were administered at the same time and just once. There was no interviewer or observer collecting data, so instrument decay could not be a threat. However, the data were collected by different teachers so data collector characteristics can be a threat to internal validity. Data collector bias occurs if collector distorts the data. In the current study, self-report instruments and objective type items were used. Thus, data collector bias can be ignored in this study. Also, testing was not considered as potential threat to internal validity, because all instruments were administered at the same time.

3.9 Ethical Issues in the Study

Fraenkel, et al. (2012) emphasizes protection of the participants against any harm, confidentiality and deception as main ethical issues to be addressed in any study. In the current study, the participants were ensured about that they would not be exposed to any physical or psychological harm by using the consents forms giving comprehensive information about the purpose of the study. These consent forms were given to both students and their parents and in the form; it was emphasized that the participants could withdraw whenever they feel discomfort during the study. In addition, they were encouraged to communicate with the researcher whatever they want to ask about the study by means of the phone number and mail address on the consent form.

Moreover, in the current study the participants were guaranteed that the data which they provided would be kept in confidence and would be used for only scientific purpose. Additionally, they were instructed about not writing their names on the instruments. Furthermore, participant schools and students were represented by numbers to ensure the confidentiality. Lastly, deception of the participants did not take place in this study because no misinformation about the study was given to the participants.

CHAPTER IV

RESULTS

This part displays results of the statistical analyses under four subtitles, Preliminary Data Analysis, Descriptive Statistics, Inferential Statistics and Summary of the Results. Preliminary data analysis part involves missing data analysis and checking the underlying assumptions of multiple regression analysis. The descriptive statistics part portrays participants' motivational beliefs, cognitive engagement, and achievement in terms of mean and standard deviation. The inferential statistic part reports the results of multiple regression analysis. Finally, Summary of the Results part provides a brief summary of the findings.

4.1 Preliminary Data Analysis

Multiple regression analysis requires the attainment of several underlying assumptions including absence of outliers among the independent variables and on the dependent variable, absence of multicollinearity and singularity, normality, linearity, and homoscedasticity of residuals, and independence of residuals. In addition, ratio of cases to independent variables is another issue to be considered before using multiple regression analysis. Following sections presents the results of assumption check as well as missing data analysis

4.1.1 Analysis of Missing Data

The missing values have the potential to lead to make erroneous interpretations. Therefore, all items were examined to determine percentage of the missing values in the data. The examination of the data indicated that the missing value percentage took the maximum value of 3.8. Tabachnick and Fidel (2007) suggested that any method for dealing with missing data brings about the comparable results if the percentage of missing values at random is less than 5. In the current study, mean substitution strategy was utilized to handle the missing data for the science achievement variable. Missing data were replaced with mode for the motivational beliefs and cognitive engagement items.

4.1.2 Analysis of Outlier

In multiple regression analysis, presence of outliers, which are very low or very high scores, can greatly influence regression solution. Thus, it is imperative to check whether there are outliers among independent variables and on the dependent variable. In order to determine whether there are outliers on the independent variables Mahalanobis distances are examined (Tabachnick & Fidell, 2007). In current study, the critical value of chi square was determined as 16.27 by means of utilizing chi-square table for df =3 and $p < .001$. Considering this critical value, only five cases were found to be as potential outliers. In order to identify, if these cases substantially influence regression equation, Cook's

Distances were explored. Because, none of the Cook's distance value exceeded +1, it was decided that there were no outliers among the independent variables (Tabachnick & Fidell, 2007). Examination of standardized residuals also revealed that there were no outliers on the dependent variable. Standardized residuals ranged from -2.4 to 2.9. Since these values are in range from -3.3 to +3.3, according to Tabachnick et al. (2007), overall, results suggested that there were no outliers on the independent variables and the dependent variable.

4.1.3. Multicollinearity and Singularity

Multicollinearity and singularity are caused by highly correlated variables and lead to both logical and statistical problems (Tabachnick & Fidell, 2007). The bivariate correlations among the variables which are smaller than .90 suggest the absence of multicollinearity (Tabachnick & Fidell, 2007). In addition VIF values less than 10 and tolerance value greater than .10 are indicative of no multicollinearity problem. In the present study, calculated bivariate correlations among the independent variables were all less than .90 (see Table 4.1). Additionally, VIF was found to be in the range from 1.6 to 2.2 and tolerance value was found to be in the range from .46 to .63. Thus, all these findings supported the absence of multicollinearity.

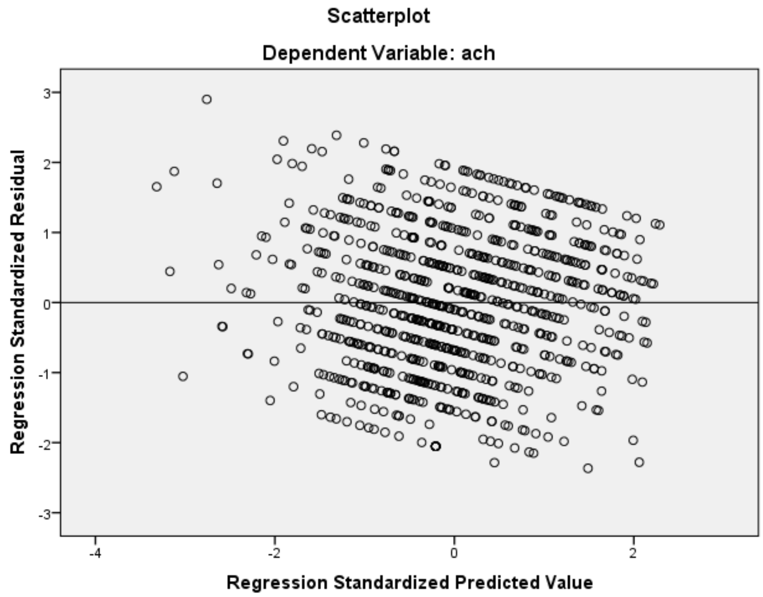
Table 4.1 Correlations between Variables

	Science Achievement	Cognitive Engagement	Task-Value	Self-Efficacy
Science Achievement	1			
Cognitive Engagement	.19**	1		
Task-Value	.30**	.58**	1	
Self-Efficacy	.32**	.53**	.69**	1

**. Correlation is significant at the .01 level (2-tailed).

4.1.4. Normality, Linearity, and Homoscedasticity of Residuals

For the purpose of analyzing whether any case can cause the violation of the assumption of normality, linearity, homoscedasticity, and independence of residuals, the following residual scatterplot of the regression standardized residuals were examined (Pallant, 2001).



Graph 4.1: The Regression Standardized Residual vs. Regression Standardized Predicted Value

As seen from the regression standardized residual vs. regression standardized predicted value graph all of the assumptions were met. That is, residuals are normally distributed around the predicted dependent variables scores, residuals have linear relationship with predicted dependent variables scores, and variability of residuals is almost the same for all predicted dependent variables scores.

4.1.5. Independence of Residuals

Multiple regression analysis requires that residuals are independent of each other. In order to check the independence of residuals assumption, Durbin-Watson statistic is examined. The values between 1.5 and 2.5 indicate the independence of residuals. In the current study, Durbin-Watson statistic of 1.6 suggested that residuals are independent of one another.

4.1.6. Ratio of Cases to Independent Variables

The other issue to be considered before running Multiple Linear Regression analysis is the sample size which is very important for generalizability (Pallant, 2001). The sufficient sample size can be calculated in term of the formula; $N > 50 + 8m$ (where m = number of independent variables) (Tabachnick & Fidell, 1996). In this study, there were 3 independent variables for Multiple Linear Regression Analysis. In this case, $N>50+8.(3)$; $N>74$ was the minimum sample size to conduct the study. Since the sample size of the study was 861, this issue was attained.

Overall, preliminary data analysis showed that all underlying assumption of multiple regression analysis was satisfied and missing data were handled. Thus, data were ready for further analysis.

4.2 Descriptive Statistics

Table 4.2 Descriptive Statistics

	M	**SD**
Self – Efficacy	2.91	.51
Task-Value	3.02	.51
Cognitive Engagement	2.87	.45
Science Achievement	7.36	3.67

As seen in the table, the means of Self-efficacy, Task-Value and Cognitive Engagement variables in the study were all above the midpoint of four-point Likert scale. This finding implied that, elementary students tend to perceive science classes as important, useful, and interesting. They also appeared to be self-efficacious in science classes. Although the lowest mean score belongs to cognitive engagement sub-scale (*M* = 2.87, *SD* = .45), the mean value well above the midpoint suggested that students are likely to use various cognitive strategies in science classes. On the other hand, the mean science achievement score of 7.36 out of 14 revealed that students have a moderate level of science achievement.

4.3. Inferential Statistics

In this section, the results of multiple linear regression analysis and simple correlation analysis were examined and presented.

4.3.1 Multiple Linear Regression Analysis

A multiple linear regression analysis was conducted to evaluate the prediction of the science achievement of students from linear combination of self-efficacy, task-value, and cognitive engagement. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity, and homoscedasticity (see section 4.1). Analysis results indicated that self-efficacy, task-value, and cognitive engagement explained 11.20 % of the variance in the students' science achievement*(R*= .34, *F (3, 857)* = 36.13, $p < .01$*)*. More specifically result revealed that although self-efficacy (β = .22, sr^2= 0.03 $p < .000$) and task-value (β = .15, sr^2 = .01 $p < .001$) significantly predicted students' science achievement, cognitive engagement (β = -.02, sr^2 =.00 $p > .05$) did not reach a statistical significance to predict science achievement. Table 4.3 summarizes the results of multiple regression analysis.

Table 4.3 Beta Coefficients, Related Significance Values and Part Correlation Coefficients

Independent Variables	***Beta***	***P***	***sr***
Self-Efficacy	.22	.000	.157
Task-Value	.15	.001	.104
Cognitive Engagement	-.02	.640	-.015

As shown in the Table 4.3, the largest β coefficient was .22, which was for the self-efficacy. In other words, the self-efficacy variable provided the strongest contribution to explaining the dependent variable (science achievement). Indeed, squared semi partial correlation of self-efficacy indicated that self-efficacy uniquely explains 3 percent of variance in students' science achievement. On the other hand, task value, which makes the second strongest contribution to the prediction of dependent variable, explains 1 percent of variance in science achievement. Sign of the beta coefficients also revealed that higher levels of self-efficacy and task-value were related with higher levels of science achievement. Thus, it appeared that students who believe in their abilities to be successful in science and find course materials, activities and content in science classes as important, useful, and interesting tend to have higher levels of science achievement.

4.3.2 Correlations

In order to address to the second research question, bivariate relations among independent variables (self-efficacy, task-value and cognitive engagement) were examined through simple correlation analyses (see Table 4.1). Results revealed that all independent variables were positively correlated with each other. These findings suggested that higher levels of self-efficacy and task value were associated with higher levels of cognitive engagement. In addition, a positive association was found between self-efficacy and task value.

4.4 Summary of the Results

The results of this study can be summarized as follows:

- Motivational beliefs (i.e. self-efficacy and task value) significantly contributed to the prediction of students' science achievement.
- Cognitive engagement failed to significantly predict students' science achievement.
- Positive and significant correlations were found among self-efficacy, task-value and cognitive engagement variables.

CHAPTER V

DISCUSSION

This part of the study begins with a brief summary of the research. Then, the findings of the study are discussed in deep in light of related literatures. Later, conclusion and possible implications of the study were presented and then, limitations of the study and recommendations for further studies were given place.

5.1 Summary of the Research Study

The present study is a cross-sectional research having the purpose of investigating the contribution of the motivational beliefs (self-efficacy and task-value) and that of cognitive engagement on seventh grade students' science achievement. For this purpose, the data of the study were gathered from the seventh grade students of public middle schools by means of three data collection instruments namely, Background Characteristics Survey (BCS), Motivation and Cognitive Engagement Scale (MCES) and Science Achievement Test for 7^{th} Grade (SAT) (Yerdelen, 2013). The MCES is a self-report instrument including the selected items from the Science Learning Inventory (SLI- Part A) (Seyedmonir, 2000) and from Turkish Version of Motivated Strategies for Learning Questionnaire (MSLQ) (Sungur, 2004) in order to measure students' motivational beliefs (self-efficacy and task-value) and the level of their cognitive engagement, Items selected from SLI-Part A were translated into Turkish by the researcher. Multiple Linear Regression Analysis was used to asses collected data from the participants. Results revealed that motivational beliefs (i.e. self-efficacy and task value) positively and significantly contributed to the prediction of students' science achievement and the self-efficacy appeared as the best predictor of the science achievement. Surprisingly, cognitive engagement failed to significantly predict students' science achievement. Afterwards, bivariate relations among independent variables (self-efficacy, task-value and cognitive engagement) were examined through simple correlation analyses. As expected, the result indicated positive and significant correlations among self-efficacy, task-value and cognitive engagement variables.

5.2 Discussion

In light of the related literature, the findings of the current study were discussed elaborately in the following part.

5.2.1 Students' Science Achievement in Relation to Motivational Beliefs

In the current study, motivational beliefs (i.e. self-efficacy and task value) were found as significant predictors of students' science achievement. This finding is parallel to the findings in the literature examining academic achievement in relation to expectancy for success (self-efficacy) and subjective task-value (Eccles, 1983; Wingfield, 1994; Eccles and Wigfield, 2002; Trautwein, Marsh, Nagengast, Lüdtke, Nagy & Jonkmann, 2012). That is to say, according to the relevant literature, students with adaptive motivational beliefs such as higher levels of self-efficacy and task value are more likely possess higher levels of academic achievement in science. In addition, in the current study, self-efficacy appeared as the best predictor of the science achievement. This result is also in congruence with the findings of the various studies in the related literature (Metallidou & Vlachou, 2007; Yerdelen, 2013; Pintrich & De Groot, 1990; Pintrich, Smith, Garcia & McKeachie, 1993). For example, Pintrich and his colleagues (Pintrich, Smith, Garcia & McKeachie, 1993) found that self-efficacy and task-value had a positive correlation with performance. Nevertheless, task-value's correlation with performance was not strong as that of the self-efficacy. In other study, Pintrich and De Groot (1990) performed a correlational study to examine the relationships between motivation, self-regulated learning, and classroom academic performance. The findings suggested that although both self-efficacy and intrinsic value have positive relations with performance, self-efficacy appeared as a better predictor of performance compared to intrinsic value. Moreover, in a more recent research, Areepattamannil, Freeman, and Klinger (2011) found that motivational beliefs and enjoying science had positive and significant effect on the science achievement. Additionally, self-efficacy was one of the variables having a quite strong positive relation with the science achievement compared to other predictors. Based on the findings, the researchers argued that students who feel more confidence in performing science related tasks and have more positive perception for their ability to learn science are more likely to show higher science achievement.

Thus, current study supported the findings of the related literature by showing that the students' motivational beliefs like self-efficacy and task-value are significant predictors of their science achievement and that the students' self-efficacy beliefs appeared as the variable to make most contribution to their science achievement. The central role of motivational beliefs in students' achievement revealed in relevant literature is as expected considering the fact that students who have high self-efficacy generally show more resistance and spend more effort on the tasks when they confront with the difficulties (Pintrich & Schunk, 2002; Schunk and Zimmerman, 2006; Schunk & Mullen, 2012). According to Wigfield and Eccles (2000) task-value beliefs are also associated with choice behaviors, persistence and effort. Thus, it is not surprising that both motivational constructs (i.e. self-efficacy and task value) are positively linked to achievement.

Overall, considering the current findings and available literature to date, it is not possible to underestimate the roles of motivational beliefs in the academic achievement, especially science achievement (Areepattamannil, Freeman, and Klinger, 2011). Thus, taking motivational beliefs into consideration during science instruction and planning process can make vital contributions to the students' science achievements.

5.2.2 Students' Science Achievement in Relation to Cognitive Engagement

Current study failed to reveal a positive association between cognitive engagement and science achievement, contrary to the findings in majority of the studies in the relevant literature suggesting that cognitive engagement and the academic achievement have a positive strong relation with each other (Ames and Archer, 1988; Appleton, Christenson, Kim, & Reschly, 2006; Pintrich & Schrauben, 1992; Reschly, Huebner, Appleton, & Antaramian, 2008; Weinstein & Mayer, 1986). In other words, according to the previous findings, high cognitive engagement appears to be associated with high academic achievement and better learning (Pintrich & Schrauben, 1992; Weinstein & Mayer, 1986). For example, Akyol (2009) found that students' science achievements were significantly predicted by the students' use of elaboration and metacognitive self-regulation strategies. In addition, Kaya and Kablan (2013) reported that combination of effort regulation, metacognitive self-regulation and critical thinking accounted for 13% of variance in the science scores.

Although, majority of the studies in the literature indicated a positive relationship between cognitive engagement and achievement, a few studies in the literature provide a support and explanation for the findings of current study (Baas, Castelijns, Vermeulen, RobMartens & Segers, 2015; Rastegar, et al., 2010; Veenman, 2011). For example, Sungur, et. al., (2007) conducted a study to explore the relationship among classroom environment perceptions, motivational (mastery goal orientation, performance goal orientation, self-efficacy, and intrinsic interest) and cognitive (strategy use) components of academic self-regulation, and science achievement. The researchers reported that the relationship between strategy use and science achievement was non-significant. This finding is similar to the present study's result. Moreover, Romainville (1994) conducted a qualitative study with 35 students to examine the relationship between university students' metacognition and their performance in terms of exploring the potential relationship between students' performance and their capacity to talk about, describe and criticize their cognitive strategies. The result indicated a positive relationship between metacognition and performance. However, the researcher reported that high achiever participants surely could not characterize their learning (cognitive) strategy, that is to say, they could generally not identify how and where they used the cognitive strategies. Thus, the high achiever participants appeared to be unconscious about the strategies they used. Likewise, the high achiever participants in the current study might not be conscious of their usage of cognitive and metacognitive strategies, assessed as cognitive engagement in the current study (Linnenbrink, et. al., 2003; Metallidou, et. al., 2007; Rastegar et al., 2010), and might report that they did not use them or gave uncertain responses to the items. In addition, Veenman (2011) claimed that the self-report instruments have some drawbacks in measuring strategy use (cognitive and metacognitive) of the students. According to the author, during responding to the items in the self-report instruments, learners need to recall their memory for reconstructing previous course of actions and performances. The process of rebuilding remembrance might cause loss or harm in memory. Furthermore, incorrect classification of the strategies can occur if the learner's declarative knowledge of strategies is poor. Therefore, self-report instruments can cause difficulties for the students during filling these instruments which require recalling and labeling the strategies that they used throughout previous activities and this situation might distort the results of analysis. In order to determine whether this explanation applies to the current findings, present study should be replicated integrating qualitative data collection tools such as observations and think aloud procedures to the research design.

Although the findings of the current study did not provide a support for majority of the studies in the related literature showing students' cognitive engagement as one of the essential components in their learnings, the researcher still suggest that science tasks and activities are designed so that students' demonstrate higher levels of cognitive engagement. Because, students who are cognitively engaged use various strategies which help them organize information, link what they newly learn to their previous knowledge, plan, monitor, and evaluate their own learning contributing to their academic achievement. Actually, as presented in the results section, in the present study, bivariate correlations revealed a positive association between cognitive engagement and science achievement.

5.2.3 Relationships between Motivational Beliefs and Cognitive Engagement

In the current study, as expected, positive and significant correlation was found between motivational beliefs (self-efficacy and task-value) and cognitive engagement. This result of the current study is in same line with findings of the related literature (Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Linnenbrink and Pintrich, 2003; Schunk 2005; Sungur, 2007; Sungur & Güngören, 2007; Yumusak, Sungur, & Çakıroğlu, 2007; Kahraman & Sungur, 2011). For instance, Pintrich and his colleagues (Pintrich, 1989; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991) showed that self-efficacy and task-value beliefs had a strong and positive association with the use of cognitive strategies (eg. rehearsal, elaboration, and organizational strategies) and metacognitive strategies (eg. planning, monitoring, and regulating). Similarly, Yumusak, Sungur and Cakiroglu (2007) examined the contribution of motivational beliefs, cognitive and metacognitive strategy use to high school students' achievement in biology. The findings of the study revealed that motivational beliefs like intrinsic goal orientation, task value and self-efficacy were positively linked to cognitive and metacognitive strategy use (cognitive engagement). Indeed, concerning the relationship between self-efficacy and cognitive engagement, Schunk (2005) reported that high self-efficacy facilitates the students to dynamically use cognitive and metacognitive strategies. In line with this idea, Linnenbrink and Pintrich (2003) articulated that self-efficacy beliefs have direct relation with behavioral, motivational and cognitive engagement of the students on academic tasks.

Furthermore, Sungur and Güngören (2007) mentioned that the level of the students' intrinsic interest in academic task and perception of usefulness and importance of the academic tasks are signals of their cognitive engagement level. In other words, if a student has high level of intrinsic interest in academic task and perception of usefulness and importance of academic tasks, students will be more likely to show more cognitive engagement. Since intrinsic interest in academic task and perception of usefulness and importance of academic tasks are component of the task-value, it can be expressed that the students' task-value beliefs are positively associated with their cognitive engagement level (cognitive and metacognitive strategy use) (Pintrich & De Groot, 1990; Sungur, 2007; Yumusak, Sungur, & Çakıroğlu, 2007). In another study, Pintrich and Schrauben (1992) stated that although value beliefs like importance and utility might not directly influence the learning or achievement, they had function providing rise in the cognitive engagement and use of diverse cognitive and metacognitive strategies.

Thus, based on the available literature and current findings, it can be expressed that cognitive engagement and task-value beliefs have a positive association with each other. In other words, the students who have high task-value beliefs on an academic task most probably show more cognitive engagement on this task. Even that these beliefs do not directly affect the academic achievement as stated by Pintrich and Schrauben (1992), they still have an important role in increasing students' cognitive engagement (cognitive and metacognitive strategy use). In this way, task-value beliefs can make contribution on the students' academic achievement, specifically science achievement. , Accordingly, as argued by Zimmerman (2005), in spite of the significance of learning strategies, there is a prerequisite for the individuals as motivating themselves to utilize these strategies. In other words, students should be motivated in order to use learning strategies. Otherwise, they do not utilize these strategies. Actually, students who have higher levels of self-efficacy and task value are more likely to exhibit cognitively engaged behaviors. Accordingly, they show more persistence, exert more effort and use various cognitive and metacognitive strategies to comprehend related subject contents. This situation can contribute on students' learning and academic achievement. Consequently, the educational medium, programs and materials should be prepared in a way to contribute on the students' motivational beliefs, namely their motivation. Motivated students more likely perform more cognitively engaged behaviors such as using cognitive and metacognitive strategies.

5.3 Implication and Conclusion

In expectancy-value theory perspective, the current study aimed to investigate the contribution of the motivational beliefs (self-efficacy and task-value) and cognitive engagement on seventh grade students' science achievement. The results of the present study showed that motivational beliefs like self-efficacy and task-value are significant predictors of the science achievement. In other words, students with high self-efficacy and task-value beliefs show better academic performance with respect to the others with low self-efficacy and low task-value beliefs. Unsurprisingly, self-efficacy appeared the best predictor of the academic achievement as in various studies in the literature (Pintrich & De Groot, 1990; Pintrich, Smith, Garcia & McKeachie, 1993; Metallidou & Vlachou, 2007; Yerdelen, 2013). However, whereas the result of the present study has the similar findings traits with previous studies, its essential contribution to the literature comes from the cross cultural generalizability of the findings of similar studies conducted in different cultures. As stated previously, Wigfield and his collagenous (2004) emphasized the inevitable effect of the culture on the individuals' goals, expectancies and task-values. Nevertheless, western theories of achievement have not paid much attention to this reality (King, et. al., (2014). Moreover, the studies about the motivational beliefs and their linkage with the cognitive engagement are very limited in the eastern countries (Taş, et. al., 2014). As seen, there is a need for such kinds of studies especially in the eastern countries. The present study tried to fulfill this gap by making contribution to the generalizability of the findings across different cultures and countries. Accordingly, in the eastern countries, future studies conducted in the field of motivational beliefs, cognitive engagement and their relation with science achievement can make additional contributions to the generalizability of the previous findings in western culture.

According to the current findings, as stated above, the self-efficacy was the best predictor of science achievement according to the present study results. This means students with high self-efficacy level tend to perform better in science classes compared to less self-efficacious students. Therefore, implementing the educational methods that help the students to develop their self-efficacy level appears to be important to improve their science achievement. Bandura (1994) claimed that individuals' self-efficacy level could be developed in term of various ways such as task mastery (e.g. success experiences); social persuasion/support; vicarious experiences (e.g. Observing others); and emotional or somatic states. Accordingly, science teachers can support their students' self-efficacy development by guiding them how to evaluate their own performance in the science activities and tasks in a way helps students to increase their self-efficacies (Kıran, 2010). In this process, teachers should stress the linkage between the students' effort and their successes by disregarding the normative comparisons (Pintrich & Schunk, 2002). To realize their success as a result of their spending effort in the science activities and tasks help the students to feel more efficacious in the next challenges. In addition, learning materials and activities in science classrooms should allow the students to have successful experiences enhancing their self-efficacy level. Additionally, social supports like teachers', parents' or classmates' verbal encouragements help the students improve their self-efficacy level. Those verbal encouragement messages should stress that the student has a competency to achieve the related science tasks and activities, but those messages should be realistic and suitable for the students and not beyond their current knowledge and capabilities (Brtiner & Pajares, 2006; Usher & Pajares, 2006). Moreover, the social interactions among the students in the classrooms may have important role in improving their self-efficacy. Similarly, teacher attitudes towards the students' behaviors can have determinative role in shaping their motivation. If a science teacher, for example, encourages students that to involve in an activity and help them see mistakes as part of learning, students can feel more efficacious and enthusiastic to take part in the activities.

Accordingly, various instructional methods such as Learning Cycle (5E or 7E), Problem Based Learning (PBL), Project Based Learning and Argumentation etc. can be used to help the students improve their motivational beliefs (self-efficacy and task-value). For instance, in PBL instructional method, students engage with ill-structured problems originated from the real-world scenarios (Finkle and Torp, 1995). While engaging these type problems, the students can relate their classroom learnings with their own daily lives. This situation can prompt the students to think of the classroom learnings as valuable for themselves (Ramsden 1997). In this manner, the students' task-value beliefs can show development and the increase in the task-value can lead to more effort, more persistency on the given tasks resulting in better academic performance. In addition, as pointed out by Dunlap (2005), dealing with ill-structured problems and the interactions inside the groups can strengthen, extend, and sustain self-efficacy, professional identity, and overall performance. Actually, ill-structured problems in the PBL require the students own to decide which sources and strategies they will use to solve the problems. This situation gives opportunity to the students to see the relation between their accomplishment and their effort. Accordingly, such kind of experiences can help the students feel more efficacious.

In general, it is advised that science teachers try to create learning environments advancing students' motivational beliefs such as putting emphasis on the importance of the learning material and stressing on the changeable nature of ability, leading discussion about the usefulness of science tasks. Such activities can improve students' self-efficacy and task-value beliefs which are influential on task choice, effort and persistence and their achievements (Eccles, et. al., 2002).

5.4. Limitations and Suggestions for Further Research

The participants of the study were limited only to seventh grade students. Similar studies can be conducted with the students from the other grade levels. In addition, variables of the current study were not examined in relation to other learner characteristics (e.g., demographic variables, family characteristics, health related factors, etc.) and teacher characteristics (e.g. teaching style). However, future studies can investigate whether such learner and teacher characteristics interact with students' motivation, cognitive engagement, and science achievement using advanced statistical techniques such as structural equation modeling or HLM. Moreover, in the current study, the data were obtained only from self-report instruments. Self-report instruments may not be sufficient to capture students' actual motivational beliefs and strategy use. Thus, the other ways of data collection like observation and interview etc. can be utilized in the similar studies in order to get an in-depth understanding of the observed relations. Since the current study is a cross-sectional correlational study, the reached results cannot indicate cause-effect relation among the variable. Experimental studies can also be designed to explain such relationships. Additionally, The Science Achievement Test (SAT) utilized in the current study is limited to the content of first semester of seventh grade science curriculum and contained 14 items. And also, many items in the SAT were generally at the comprehension level. In the future studies, science achievement tests covering a wider range of subject matter and, accordingly, more items and emphasizing higher order thinking skills can be used to evaluate the science achievement of the participants. Finally, the present study was realized only in one district of Ankara, similar studies can be realized in other districts and provinces.

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APPENDICES

APPENDIX-A

A. DEMOGRAPHICAL QUESTIONNAIRE

BÖLÜM 1. KİŞİSEL BİLGİ FORMU

1.Okul Adı:

2.Şube Adı:

3. Cinsiyetiniz nedir?

① Kız ② Erkek

4.Sınıf Seviyesi:

① 6. sınıf ② 7. sınıf ③ 8. sınıf

5.Doğum tarihiniz(yıl olarak)**:**

① 2001 ② 2002 ③ 2003

④ 2004 ⑤ 2005 ⑥ 2006

6. Kardeş sayısı(sizin dışınızda)**:**

① 0 ② 1 ③ 2

④ 3 ⑤ 4 ⑥ 5 ve üstü

7.Geçen dönemki Fen Bilimleri dersi karne notunuz hangi aralıktadır:

① 1 ② 2

③ 3 ④ 4

⑤ 5

8. Anneniz çalışıyor mu?

① Çalışıyor ② Çalışmıyor

③ Düzenli bir işi yok ④ Emekli

9. Babanız çalışıyor mu?

① Çalışıyor ② Çalışmıyor

③ Düzenli bir işi yok ④ Emekli

Anne ve babanızın eğitim düzeyi nedir?

10.Anne	**11.Baba**
① Hiç okula gitmemiş	① Hiç okula gitmemiş
② İlkokul	② İlkokul
③ Ortaokul	③ Ortaokul
④ Lise	④ Lise
⑤ Üniversite	⑤ Üniversite
⑥ Yüksek lisans	⑥ Yüksek lisans
⑦ Doktora	⑦ Doktora

12. Evinizde kaç tane kitap bulunuyor? (Magazin dergileri, gazete ve okul kitapları dışında)

① Hiç yok ya da çok az (0 – 10) ② 11 - 25 tane

③ 26 - 100tane ④ 101 - 200 tane

⑤ 200 taneden fazla

13. Evinizde bir çalışma odanız var mı?

① Evet ② Hayır

14. Ne kadar sıklıkta eve gazete alıyorsunuz?

① Hiçbir zaman ② Bazen ③ Her zaman

15. Evinizde bilgisayar var mı?

① Evet ② Hayır

16. Bilgisayarınızın internet bağlantısı var mı?

① Evet ② Hayır

APPENDIX-B

B. MOTIVATION AND COGNITIVE ENGAGEMENT SCALE (MCES)

Bölüm 2.				
Lütfen aşağıda verilen her bir ifadeyi dikkatlice okuyunuz ve her bir ifadeye ne derece katıldığınızı uygun rakamı işaretleyerek belirtiniz. . Unutmayınız Doğru ya da Yanlış cevap yoktur.				
	Kesinlikle Katılmıyorum	**Katılmıyorum**	**Katılıyorum**	**Kesinlikle Katılıyorum**
1. Fen ve Teknoloji dersinde öğrendiklerimi başka derslerde de kullanabileceğimi düşünüyorum.	①	②	③	④
2. Fen ve Teknoloji dersinden çok iyi bir not alacağımı düşünüyorum.	①	②	③	④
3.Fen ve Teknoloji dersini günlük hayatla çok yakın ilişkili buluyorum.	①	②	③	④
4. Fen ve teknoloji dersi ile ilgili okumalarda yer alan en zor konuyu bile anlayabileceğime eminim.	①	②	③	④
5. Fen ve teknoloji dersindeki konuları öğrenmek benim için önemlidir.	①	②	③	④
6. Fen ve teknoloji dersinde öğretilen temel kavramları öğrenebileceğimden eminim.	①	②	③	④
7. Fen ve Teknoloji dersindeki bilimsel kavramları anlamak benim için nottan daha önemlidir.	①	②	③	④
8. Fen ve Teknoloji dersinde, öğretmenin anlattığı en karmaşık konuyu bile anlayabileceğimden eminim.	①	②	③	④
9. Fen ve Teknoloji dersinde öğrendiklerimizi sıkıcı buluyorum.	①	②	③	④
10. Fen ve Teknoloji dersinin kapsamında yer alan konular çok ilgimi çekiyor.	①	②	③	④
11. Fen ve Teknoloji dersine ne kadar çalışırsam çalışıyım **hiçbir zaman anlayamayacağım** bazı kavramlar vardır.	①	②	③	④

12. Fen ve Teknoloji dersinde verilen sınav ve ödevleri en iyi şekilde yapabileceğimden eminim.	①	②	③	④
13. Fen ve Teknoloji dersinde öğretilen çoğu kavramı, sınav harici bir yerde kullanabileceğimi **düşünmüyorum.**	①	②	③	④
14. Fen ve Teknoloji dersi ile ilgili dergi ve kitaplar okumaktan hoşlanırım.	①	②	③	④
15. Fen ve Teknoloji dersinde çok başarılı olacağımı umuyorum.	①	②	③	④
16. Fen ve Teknoloji dersinde öğrendiklerimi günlük hayatta kullanabileceğimi düşünüyorum.	①	②	③	④
17. Fen ve Teknoloji dersinde öğrendiklerimin benim için faydalı olduğunu düşünüyorum.	①	②	③	④
18. Fen ve Teknoloji dersinde aynı olayı açıklayan farklı teorilerin olması (örneğin; atom teorileri gibi.), bu dersi benim için zor ve kafa karıştırıcı yapıyor.	①	②	③	④
19. Fen ve Teknoloji dersindeki konulardan hoşlanıyorum	①	②	③	④
20. Fen ve Teknoloji dersinde başarılı olabilmek için yeterli bir altyapıya sahibim.	①	②	③	④
21. Fen ve Teknoloji dersindeki konuları anlamak benim için önemlidir.	①	②	③	④
22. Fen ve Teknoloji dersinde birbiriyle çelişen bilgilere açıklık getirebilmek benim için zordur.	①	②	③	④
23. Fen ve Teknoloji dersinde öğretilen becerileri iyice öğrenebileceğimden eminim.	①	②	③	④
24. Fen ve Teknoloji dersi ile ilgili projeler, etkinlikler ya da alıştırmalar yaparken keyif alırım.	①	②	③	④
25. Dersin zorluğu, öğretmen ve benim becerilerim göz önüne alındığında, Fen ve Teknoloji dersinde başarılı olacağımı düşünüyorum.	①	②	③	④

Bölüm 3.				
Lütfen aşağıda verilen her bir ifadeyi dikkatlice okuyunuz ve her bir ifadeye ne derece katıldığınızı uygun rakamı işaretleyerek belirtiniz. . Unutmayınız Doğru ya da Yanlış cevap yoktur.				
	Kesinlikle Katılmıyorum	**Katılmıyorum**	**Katılıyorum**	**Kesinlikle Katılıyorum**
1. Fen ve Teknoloji ders kitabını okurken, dikkatimi daha çok gerçeğe dayalı bilgilere veririm.	①	②	③	④
2. Fen ve Teknoloji dersinde, yeni konuları öğrenmeme ve/veya açıklamama yardımcı olması için benzetmelerden ve örneklerden faydalanırım.	①	②	③	④
3. Fen ve Teknoloji dersinde, yeni bir kavramı öğrenirken, bu kavramı daha önceden öğrendiğim veya bildiğim kavramlarla ilişkilendiririm.	①	②	③	④
4. Fen ve Teknoloji dersinde verilen bilgiler mantığıma uymasa bile kabullenirim.	①	②	③	④
5. Fen ve Teknoloji dersini çoğunlukla ezberleyerek geçerim.	①	②	③	④
6. Fen ve Teknoloji dersi ile ilgili ilginç bir konu ya da bir fikir okuduğumda, genellikle okuduklarıma ilişkin olası sorular ve bu soruların olası cevapları hakkında düşünürüm.	①	②	③	④
7. Fen ve Teknoloji dersinde anlatılan konular mantığıma uymazsa, derste sık sık düşüncelerimi dile getirir/sorular sorarım.	①	②	③	④
8. Fen ve Teknoloji ders kitabını okurken ya da dersi dinlerken sıklıkla durur ve konuyu anlayıp anlamadığımı sorgularım.	①	②	③	④
9. Fen ve Teknoloji ders kitabından bir konuya çalışırken, edindiğim bilgileri organize etmek için sıklıkla şemalar, grafikler ve kavram haritaları oluştururum.	①	②	③	④

10. Fen ve Teknoloji dersinde sınav kâğıtlarımız geri verildiğinde, nerede ve niçin hata yaptığımı anlayabilmek için kâğıdımı dikkatle incelerim	①	②	③	④
11. Fen ve Teknoloji dersindeki sınavların çoğuna, kavramları ezberleyerek girme eğilimindeyimdir.	①	②	③	④
12. Fen ve Teknoloji ders kitabından bir konuya çalışırken, konuyu anladığımdan emin olabilmek için kendi kendime sorular sorarım.	①	②	③	④
13. Fen ve Teknoloji dersinde sadece sınavlarda ya da ödevlerde çıkacak konulara çalışırım.	①	②	③	④
14. Fen ve Teknoloji ders kitabını okurken, kitapta bahsedilen kavramların ne tür uygulamalarının olabileceği hakkında düşünürüm.	①	②	③	④
15. Fen ve Teknoloji dersinde önemli kavramların listesini çıkarır ve bu listeyi ezberlerim.	①	②	③	④
16. Fen ve Teknoloji dersindeki, bilimsel teorileri ya da kavramları çalışırken onların ortak yönlerini veya farklarını belirleyerek bütünleştirmeye çalışırım.	①	②	③	④
17. Fen ve Teknoloji dersine çalışırken, dersle ilgili okumaları ve ders sırasında aldığım notları defalarca okurum.	①	②	③	④
18. Fen ve Teknoloji dersindeki önemli kavramları hatırlamak için anahtar kelimeleri ezberlerim.	①	②	③	④
19. Fen ve Teknoloji dersine çalışırken, önemli bilgileri içimden defalarca tekrar ederim.	①	②	③	④

APPENDIX-C

THE SUBSCLES ITEMS IN TURKISH

* MSLQ items were translated and adopted by Sungur (2004).

*SLI-A items were translated and adopted by the researcher.

SELF-EFFICACY ITEMS IN TURKISH

q2:	Fen ve Teknoloji dersinden çok iyi bir not alacağımı düşünüyorum.	MSLQ
q4:	Fen ve teknoloji dersi ile ilgili okumalarda yer alan en zor konuyu bile anlayabileceğime eminim.	MSLQ
q6:	Fen ve teknoloji dersinde öğretilen temel kavramları öğrenebileceğimden eminim.	MSLQ
q8:	Fen ve Teknoloji dersinde, öğretmenin anlattığı en karmaşık konuyu bile anlayabileceğimden eminim.	MSLQ
q11:	Fen ve Teknoloji dersine ne kadar çalışırsam çalışıyım hiçbir zaman anlayamayacağım bazı kavramlar vardır	SLI-A
q12:	Fen ve Teknoloji dersinde verilen sınav ve ödevleri en iyi şekilde yapabileceğimden eminim.	MSLQ
q15:	Fen ve Teknoloji dersinde çok başarılı olacağımı umuyorum.	MSLQ
q18:	Fen ve Teknoloji dersinde aynı olayı açıklayan farklı teorilerin olması (örneğin; atom teorileri gibi.), bu dersi benim için zor ve kafa karıştırıcı yapıyor.	SLI-A
q20:	Fen ve Teknoloji dersinde başarılı olabilmek için yeterli bir altyapıya sahibim.	SLI-A
q22:	Fen ve Teknoloji dersinde birbiriyle çelişen bilgilere açıklık getirebilmek benim için zordur.	SLI-A
q23:	Fen ve Teknoloji dersinde öğretilen becerileri iyice öğrenebileceğimden eminim.	MSLQ
q25:	Dersin zorluğu, öğretmen ve benim becerilerim göz önüne alındığında, Fen ve Teknoloji dersinde başarılı olacağımı düşünüyorum.	MSLQ

TASK-VALUE ITEMS IN TURKISH

q1:	Fen ve Teknoloji dersinde öğrendiklerimi başka derslerde de kullanabileceğimi düşünüyorum.	MSLQ
q3:	Fen ve Teknoloji dersini günlük hayatla çok yakın ilişkili buluyorum.	SLI-A
q5:	Fen ve teknoloji dersindeki konuları öğrenmek benim için önemlidir.	MSLQ
q7:	Fen ve Teknoloji dersindeki bilimsel kavramları anlamak benim için nottan daha önemlidir.	SLI-A
q9:	Fen ve Teknoloji dersinde öğrendiklerimizi sıkıcı buluyorum.	SLI-A
q10:	Fen ve Teknoloji dersinin kapsamında yer alan konular çok ilgimi çekiyor.	MSLQ
q13:	Fen ve Teknoloji dersinde öğretilen çoğu kavramı, sınav harici bir yerde kullanabileceğimi **düşünmüyorum.**	SLI-A
q14:	Fen ve Teknoloji dersi ile ilgili dergi ve kitaplar okumaktan hoşlanırım.	SLI-A
q16:	Fen ve Teknoloji dersinde öğrendiklerimi günlük hayatta kullanabileceğimi düşünüyorum.	SLI-A
q17:	Fen ve Teknoloji dersinde öğrendiklerimin benim için faydalı olduğunu düşünüyorum.	MSLQ
q19:	Fen ve Teknoloji dersindeki konulardan hoşlanıyorum	MSLQ
q21:	Fen ve Teknoloji dersindeki konuları anlamak benim için önemlidir.	MSLQ
q24:	Fen ve Teknoloji dersi ile ilgili projeler, etkinlikler ya da alıştırmalar yaparken keyif alırım.	SLI-A

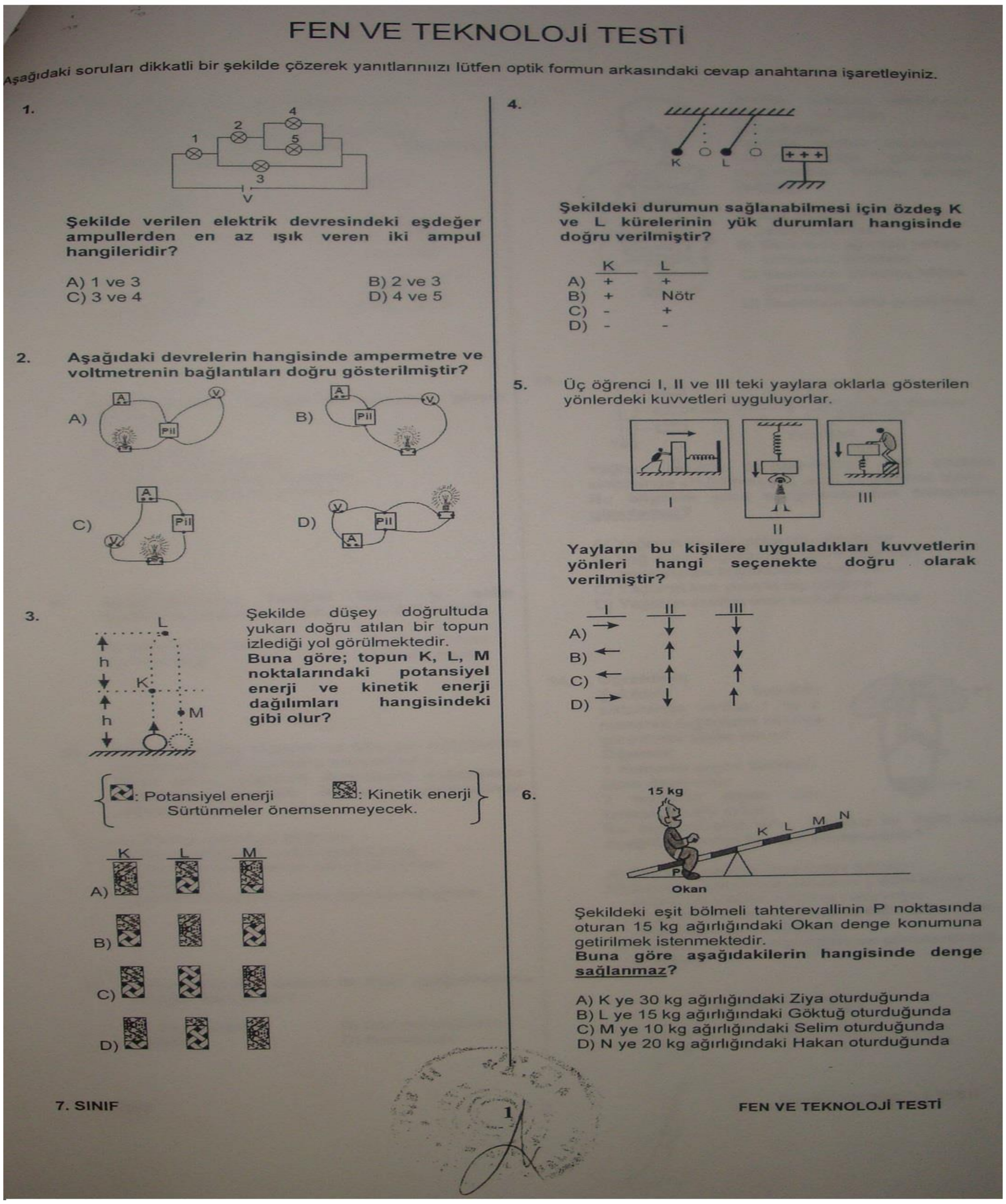
COGNITIVE ENGAGEMENT ITEMS IN TURKISH

q1:	Fen ve Teknoloji ders kitabını okurken, dikkatimi daha çok gerçeğe dayalı bilgilere veririm.	SLI-A
q2:	Fen ve Teknoloji dersinde, yeni konuları öğrenmeme ve/veya açıklamama yardımcı olması için benzetmelerden ve örneklerden faydalanırım.	SLI-A
q3:	Fen ve Teknoloji dersinde, yeni bir kavramı öğrenirken, bu kavramı daha önceden öğrendiğim veya bildiğim kavramlarla ilişkilendiririm.	SLI-A
q4:	Fen ve Teknoloji dersinde verilen bilgiler mantığıma uymasa bile kabullenirim.	SLI-A
q5:	Fen ve Teknoloji dersini çoğunlukla ezberleyerek geçerim.	SLI-A
q6:	Fen ve Teknoloji dersi ile ilgili ilginç bir konu ya da bir fikir okuduğumda, genellikle okuduklarıma ilişkin olası sorular ve bu soruların olası cevapları hakkında düşünürüm.	SLI-A
q7:	Fen ve Teknoloji dersinde anlatılan konular mantığıma uymazsa, derste sık sık düşüncelerimi dile getirir/sorular sorarım.	SLI-A
q8:	Fen ve Teknoloji ders kitabını okurken ya da dersi dinlerken sıklıkla durur ve konuyu anlayıp anlamadığımı sorgularım.	SLI-A
q9:	Fen ve Teknoloji ders kitabından bir konuya çalışırken, edindiğim bilgileri organize etmek için sıklıkla şemalar, grafikler ve kavram haritaları oluştururum.	SLI-A
q10:	Fen ve Teknoloji dersinde sınav kâğıtlarımız geri verildiğinde, nerede ve niçin hata yaptığımı anlayabilmek için kâğıdımı dikkatle incelerim	SLI-A
q11:	Fen ve Teknoloji dersindeki sınavların çoğuna, kavramları ezberleyerek girme eğilimindeyimdir.	SLI-A
q12:	Fen ve Teknoloji ders kitabından bir konuya çalışırken, konuyu anladığımdan emin olabilmek için kendi kendime sorular sorarım.	MSLQ
q13:	Fen ve Teknoloji dersinde sadece sınavlarda ya da ödevlerde çıkacak konulara çalışırım.	SLI-A
q14:	Fen ve Teknoloji ders kitabını okurken, kitapta bahsedilen kavramların ne tür uygulamalarının olabileceği hakkında düşünürüm.	SLI-A

q15:	Fen ve Teknoloji dersinde önemli kavramların listesini çıkarır ve bu listeyi ezberlerim.	MSLQ
q16:	Fen ve Teknoloji dersindeki, bilimsel teorileri ya da kavramları çalışırken onların ortak yönlerini veya farklarını belirleyerek bütünleştirmeye çalışırım.	SLI-A
q17:	Fen ve Teknoloji dersine çalışırken, dersle ilgili okumaları ve ders sırasında aldığım notları defalarca okurum.	MSLQ
q18:	Fen ve Teknoloji dersindeki önemli kavramları hatırlamak için anahtar kelimeleri ezberlerim.	MSLQ
q19:	Fen ve Teknoloji dersine çalışırken, önemli bilgileri içimden defalarca tekrar ederim.	MSLQ

APPENDIX-D

D. SCIENCE ACHIEVEMENT TEST (SAT)



FEN VE TEKNOLOJİ TESTİ

Aşağıdaki soruları dikkatli bir şekilde çözerek yanıtlarınızı lütfen optik formun arkasındaki cevap anahtarına işaretleyiniz.

1.

Şekilde verilen elektrik devresindeki eşdeğer ampullerden en az ışık veren iki ampul hangileridir?

A) 1 ve 3 B) 2 ve 3
C) 3 ve 4 D) 4 ve 5

2. Aşağıdaki devrelerin hangisinde ampermetre ve voltmetrenin bağlantıları doğru gösterilmiştir?

A) B) C) D)

3. Şekilde düşey doğrultuda yukarı doğru atılan bir topun izlediği yol görülmektedir.
Buna göre; topun K, L, M noktalarındaki potansiyel enerji ve kinetik enerji dağılımları hangisindeki gibi olur?

: Potansiyel enerji : Kinetik enerji
Sürtünmeler önemsenmeyecek.

	K	L	M
A)			
B)			
C)			
D)			

4.

Şekildeki durumun sağlanabilmesi için özdeş K ve L kürelerinin yük durumları hangisinde doğru verilmiştir?

	K	L
A)	+	+
B)	+	Nötr
C)	-	+
D)	-	-

5. Üç öğrenci I, II ve III teki yaylara oklarla gösterilen yönlerdeki kuvvetleri uyguluyorlar.

Yayların bu kişilere uyguladıkları kuvvetlerin yönleri hangi seçenekte doğru olarak verilmiştir?

	I	II	III
A)	→	↓	↓
B)	←	↑	↓
C)	←	↑	↑
D)	→	↓	↑

6.

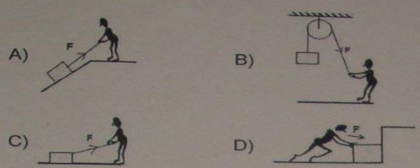
Şekildeki eşit bölmeli tahterevallinin P noktasında oturan 15 kg ağırlığındaki Okan denge konumuna getirilmek istenmektedir.
Buna göre aşağıdakilerin hangisinde denge sağlanmaz?

A) K ye 30 kg ağırlığındaki Ziya oturduğunda
B) L ye 15 kg ağırlığındaki Göktuğ oturduğunda
C) M ye 10 kg ağırlığındaki Selim oturduğunda
D) N ye 20 kg ağırlığındaki Hakan oturduğunda

7. SINIF 1 FEN VE TEKNOLOJİ TESTİ

7. Fiziksel anlamda iş yapılabilmesi için;
- Kuvvet uygulanmalı
- Kuvvet etkisindeki cisim yol almalıdır.

buna göre aşağıdakilerden hangisinde <u>kesinlikle iş yapılamaz</u>?



8. Aşağıdakilerden hangisi burnumuzun görevi <u>değildir</u>?

A) Koku alma
B) Alınan havayı süzme
C) Alınan nemli havayı kurutma
D) Alınan soğuk havayı ısıtma

9. Aşağıdakilerden hangisi diğer iç salgı bezlerinin çalışmasını denetler ve düzenler?

A) Böbrek üstü bezi   B) Hipofiz bezi
C) Tiroit bezi   D)Yumurtalık

10. Korku, heyecan, mutluluk ve öfke gibi durumlarda vücutta adrenalin hormonu seviyesi artar.
Buna göre, aşağıdaki durumların hangisinde Hülya'nın adrenalin hormonu seviyesinde artma beklenir?

A) Yemek yerken su içtiğinde
B) Ders çalıştıktan sonra uyuduğunda
C) Her gün, ev işlerinde annesine yardım ettiğinde
D) Sınavda başarılı olunca aşırı sevindiğinde

11. Göze gelen ışık ışınları ilk önce aşağıdakilerin hangisinden geçer?

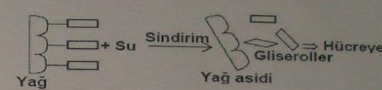
A) Sarı benekten   B) Göz merceğinden
C) İristen   D) Korneadan

12.

Şekilde sindirim sisteminin bazı organları okla gösterilmiştir.
Aşağıda verilen olaylardan hangisi okla gösterilen organlardan birinin görevi <u>değildir</u>?

A) Atık maddelerin vücuttan uzaklaştırılması
B) Besinlerin ağızdan yemek borusuna iletilmesi
C) Besinlerin bulamaç hâline getirilmesi
D) Besinlerin kana geçirilmesi

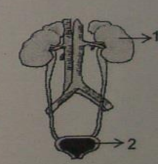
13.



Yağlar, şekilde de görüldüğü gibi sindirim sisteminde sindirilerek yağ asidi ve gliserole ayrılır.
Bu bilgilere göre aşağıdakilerden hangisine <u>ulaşılamaz</u>?

A) Yağların büyük moleküllü olduğuna
B) Yağ asidi ve gliserolün hücre zarından geçebilecek büyüklükte olduğuna
C) Yağların kan yoluyla taşındığına
D) Yağların sindiriminde su kullanıldığına

14. Öğretmen;
Şekildeki boşaltım sisteminde verilen 1 ve 2 numaralı organların isim ve görevlerini söyler misin?
Öğrenci;
1 numaralı organ böbrektir, idrarı depo eder.
2 numaralı organ idrar kesesidir, kanı süzer.



Bu açıklamalara göre öğrenci ile ilgili olarak aşağıdakilerden hangisi söylenebilir?

A) Boşaltım sistemi organlarını bilmiyor.
B) Boşaltım sistemi organlarının şeklini biliyor, ancak görevlerini birbirine karıştırıyor.
C) Boşaltım sistemi organları ile diğer sistemlerin organlarını ayırt edemiyor.
D) Boşaltım sistemi organlarını ve görevlerini çok iyi biliyor.

TEST BİTTİ

...

APPENDIX-E

E. EXTENDED TURKISH SUMMARY

(Genişletilmiş Türkçe Özet)

MOTİVASYON VE BİLİŞSEL KATILIMIN FEN BAŞARISINDAKİ ROLÜ

Giriş ve İlgili Literatür

Yarım yüzyıldan fazla süredir, beklenti-değer kuramı öğrencilerin başarı davranışlarını açıklamada genel kabul gören kuramlar arasındadır (Wigfield, 1994). Bu kuramın temel iddiası bireylerin performansları, belirli bir görevdeki süreklilikleri ve görev seçimleri onların bu görevlerdeki başarı beklentilerine ve bu görevlere verdikleri değere bağlıdır (Atkinson, 1957; Eccles, Adler, Futterman, Goff, & Kaczala, 1983; Eccles & Wigfield, 2002; Trautwein, Marsh, Nagengast, Oliver Lüdtke, Nagy & Jonkmann, 2012; Wigfield, 1994; Wigfield & Eccles, 1992; Wigfield, 1994). Bundan dolayı bu kuram iki temel kavrama dayanmaktadır. *"Başarı beklentisi"* bireylerin belirli bir görevde göstereceklerini düşündükleri başarıya olan inanç derecesini ifade eder. *"Görev-değer"* kavramı ise bireylerin bir görev hakkında değer yargılarını yani bu görevi ne kadar önemli, yararlı ve eğlenceli gördüklerini ifade eder. Pek çok teorik ve deneysel çalışma kuramın bu öngörülerini destekleyen sonuçlar elde etmiştir (Eccles, 1983; Wingfield, 1994; Eccles and Wigfield, 2002; Nagengast, Marsh, Scalas, Xu, Hau & Trautwein, 2011; Trautwein, Marsh, Nagengast, Lüdtke, Nagy & Jonkmann, 2012). Sonuç olarak, başarı beklentisinin ve görev-değer inançlarının incelenmesi görev bağlılığı, ilgi sürekliliği ve akademik başarının tahmin edilmesinde temel yöntemlerden birisidir (Pamuk, 2014; Yerdelen, 2013). Kısaca beklenti-değer kuramı öğrencilerin başarı güdüsünü açıklamayı hedefleyen eğitim çalışmalarına kuvvetli bir teorik temel oluşturmaktadır.

Eccles ve Wigfield (2002) başarı beklenti kavramı ile Bandura'nın "*öz-yeterlilik*" kavramlarının benzer anlamlar ifade ettiğini ve benzer şekillerde ölçülebileceğini belirtmişlerdir. Bu çalışmada buna uygun hareket edilerek öğrencilerin başarı beklenti dereceleri, öz-yeterlilik ölçeğiyle belirlenmiştir. Öz-yeterlilik kavramı bir görevle ilgili olarak bireyin kendi yeteneklerine olan inanç derecesini ifade eder. Bundan dolayı, hedef belirleme, etkinlik seçimi, çaba harcama arzusu, bir zorluk karşısında vazgeçmeme bireylerin öz-yeterliliklerinden kaynaklanır. Hoy (2004) tarafından yapılan çalışma öz-yeterliliği yüksek olan öğrencilerin daha fazla çaba sarf etme, bir zorluk karşısında vazgeçmeme, öğrenme etkinliklerinde çeşitli öğrenme stratejileri kullanma eğiliminde olduğunu göstermiştir. Bu bulgular paralel olarak pek çok çalışma öz-yeterlilik ile öğrencilerin fen başarısı arasında anlamlı ve pozitif bir ilişki olduğunu göstermiştir (Britner2008; Caprara, Fida,Vecchione, Del Bove, Vecchio, Barbaranelli, & Bandura,2008; Hidi, Ainley, Berndorff, & DelFavero, 2006; House, 2008; Lavonen & Laaksonen, 2009; Yoon, 2009). Aslında, Linnenbrik ve Pintrich (2003) öz-yeterliliğin öğrenci başarısını açıklamaya çalışan her güdülenme çalışmasının ayrılmaz bir parçası olduğunu belirtmişlerdir. Bandura' ya (1997) göre, öz-yeterliliğin derecesi ve kuvveti başarı deneyimleriyle, diğer bireyleri gözlemleme yoluyla (vicarious experience), sözel sosyal destek yoluyla (verbal persuasion) ve psikolojik durumlarla (stres, yorgunluk, ruh hali, duygular ve acı hissetme) değiştirilebilir. Buna bağlı olarak, fen derslerinin yapıldığı ortam ve kullanılan araçlar-gereçler öğrencilerin öz-yeterliliğini artırıcı yönde düzenlenmesi gereklidir. Beklenti-değer teorisindeki diğer önemli kavram ise "*görev-değer*" kavramıdır (Eccles, et al. , 1983). Bireylerin görev-değer inançları (task-value); etkinliğe verilen önemi (importance), bireylerin etkinliğe olan ilgisini (interest), etkinliğin faydalılığı düşüncesini (usefulness) ve algılanan maliyet düşüncesini (cost) kasteder. Bu bileşenler öğrencilerin göstereceği çabada, etkinlikte süreklilik göstermede ve görev ya da etkinlik seçiminde belirleyicidir (Wigfield &Eccles, 2000). Başka bir deyişle görev-değer inançları yüksek olan öğrenciler görev-değer inançları düşük olan diğer öğrencilere göre muhtemelen değer verdikleri görev ya da etkinliklere katılmayı daha çok tercih edecek, bu etkinliklerde daha fazla süreklilik gösterecek ve daha fazla çaba ortaya koyacaklardır (Cole, Bergin & Whittaker, 2008). Benzer şekilde alan yazınında pek çok çalışma öğrencilerin görev-değer inançları ile akademik başarıları arasında pozitif ilişki ortaya koymuştur (Eccles & Wigfield, 2002; Pintrich & De Groot, 1990; Pintrich & Schunk, 2002). Fen başarısı ile görev-değer inançları arasında ilişkiyi odaklanan çalışmalar da alan yazınında yer almaktadır (Sungur, 2007; Yumusak, Sungur, & Çakıroğlu, 2007). Kısaca, taranan alan yazını öz-yeterlilik ve görev-değer gibi güdülenme inançlarının öğrencilerin etkinlik seçiminde, belirli etkinlikte göstermiş oldukları çabalarında, sürekliliklerinde ayrıca öğrenme stratejilerini etkin kullanma ve akademik başarılarında büyük bir etkiye sahip olduğunu göstermiştir. Beklenti-değer kuramı ile ilgili yapılan deneysel çalışmaların sonuçları, bu kuramın ön gördüğü kuramsal tahminler ile paralellik göstermiştir. Buna rağmen, bazı araştırmacılar güdülenme inançları ve akademik başarı arasında ilişkinin muğlak olduğu ve daha fazla bilimsel çalışmalara ihtiyaç olduğunu belirtmişlerdir (Kulwinder Sigh, 2014). Mevcut çalışma güdülenme inançları ve bu inançların fen başarısı ile olan ilişkisinin daha belirgin şekilde anlaşılmasına katkıda bulunmayı hedeflemektedir. Bu şekilde, müfredat çalışmalarına ve eğitimcilere faydalı öngörüler sağlayabilir. Yukarıda belirtilen alan yazının ışığında mevcut çalışma güdülenme inançları ve fen başarısı arasında pozitif bir ilişki öngörmüştür.

Bu çalışmada yer verilen diğer önemli kuramsal yapı ise bilişsel katılımdır (cognitive engagement). Bilişsel katılım öğrencilerin çaba harcama arzusunu, bir konuyu anlamak için uzun süre çalışabilme veya zor bir beceriye sahip olmak için uğraşma ve öğrenmede kullandıkları stratejilerle ilgilidir (Fredericks, Blumenfeld & Paris, 2004; Ravindran, Greene, & Debacker, 2005; Rotgans & Schmidt, 2010).

Weinstein ve Mayer'e (1986) göre bilişsel katılım öğrenmenin ve akademik başarının işlevsel bir göstergesidir. Ayrıca, Blumenfeld ve Paris (2004) bilişsel katılımı yüksek olan öğrencilerin çeşitli öğrenme stratejileri kullanma eğilimlerinin fazla olduğunu rapor etmişlerdir. Öğrencilerin kullanmış oldukları, öğrenme stratejileri öğrenci başarısını etkileyen temel faktörlerdendir. Bunun sebebi öğrenme stratejilerinin öğrencilerin anlamlı öğrenmelerini sağlamasıdır (Yumuşak, 2006).

Öğrenme stratejileri bilişsel ve biliş-ötesi stratejiler olmak üzere iki gruba ayrılabilir (Pintrich, Smith, Garcia & McKeachie, 1993). Tekrar yapma (Rehearsal), detaylandırma (elaboration) ve düzenleme stratejileri (organizational strategies) ve eleştirel düşünme (critical thinking) bilişsel öğrenme stratejileri örnekleridir (Weinstein & Mayer, 1996). Çeşitli çalışmalar bilişsel stratejilerin kullanımının akademik başarıyla olan ilişkisini ortaya koymuştur. Ayrıca var olan ilişkinin kuvveti hangi bilişsel stratejini kullanıldığına bağlı olarak değişiklik göstermektedir (Pintrich, Smith, Garcia, and McKeachie 1993; Sedaghat, Abedin, Hejazi, & Hassanabadi, 2011; Yumuşak, 2006). Örneğin; detaylandırma (elaboration), düzenleme (organization) ve eleştirel düşünme (critical thinking) bilişsel stratejileri bilginin derinlemesine işlenmesini veya analiz edilmesini gerektirirken, tekrar (rehearsal) yaparak öğrenme gibi stratejiler yüzeysel bir bilgi işlemeyi içerir (Weinstein & Mayer, 1986). Bundan dolayı, detaylandırma (elaboration), düzenleme (organization) ve eleştirel düşünme (critical thinking) gibi yöntemleri kullanan öğrenciler tekrarlama (rehearsal) gibi yüzeysel stratejiler kullanan öğrencilere göre daha iyi akademik performans göstermesi beklenmektedir (Pintrich's et al., 1993; Sedaghat et al., 2011).

Öz-denetleme (monitoring), planlama (planing) , düzenleme stratejileri (regulating strategies) gibi öğrenme stratejileri biliş-ötesi strateji (meta-cognitive strategies) kullanımı örnekleridir ve bu stratejiler bilişsel düzenlemeyle (cognitive regulation) ilişkilidirler (Pintrich, 1999). Başka bir deyişle, bir konu öğrenirken ya da problem çözerken nasıl düşündüğü hakkında düşünmek biliş-ötesi strateji kullanımının bir göstergesidir (Livingston, 2003; Metcalfe & Shimamura, 1994; Flavell, 1999). Biliş-ötesi strateji kullanımı bilişsel katılımın önemli bir göstergesidir ve eğitimciler tarafından öğrencilerin göstermesi arzu edilen bir durumdur (Linnenbrink & Pintrich, 2003). Akyol (2003) çalışmasında bunu destekler nitelikte biliş-ötesi strateji kullanımı ile fen başarısı arasında pozitif bir ilişki ortaya koymuştur.

Mevcut çalışmada pek çok çalışmada olduğu gibi, bilişsel ve biliş-ötesi öğrenme stratejileri bilişsel katılımın bileşenleri olarak değerlendirilmiştir (Linnenbrink & Pintrich, 2003; Metallidou et al. 2007; Rastegar, Jahromi, Haghighi and Akbari, 2010). Örneğin, Greene, Miller, Crowson, Duke ve Akey (2004) bilişsel ve biliş-ötesi öğrenme stratejileri bilişsel katılımı ölçmek için kullanmış ve bilişsel katılım ile akademik performans arasın pozitif bir ilişki elde etmişlerdir.

Kısaca, ilgili alan yazınında bilişsel katılım öğrencilerin öğrenme seviyelerinin ve başarılarının iyi bir göstergesi olarak dikkat çekmiştir. Diğer pek çok alanın yanında fen başarısı da öğrencilerin bilişsel katılım seviyeleriyle ilgili bulunmuştur. Esasen, bilişsel katılım gösteren öğrenciler öğrenirken çeşitli öğrenme stratejileri kullanmaktadır. Bu durum bu tip öğrencilerin akademik başarılarına katkı sağlamaktadır. Bu doğrultuda ve ilgili alan yazınına dayanarak, mevcut çalışma bilişsel katılım ve fen başarısı arasında pozitif bir ilişki öngörmüştür.

Garcia ve Pintrich (1993) güdülenme değişkenleri ile bilişsel katılım gibi öğrenci kazanımları arasında ilişki olduğunu öne sürmüşlerdir. Bununla birlikte ilgili alan yazınında öz-yeterlilik ve görev değer gibi güdülenme inançları ile bilişsel katılım arasında bu öngörüyü destekleyici bulgular içeren pek çok çalışma yer almaktadır (Kahraman & Sungur, 2011; Linnenbrink and Pintrich, 2003; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Schunk 2005; Sungur, 2007; Sungur & Güngören, 2007; Yumusak, Sungur, & Çakıroğlu, 2007). Örneğin; Pintrich ve meslektaşlarının çalışmalarının sonuçları öz-yeterlilik ve görev-değer gibi güdülenme inançlarıyla biliş ve biliş-ötesi öğrenme stratejileri kullanımı ve akademik başarı arasında kuvvetli pozitif bir ilişki olduğunu ortaya koymuşlardır.

Özetle, ilgili alan yazını öz-yeterlilik ve görev-değer gibi güdülenme inançları ile öğrencilerin bilişsel katılım düzeyleri arasında pozitif bir ilgi önermiştir. Sonuç olarak, bu tür güdülenme inançları olan öğrenciler daha çok bilişsel katılım içeren davranışlar sergilemektedir. Başka bir deyişle, bu tür öğrenciler öğrenme etkinliklerinde daha fazla süreklilik, daha fazla çaba ve çeşitli bilişsel ve biliş-ötesi öğrenme stratejilerini kullanma gibi davranışları yeni konular öğrenirken daha çok göstermektedir. Bu şekilde, güdülenme inançları öğrencilerin bilişsel katılım düzeylerine ve akademik başarılarına katkı sağlamaktadır. Bununla birlikte, Taş ve Çakır (2014) güdülenme inanç yapıları ve bu yapıların öğrenme stratejilerini inceleyen çalışmaların çoğunlukla batılı ülkelerde yer alırken, çok daha az sayıda ilgili çalışmanın batılı olmayan ülkelerde yapıldığını belirtmişlerdir. Mevcut çalışma batılı olmayan ülkelerdeki yapılan sınırlı çalışmalara katkıda bulunmayı hedeflemektedir. Ayrıca, kültürel boyutlara yer verilmemesine rağmen bu çalışmanın bulguları batılı ülkelerde elde edilen bulguların diğer kültürlere genelleştirilmesinde fayda sağlayacaktır. Bununla birlikte, ilgili alan yazınına dayanarak mevcut çalışma güdülenme inançları ile bilişsel katılım arasında pozitif bir ilişki öngörmektedir.

Yöntem

Bu çalışmanın temel amacı ortaokul öğrencilerinin güdüsel inançlarının ve bilişsel katılımlarının fen başarısının tahminine olan katkısının ve ortaokul öğrencilerinin güdüsel inançlarının bilişsel katılım ile olan ilişkisinin araştırılmasıdır. Bu ilişkileri incelemek için öz-bildirim anketlerinden elde edilen verilere dayalı olarak korelasyon çalışması gerçekleştirilmiştir. Bu çalışmadaki hedef evren Ankara'daki bütün 7. Sınıf öğrencileridir. Bu evrene ulaşmak kolay olmadığından, erişilebilir evren belirlenmesi uygun görülmüştür. Erişilebilir evren, Etimesgut İlçesinde devlet okullarında okuyan bütün yedinci sınıf öğrencileri olarak belirlenmiştir. Bu çalışmanın sonuçları bu evrene genelleştirilebilir.

Küme örneklemesi (cluster random sampling) ve kolayda örnekleme (convenience sampling) yöntemleri mevcut çalışmanın örneklemini belirlenmesinde kullanılmıştır. Örneklem sürecinde öncelikle Etimesgut İlçesi kolaylık örneklemine uygun olarak belirlenmiştir. Bu durumda maliyet, ulaşım ve idari kısıtlamalar gibi konular etkili olmuştur. Daha sonra beş farklı ortaokul bu ilçeden küme örneklemesi yöntemiyle rastgele olarak belirlenmiştir. Etimesgut İlçe Milli Eğitim Müdürlüğü kayıtlarına göre ilçede 42 ortaokul bulunmakta olup bu beş okul ilçedeki ortaokulların %10 fazla bir yüzdeye sahiptir. Buda bu örneklemin yeterli temsili sağladığını gösterebilir. Mevcut çalışmanın katılımcılarını bu okullardan gelen 861 yedinci sınıf öğrencisi oluşturmaktadır. Bu öğrencilerden 398'ni (%42) kız, 456'nı (%53) erkek öğrenciler meydana getirmektedir.

Bu çalışmada veri toplamak amacıyla üç farklı anket kullanılmıştır. İlk anket kişisel bilgiler formu olup öğrencilerin oluşturmuş olduğu örneklemi tanımlamak ve öğrencilerin sosyal-ekonomik statülerini belirlemek amacıyla oluşturulmuştur ve 16 maddeden oluşmaktadır (Bkz. EK-A).

İkinci anket ise Güdülenme ve Bilişsel Katılım Ölçeğidir (Bkz. EK-B). Bu ölçekte yer alan maddeler Fen Öğrenme Envanterinin (Science Learning Inventory) (Seyedmonir, 2000) A kısmındaki maddelerden ve Öğrenmede Güdüsel Stratejiler Anketinin (MSLQ) (Pintrich et al. , 1991) güdülenme inançlarından öz-yeterliliği ve görev-değeri kapsayan ve ayrıca öğrencilerin bilişsel katılım düzeylerini ölçmek için kullanılan maddelerden derlenmiştir. Bu ölçek öğrencilerin fen dersindeki güdülenme inançlarını ve bilişsel katılım düzeylerini ölçmek için kullanılmıştır.

Öğrenmede Güdüsel Stratejiler Anketi (MSLQ) Pintrich ve meslektaşları tarafından (1991) tarafından geliştirilmiştir. Bu öz-bildirim ölçeğinde Likert tipi tarzında ve değerleri 1 (kesinlikle katılmıyorum) ile 7 (kesinlikle katılıyorum) arasında derecelendirilmiş 81 madde bulunmaktadır. Güdülenme ve Öğrenme Stratejileri bölümleri bu ölçeğin iki ana kısmını oluşturmaktadır. Güdülenme bölümü 31 maddeden, öğrenme stratejileri bölümü ise 50 maddeden oluşmaktadır.

Bu ölçeğin geçerlilik ve güvenirlik değerlerini belirlemek amacıyla farklı alanlardan gelen 380 üniversite öğrencisi ile çalışma gerçekleştirilmiş ve güdülenme bölümünün her bir alt ölçeğinin güvenirlik değerleri 0,62 ile 0,93 arasında yer almıştır. Öğrenme stratejileri bölümünde yer alan alt-ölçeklerin güvenirlik değerleri 0,52 ile 0,82 arasında değişiklik göstermiştir. Doğrulayıcı faktör analizi (CFA) sonuçları güdülenme bölümünde yer alan altı faktörle ilgili olarak (χ^2/df = 3.49, GFI = .77, AGFI = .73, RMR = .07) ve öğrenme stratejileri bölümünde yer alan 9 faktörle ilgili olarak (χ^2/df = 2.26, GFI = .78, AGFI = .75 RMR = .08) sonuçlarını vermiştir ve iyi bir model uyumu olduğunu ortaya koymuştur. Öğrenmede Güdüsel Stratejiler Anketi (MSLQ) ölçeğini geliştirmiş olan Pintrich ve meslektaşları (1991) bu ölçeğin modüler olduğunu ve araştırmacıların amaçlarına uygun olan alt bölümleri kullanabileceklerini belirtmişlerdir. Öğrenmede Güdüsel Stratejiler Anketi, Sungur (2004) tarafından Türkçe' ye çevrilmiş ve uyarlanmıştır. Sungur (2004) 448 lise öğrencisiyle ölçeğin güvenirlik ve geçerlilik değerlerini belirlemek amacıyla çalışma gerçekleştirmiştir. Bu çalışmanın sonuçları ölçeğin Türkçe versiyonun güdülenme kısmına ait olan alt ölçeklerin güvenirlik değerlerinin 0,54 ile 0,81 arasında değişirken ölçeğin öğrenme stratejilerine ait alt ölçeklerin güvenirlik değerleri 0,57 ile 0,81 arasında bulunmuştur. Doğrulayıcı faktör analizi (CFA) ölçeğin Türkçe versiyonun orijinal sürümü ile benzer indekslere sahip olduğunu ortaya koymuştur. Güdülenme bölümünde (χ^2/df = 5.3, GFI = .77, RMR = .11) ve öğrenme stratejileri bölümünde ise (χ^2/df = 4.5, GFI = .71, RMR = .08) olarak elde edilmiştir. Mevcut çalışmada öğrenme ve performans için öz-yeterlilik, görev-değer ve bilişsel katılım bölümünde bulunan tekrarlama (rehearsal) ile ilgili maddeler güdüsel inançlar ve bilişsel katılım ölçeği (MCES) geliştirilirken öğrenmede güdüsel stratejiler anketinin (MSLQ) Türkçe versiyonundaki ilgili maddelerden derlenmiştir.

Seyedmonir (2000) tarafından geliştirilen fen öğrenme envanteri Likert tarzında ve 1 (kesinlikle katılmıyorum) ile 5 (kesinlikle katılıyorum) arasında derecelendirilen maddelerden oluşmaktadır. Bu anket A kısmı (kavramsal ekoloji ve bilişsel katılım) ve B kısmı (fen epistemolojisi) olmak üzere iki ana bölümden oluşmaktadır. A kısmında üç alt başlık halinde *mevcut kavramlar* (11), *güdülenme* (21) ve *bilişsel katılım* (16) olmak üzere 48 madde bulunmaktadır. Mevcut çalışmadaki güdülenme ve bilişsel katılım ölçeği (MCES) geliştirilirken fen öğrenme envanterinin (SLI) A kısmında yer alan güdülenme, bilişsel katılım ve süreçler alt başlığı altındaki ilgili maddelerden derleme yapılmıştır.

Güdüsel inançlar ve bilişsel katılım ölçeği (MCES) öğrencilerin güdülenmiş öğrenme ve bilişsel katılım düzeylerini öz-yeterlilik, görev-değer ve bilişsel katılım olmak üzere üç boyutta ölçmek için geliştirilmiştir. MCES geliştirilmesi sürecinde öğrencilerin öz-yeterlilik, görev-değer ve bilişsel katılımlarını ölçmeyi hedefleyen maddeler öğrenmede güdüsel stratejiler anketinin (MSLQ) ve fen öğrenme envanterinin A kısmındaki (SLI-A) maddelerden seçilmiştir. Ankette yer alan 8 öz-yeterlilik maddesi MSLQ anketinden, 5 öz-yeterlik maddesi ise SLI anketinin A kısmında bulunan güdülenme kısmından derlenmiştir. Bunu yanında öğrencilerin görev-değer inançlarını ölçmeyi hedefleyen 6 madde MSLQ anketinden, geri kalan 7 madde ise SLI anketinin A kısmındaki güdülenme kısmından seçilmiştir. Bilişsel katılımı ölçmek için kullanılan maddelerin büyük çoğunluğu (15) SLI anketinin A kısmında bulunan bilişsel katılım ve süreçler bölümünden seçilmiştir. Diğer 1 madde ise MSLQ anketinin biliş-ötesi öz-düzenleme alt ölçeğinden seçilmiştir (Bkz. Tablo-3. 4).

Güdüsel inançlar ve bilişsel katılım ölçeğinin (MCES) psiko-metrik özelliklerini belirlemek amacıyla 251 ortaokul yedinci sınıf öğrencisiyle bir pilot çalışma gerçekleştirilmiştir. Analiz sonuçları güdüsel inançlar ve bilişsel katılım ölçeğinin (MCES) yüksek düzeyde güvenirlik değer indeksine sahip olduğunu göstermiştir. Ölçekte bulunan her bir alt başlığın güvenirlik katsayıları öz-yeterlilik için 0,86, görev-değer için 0,86 ve bilişsel katılım için 0,81 olarak belirlenmiştir. Yapılan geçerlilik analizinde güdülenme ve bilişsel katılım ölçeğinin (MCES) üçlü faktör yapısını değerlendirmek için doğrulayıcı faktör analizi (CFA) LISREL 8.80 kullanılarak yapılmıştır. Doğrulayıcı faktör analizi (CFA) sonuçları GFI indeksi dışındaki diğer indekslerin modelin üçlü faktör yapısını desteklediği ve modelin uygun olduğu göstermiştir (χ^2/df = 1.55, CFI=.97, GFI = .79, NFI=.93, RMR = .05, SRMR=.06, RMSEA=.05). Bununla birlikte ölçeğin güvenirlik ve geçerlik değerlerini geliştirmek amacıyla bazı değişikler pilot çalışmanın sonuçları ve katılımcıların geri-bildirimleri göz önüne alınarak yapılmıştır. Yapılan değişikliklerden sonra güdülenme ve bilişsel katılım ölçeği (MCES) 12 öz-yeterlilik, 13 görev-değer ve 19 bilişsel katılım maddesi olmak üzere 44 maddeden oluşmuştur. Ana çalışmada son değişiklikleri içeren ölçek kullanılmıştır (Bkz. EK-B). Revizyona uğrayan ölçeğin yapılan doğrulayıcı faktör analizine (CFA) göre uygun model indekslerine sahip olduğu görülmüştür (χ^2/df = 2.95, CFI=.97, GFI = .85, NFI=.93, RMR = .05, SRMR=.06, RMSEA=.05). Ayrıca ana çalışmadaki alt ölçeklerin güvenirlik katsayıları 0, 65 ile 0,84 arasında değişim göstermiştir.

Son veri toplama aracı ise Yerdelen (2013) tarafından geliştirilmiş olan Fen Başarı Testidir (SAT). Fen başarı testi (SAT) öğrencilerin fen başarı düzeylerini ölçmek amacıyla 14 çoktan seçmeli sorudan oluşturulmuştur (Bkz. EK-D). Testteki sorular yedinci sınıf fen ve teknoloji dersi müfredatının birinci döneminde yer alan vücudumuz, kuvvet ve hareket, yaşamımızdaki elektrik üniteleriyle ilgili konuları kapsamaktadır. Bu testin güvenirlik katsayısı Kuder-Richardson-20 formülü uygulanarak hesaplanmış ve 0,78 olduğu görülmüştür (Yerdelen, 2013). Mevcut çalışmada aynı yöntem kullanılarak hesaplanan güvenirlik katsayısı 0,81 olarak ortaya çıkmıştır. Bu değer yeterince yüksek bir güvenirlik derecesini göstermektedir.

Veri Toplanması

Bu çalışmadaki ilk adım araştırma problemlerinin belirlenmesi olmuştur. Bu aşamadan sonra ilgili alan yazını araştırma sorularındaki değişkenlere bağlı kalınarak taranmıştır. Bu değişkenler ERIC, YÖK tez veri tabanı, TUBİTAK-ULAKBIM, ODTÜ kütüphanesi ve internet (örneğin; Google Akademik arama motoru vb.) gibi veri tabanları taranarak alan yazınında elde edilen sonuçlar incelenmiştir. Daha sonra güdülenme ve bilişsel katılım ölçeğinin (MCES) geliştirilmesine geçilmiştir. Bu ölçek MSLQ anketinin Türkçe sürümündeki (Sungur, 2004) ve SLI-A anketinin ilgili bölümlerinden seçilen ve Türkçeye çevrilip, uyarlanan Likert tarzı maddelerden oluşturulmuştur. Gerekli izinler alınarak, pilot çalışma ve ana çalışma 2014-2015 eğitim-öğretim yılında gerçekleştirilmiştir. Pilot çalışma Ankara'nın Etimesgut ilçesinde bulunan bir ortaokulun 251 yedinci sınıf öğrencisi ile gerçekleştirilmiştir. Doğrulayıcı faktör analiz (CFA) sonuçlarına bağlı kalınarak ölçekte bazı geliştirmeler yapılmıştır. Daha sonra ana çalışmaya geçilmiştir. Ana çalışmada aynı ilçede yer alan beş farklı devlet okulundan 861 yedinci sınıf öğrencisi yer almıştır. Çalışma 2014-2015 eğitim-öğretim yılının ikinci döneminde gerçekleştirilmiştir. Elde edilen veriler öğretmen ve idarecilerin işbirliği ile araştırmacı tarafından toplanmıştır. Bu süreçte araştırmanın amacıyla ilgili olarak idareci, öğretmen ve öğrencilere kısa açıklamalar yapılmıştır.

Katılımcılar çalışmanın herhangi bir fiziksel ve psikolojik zararlı etkisinin olmadığı, toplanan bilgilerin gizlilik altında tutulacağı, sonuçların ders notlarına herhangi bir etkisi olmayacağı konularında bilgilendirilmişlerdir. Ayrıca öğrenciler katılımın zorunlu olmadığı, istedikleri zaman çalışmadan çekilebilecekleri konularında da bilgilendirilmişlerdir. Güdülenme ve bilişsel katılım anketinde (MCES) doğru veya yanlış cevap olmadığı vurgulanmış, katılımcılardan maddeleri boş bırakmadan samimi bir şekilde sorulara cevap vermeleri istenmiştir. Anketin uygulanması bir ders saati sürmüştür.

Data Analizi

Mevcut çalışmada betimsel ve çıkarımsal istatistik analizleri SPSS 22 ve LISREL 8.80 yazılımları vasıtasıyla gerçekleştirilmiştir. Betimsel istatistik ve Çoklu doğrusal ilgileşim analizi (Multiple Linear Regression Analyse) SPSS 22 kullanılarak gerçekleştirilirken, doğrulayıcı faktör analizi (CFA) LISREL 8.80 kullanılarak yürütülmüştür.

Sonuçlar

Mevcut çalışmanın sonuçları güdüsel inançlarının anlamlı bir şekilde öğrencilerin fen başarısının tahmin edilmesine katkı sağladığını göstermiştir (öz-yeterlilik (β = .22, sr^2= 0.03 p < .000), görev-değer (β = .15, sr^2 = .01 p < .001)). Bununla birlikte, bilişsel katılım değişkeni öğrencilerin fen başarısının tahminine anlamlı bir biçimde katkıda bulunmamıştır (β = -.02, sr^2 =.00 p > .05). Son olarak, öz-yeterlilik, görev-değer ve bilişsel katılım değişkenleri arasında pozitif bir korelasyon elde edilmiştir (Bkz. Table-4.3).

Tartışma ve Öneriler

Mevcut çalışma güdüsel inançların (öz-yeterlilik ve görev-değer) fen başarısının tahminine önemli ve anlamlı katkı sağladıklarını ortaya koymuştur. Bu bulgular ilgili alan yazınında yer alan pek çok çalışmanın sonuçlarıyla paralellik göstermiştir (Eccles, 1983; Wingfield, 1994; Eccles and Wigfield, 2002; Trautwein, Marsh, Nagengast, Lüdtke, Nagy & Jonkmann, 2012). Mevcut çalışmanın ve ilgili alan yazınında yer alan çalışmaların sonuçları öz-yeterlilik ve görev-değer inançları yüksek olan öğrencilerin fen dersinde daha iyi performans sergilediklerini göstermiştir. Ayrıca diğer çalışmalarla uyumlu olarak mevcut çalışmada da fen başarısının tahminine en fazla katkıyı sunan güdüsel inancının öz-yeterlilik olduğu bulunmuştur (Metallidou & Vlachou, 2007; Yerdelen, 2013; Pintrich & De Groot, 1990; Pintrich, Smith, Garcia & McKeachie, 1993). Alan yazınındaki ve mevcut çalışmanın bulgularına dayanarak fen dersinde yer alan etkinliklerde kendilerine güvenen ve kendi becerileri hakkında pozitif düşünen öğrenciler muhtemelen daha iyi performans göstermektedirler. Ayrıca, öz-yeterlilikleri yüksek olan öğrenciler etkinlerde esnasında herhangi zorlukla karşılaştıklarında daha fazla sabır göstermekte ve daha fazla çaba sarf etmektedirler (Pintrich & Schunk, 2002; Schunk and Zimmerman, 2006; Schunk & Mullen, 2012). Wigfield ve Eccles (2000) görev-değer inançlarının etkinlik veya görev seçimi davranışlarıyla, etkinliklerde gösterilen süreklilikle ve harcanan çaba ile ilgili olduğunu rapor etmişlerdir. Sonuç olarak öz-yeterlilik ve görev-değer gibi güdüsel inançlarının akademik başarıyla olan ilişkisi şaşırtıcı değildir.

Genel olarak, mevcut çalışmanın ve ilgili alan yazınındaki bulgular güdüsel inançlarının akademik başarıyla özellikle fen başarısıyla olan ilişkisinin görmezden gelinemeyeceğini ortaya koymuştur (Areepattamannil, Freeman, and Klinger, 2011). Bunun sonucu olarak fen eğitimi ve planlaması sürecinde güdüsel inançlarının dikkate alınması öğrencilerin fen başarılarına önemli katkılar sağlayabilir.

Mevcut çalışmanın sonuçları, alan yazınında yer alan çalışmaların gösterdiği genel bulgulara karşın, bilişsel katılım ve fen başarısı arasında anlamlı bir ilişki elde edememiştir. Başka bir deyişle, önceki pek çok çalışmanın bulguları yüksek bilişsel katılımın yüksek akademik başarıyla ve daha iyi öğrenmeyle ilgili olduğunu göstermiştir (Ames and Archer, 1988; Appleton, Christenson, Kim, & Reschly, 2006; Pintrich & Schrauben, 1992; Reschly, Huebner, Appleton, & Antaramian, 2008; Weinstein & Mayer, 1986). Bununla birlikte, alan yazınında yer alan az sayıdaki çalışma mevcut çalışmanın sonuçlarına destek ve açıklama sağlamaktadır (Baas, Castelijns, Vermeulen, RobMartens & Segers, 2015; Rastegar, et al., 2010; Veenman, 2011). Örneğin; Sungur ve meslektaşları (2007) tarafında yapılan ve sınıf ortamı algıları ve akademik öz-düzenlemenin güdüsel ve bilişsel bileşenleri ile fen başarısı arasındaki ilişkiyi araştıran çalışmanın sonuçları öğrenme stratejileri kullanımı ile fen başarısı arasındaki ilişkinin anlamlı olmadığını rapor etmiştir. Bu sonuç mevcut çalışmanın bulgularıyla benzerlik göstermektedir. Başka bir çalışmada, Romainville (1994) 35 öğrenciyle yapmış olduğu nitel çalışmada öğrencilerin biliş-ötesi öğrenme strateji kullanımları ile akademik performansları arasındaki ilişkiyi incelemiş ve bu değişkenler arasında pozitif bir ilişki olduğunu saptamıştır. Buna rağmen, araştırmacı yüksek akademik performansa sahip katılımcıların öğrenme stratejilerini nerede ve nasıl kullandıklarını kendilerinden emin bir şekilde ifade edemediklerini belirtmiştir. Bundan dolayı, yüksek performansa sahip katılımcıların kullandıkları stratejiler hakkında yeterli bilince sahip olmadıkları sonucuna ulaşılmıştır. Benzer şekilde, mevcut çalışmada katılımcılar bilişsel katılım olarak değerlendirilen bilişsel ve biliş-ötesi öğrenme stratejileri hakkında yeterli bilince sahip olmayabilirler. Sonuç olarak anketteki maddelere bu stratejileri kullanmadıkları şeklinde ya da muğlak yanıtlar vermiş olabilirler. Bunlara ilave olarak, Veenman (2011) öz-bildirim anketlerinin öğrenme stratejileri kullanımını ölçmekte yetersiz kaldığını belirtmiştir. Yazara göre katılımcılar maddeleri yanıtlarken daha önceden yapmış oldukları davranış biçimlerini hatırlamak zorundadırlar. Bu süreçte zihinde hatıralar tekrar inşa edilmektedir. Hatıraların inşa süreci sırasında hafızada kayıplar yaşanabilir. Ayrıca, açıklayıcı becerileri gelişmemiş olan katılımcılar stratejileri yanlış sınıflandırmış olabilirler. Kısaca, öz-bildirim ölçekleri öğrencilerin daha önceden yapmış oldukları davranışları hatırlamalarını ve etiketlemelerini gerektirdiği için bazı zorluklara neden olmaktadır. Bunlardan dolayı, mevcut çalışmada bilişsel katılım ve fen başarısı arasındaki ilişki diğer çalışmaların aksine anlamlı bir şekilde belirmemiş olabilir. Mevcut çalışmanın bulgularına getirilen açıklamaların doğruluğunun saptanabilmesi için bu çalışmadaki veri toplama yöntemlerine ilave olarak gözlem ve sesli düşünme gibi nitel veri toplama araçlarından faydalanılarak, mevcut çalışma yinelenebilir.

Mevcut çalışmanın bulguları destek sağlayamamasına rağmen, genel alan yazınına bakıldığında bilişsel katılımın öğrencilerin öğrenmesinde ana etkenlerden biri olduğu görülecektir. Bundan dolayı, fen dersinde yer alan etkinlikler ve görevler öğrencilerin bilişsel katılımını artıracak şekilde düzenlenmelidir. Çünkü bilişsel katılımı yüksek olan öğrenciler bilgileri organize etme, önceden var olan bilgilerle ilişkilendirme, planlama yapma, öz-denetim gibi akademik başarılarına katkı sağlayacak öğrenme stratejilerini daha çok kullanmaktadırlar. Bunlarla paralellik gösterecek şekilde, mevcut çalışmadaki ikili korelasyon (correlation) değerleri bilişsel katılım ve fen başarısı arasında pozitif bir ilişki ortaya koymuştur.

Mevcut çalışmada beklenildiği gibi güdüsel inançlar ve bilişsel katılım arasında pozitif ve anlamlı bir ilişki bulunmuştur. Mevcut çalışmanın elde ettiği bu sonuç ilgili alan yazını ile uyum göstermektedir (Pintrich & De Groot, 1990; Pintrich & Garcia, 1991; Linnenbrink and Pintrich, 2003; Schunk 2005; Sungur, 2007; Sungur & Güngören, 2007; Yumusak, Sungur, & Çakıroğlu, 2007; Kahraman & Sungur, 2011). Örneğin; Pintrich ve meslektaşları (Pintrich, 1989; Pintrich & De Groot, 1990; Pintrich & Garcia, 1991) öz-yeterlilik ve görev-değer inançlarının bilişsel ve biliş-ötesi öğrenme stratejileri ile güçlü ve pozitif bir ilişkiye sahip olduğunu rapor etmişlerdir. Benzer şekilde Yumuşak, Sungur ve Çakıroğlu (2007) güdüsel inançlarının, bilişsel ve biliş-ötesi inançların lise öğrencilerinin biyoloji başarısına olan etkisi incelemişlerdir. Çalışmanın bulguları öz-yeterlilik ve görev-değer gibi güdüsel inançlarının bilişsel ve biliş-ötesi öğrenme stratejilerinin kullanımıyla pozitif bir ilişkiye sahip olduğunu bulmuşladır. Ayrıca, Schunk (2005) öz-yeterliliğin öğrencilerin bilişsel ve biliş-ötesi stratejileri dinamik bir şekilde kullanmalarını sağladığını söylemiştir.

Sonuç olarak, yüksek öz-yeterlilik ve görev-değer inancına sahip öğrencilerin muhtemel olarak daha fazla bilişsel katılım davranışları sergileyeceklerdir. Diğer bir deyişle, bu tarz öğrenciler zorluklara karşı daha fazla direnç, etkinliklerde daha fazla çaba sergileyecek, çeşitli bilişsel ve biliş-ötesi öğrenme stratejileri kullanacaklardır. Bu durum öğrencilerin öğrenme seviyelerine dolayısıyla akademik başarılarına katkı sağlayabilir. Bunun doğal sonucu olarak, eğitim ortamları, programları ve materyalleri öğrencilerin güdüsel inançlarına katkı sağlayacak şekilde düzenlenmesi tavsiye edilebilir. Bu düzenlemeler öğrencilerin güdülenmesine katkı sağlayarak onların bilişsel ve biliş-ötesi öğrenme stratejileri gibi bilişsel katılım işareti olan davranışlar sergileme olanağı artırabilir.

Sınırlıklar ve Gelecekteki Çalışmalar için Öneriler

Bu çalışmadaki katılımcıları ortaokul yedinci sınıf öğrencileri oluşturmaktadır. Benzer çalışmalar farklı sınıf derecesinde bulunan öğrencilerle gerçekleştirilebilir. Mevcut çalışmada değişkenlerin katılımcıların demografik özellikleri (cinsiyet, sosyal-ekonomik arka plan vb.), öğretmen karakterleri gibi değişkenlerle olan ilişkileri incelenmemiş olup gelecekte yapılacak çalışmalar bu tür değişkenlere yer verebilir. Gelecekteki çalışmalar öğrenci ve öğretmenlerin karakterlerinin öğrenci güdülenmesine, bilişsel bağlılığa ve fen başarısına olan etkilerini daha gelişmiş istatistiksel yöntemler (Yapısal Modelleme, HLM vb.) kullanarak inceleyebilir. Ayrıca mevcut çalışmadaki veriler öz-bildirim anketleriyle toplanmıştır. Öz-bildirim anketleri öğrencilerin güdüsel inançlarını ve bilişsel bağlılığı ölçmede yetersiz kalmış olabilir. Bundan dolayı gözlemler, röportaj gibi nitel veri toplama araçları benzer çalışmalarda gözlenen ilişkilerin daha iyi anlaşılmasında faydalı olabilir. Mevcut çalışma korelasyonel bir çalışma olduğundan bulgular sebep-sonuç ilişkisi ortaya koymamaktadır. Deneysel çalışmalar bu tür ilişkilerin anlaşılmasında faydalı olabilir. Çalışmada kullanılan başarı testi sadece yedinci sınıf müfredatının birinci dönemini kapsamaktadır ve genel olarak kavrama düzeyini ölçmeye sorular kapsamaktadır. Gelecekteki çalışmalar daha fazla üniteyi kapsayan ve daha üst düzey öğrenme düzeylerini ölçen ölçeklerle yapılabilir. Son olarak, çalışma Ankara'nın bir ilçesinde gerçekleştirilmiştir. Benzer çalışmalar farklı il ve ilçelerde gerçekleştirilebilir.

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